Species grouping and key to known species of the ant genus *Echinopla* Smith (Hymenoptera: Formicidae) with reports of Chinese species

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ABSTRACT. Twenty-three valid species of the formicine ant genus *Echinopla* Smith are recorded in the world. Body surface sculptures of the genus are summarized into four types: shagreened, longitudinally striate, bluntly spined with background retirugose and cribrate with interstice retirugose. The twenty-three species are divided into five species-groups based on the body surface sculpture types and other important characters. A key to known species of the genus is provided based on worker and queen castes. *E. striata* Smith, 1857 is recorded in China for the first time, *E. cherapunjiensis* Bharti & Gul, 2012 is recorded in Tibet and Guangxi regions of China, and this is the northernmost record of the genus in the world.

Keywords: Hymenoptera, Formicidae, *Echinopla*, species-groups, key, Chinese species.

INTRODUCTON

The formicine ant genus *Echinopla* Smith, 1857 is distributed in the Oriental, Indo-Australian, and Australasian regions (Bolton, 1995). Wheeler (1911) designated *Echinopla melanarctos* as the type-species of the genus. Bolton (1994) treated *Mesoxena* Smith, 1860 as a junior synonym of *Echinopla*. Emery (1896, 1900, 1925), Donisthorpe (1932, 1943), Taylor (1992) and Bolton (1995) revised some species of the genus.

After the establishment of the genus, twenty-three valid species of the genus were separately recorded in the world (Bolton, 2014). Ten species were described from Indonesia (Smith, 1859, 1860, 1862, 1863; Mayr, 1862; Emery, 1887, 1898; Forel, 1901; Karavaiev, 1927; Donisthorpe, 1936a). Seven species were reported in Borneo (Smith, 1857; André, 1892; Stitz, 1938; Forel, 1901; AntWiki, 2015) and New Guinea (Stitz, 1911, 1938; Donisthorpe, 1936b, 1941, 1943; AntWiki, 2015). Four species were recorded in Philippines (Smith, 1858; AntWiki, 2015). Two species were recorded in Australia (Forel, 1901), Sulawesi (AntWiki, 2015), Thailand (AntWiki, 2015) and India (Mayr, 1862; Bharti & Gul, 2012) respectively. And one species was recorded in Malaysia (Smith, 1857), Singapore (Smith, 1857; AntWiki, 2015), Nicobar Island (AntWiki, 2015), Kratakau Island (AntWiki, 2015) and China (Liu et al., 2015) separately. According to the distribution data of species, Indonesia, Borneo and New Guinea are the distribution center of the genus, meanwhile spreading south to Australia, and north to India and China.

Unfortunately, many early species descriptions were very brief, providing quite limited information. No systematic work has been done in the genus to date. The absence of a taxonomic key causes a lot of difficulty in identifying the species of this genus.

The establishment of the AntWeb (2014) by the California Academy of Sciences and Ant-Base.Net (2014) by Martin Pfeiffer, and the increasing of image resources make it easier to observe the type specimens of most species. Based on the AntWeb (2014) and AntBase.Net (2014) images, and the original descriptions, we summarized the morphological characters of the genus. Body surface sculpture is important for species identification in Echinopla. In the separate species descriptions, similar sculptures of the genus were described in different expressions by different myrmecologists. In this study, we summarized the body surface sculptures of the genus into four types: (1) shagreened, (2) longitudinally striate, (3) bluntly spined with background retirugose, and (4) cribrate with interstice retirugose. Based on the body surface sculpture types and other important characters, the twenty-three known species of the genus are divided into five speciesgroups. A key to the known species is prepared, based on the worker and queen castes.

Based on the long term collection from 1996 to 2014, *E. striata* Smith, 1857 is recorded in China for the first time, meanwhile *E. cherapunjiensis* Bharti & Gul, 2012 is recorded in Tibet and Guangxi Regions, China. Previously, the latter species was recorded in Yunnan Province, China by Liu et al. (2015). This is the northernmost record of the genus in the world.

MATERIALS AND METHODS

Images of type specimens and identified specimens of most species were downloaded from AntWeb and AntBase.Net. Original descriptions and figures of *E. arfaki* Donisthorpe, *E. densistriata* Stitz, *E. maeandrina* Stitz, *E. octodentata* Stitz and *E. rugosa* André were obtained from AntCat. Chinese specimens of *E. striata* and *E. cherapunjiensis* were collected through sampleplot (Xu, 2002), search-collecting (Xu et al., 2011) and Berlese (Burwell & Nakamura, 2011) methods. The Chinese specimens were observed and measured under a Jiangnan XTB-1 stereo microscope with a micrometer. Illustrations of the Chinese species were drawn under a Motic-700Z stereo microscope with illustrative equipment. Standard measurements and indices are as defined in Bolton (1975), with the addition of ED and MSL outlined below:

- TL Total Length: The total outstretched length of the individual, from the mandibular apex to the gastral apex.
- HL Head Length: The straight-line length of the head in perfect full-face view, measured from the mid-point of the anterior clypeal margin to the midpoint of the posterior margin including spines. In species where one or both of these margins is concave, the measurement is taken from the mid-point of a transverse line that spans the apices of the projecting portions.
- HW Head Width: The maximum width of the head in full-face view including spines, excluding the eyes.
- CI Cephalic Index = $HW \times 100/HL$.
- SL Scape Length: The straight-line length of the antennal scape, excluding the basal constriction or neck.
- SI Scape Index = $SL \times 100/HW$.
- ED Eye Diameter: The maximum diameter of the eye.
- PW Pronotal Width: The maximum width of the pronotum measured in dorsal view including spines.
- MSL Mesosoma Length (=AL-Alitrunk Length): The diagonal length of the mesosoma in lateral view, measured from the point at which the pronotum meets the cervical shield to the posterior basal angle of the metapleuron.
- PL Petiole Length: The length of the petiole measured in lateral view from the anterior process to the posteriormost point of the tergite, where it surrounds the gastral articulation.

- PH Petiole Height: The height of the petiole measured in lateral view from the apex of the ventral (subpetiolar) process vertically to a line intersecting the dorsalmost point of the node including spines.
- DPW Dorsal Petiole Width: The maximum width of the petiole in dorsal view including spines.
- LPI Lateral Petiole Index = $PH \times 100/PL$.
- DPI Dorsal Petiole Index = $DPW \times 100/PL$.

All measurements are expressed in millimeters.

ECHINOPLA SMITH, 1857

Echinopla Smith, 1857: 79. Type-species: *Echinopla melanarctos*, by subsequent designation of Wheeler, 1911: 162.

Mesoxena Smith, 1860: 106. Type-species: *Mesoxena mistura*, by monotypy. Junior synonym of *Echinopla*: Bolton, 1994: 50.

Diagnosis of worker: Robust arboreal ants with the following combination of characters.

Head rectangular to trapezoidal, usually broader than long and narrowed anteriorly. Mandibles robust, subtriangular, masticatory margin with 5 teeth. Palpi formula 6, 4. Clypeus broad and relatively short, anterior margin usually weakly convex. Antennal fossae widely apart. Antennae long, 12-segmented, scapes distinctly surpassing posterior head corners, flagella weakly incrassate toward apex Frontal lobes well developed, elevated or laterally expanded, usually concealing antennal fossae. Frontal carinae short, not surpassing the line connecting midpoints of the eyes. Eyes small, convex or protruding, placed laterally, well behind midpoint of head side, rarely situated at midpoint of the side. Ocelli absent.

Mesosoma oblong quadrate, dorsal outline completely arched or interrupted by impressed metanotal groove, at the latter case mesosoma strongly constricted at metanotal groove. Rarely dorsal outline of mesosoma straight and entire. Promesonotal suture and metanotal groove absent or present. Humeral corners of pronotum usually spined, toothed, or angled, rarely unarmed. Propodeal spiracles slit-like or elliptical, relatively lower on the side. Metapleural bulla and orifice present.

Petiole transverse and erect, narrowing dorsally, usually spined or toothed laterally and dorsally, without subpetiolar process. Rarely petiole node-like and cubic, without spines and teeth.

Gaster globose to ovate, the first segment very large and usually concealing the other segments beneath it.

Body surface usually strong sculptured, longitudinally striate, bluntly spined with background retirugose or densely cribrate with interface retirugose. Rarely body surface shagreened or smooth.

Pilosity and pubescence usually abundant, rarely body dorsum hairless.

Diagnosis of queen: With the common characters of worker, but head with three distinct ocelli. Mesosoma with tegulae. Mesonotum massive, each side with a tooth-like or lobe-like process, scutum long and broad, scutellum short and broad. Metanotum very short and transverse. Dorsum of propodeum short and broad, posterior margin rounded.

Systematic position: Formicinae: Camponotini.

Geographical range: Oriental, Indo-Australian and Australasian.

SPECIES GROUPING

Based on the characters of sculptures types, eyes, frontal lobes, mesosoma, petiole, and pilosity, the twenty-three species of the genus can be divided into five species-groups. The *serrata*-group is richest in species diversity, successively the *striata*-group and *melanarctos*-group, the *mistura*-group and *nitida*-group each contain one species only.

 mistura-group: Eyes located at midlength of head. Frontal lobes very narrow and suberect, antennal fossae exposed (Fig. 1). Mesosoma dorsum straight and entire, without suture and groove (Fig. 9). Petiole cubic, without spines and teeth. Body surface shagreen, without strong sculptures. Body dorsum hairless (Fig. 18). Includes 1 species. *mistura* (Smith, 1860): Moluccas (Indonesia)

- 2. *striata*-group: Eyes located close to posterior corners of head. Frontal lobes narrow and elevated, lateral margin straight, posterior corner broadly rounded, concealing half of antennal fossae (Figs. 2-8). Mesosoma dorsum convex and interrupted by impressed metanotal groove (Figs. 10-17). Mesosoma constricted at metanotal groove. Petiole transverse, sides and upper margin spined and toothed. Body dorsum longitudinally striate. Body surface with abundant hairs and pubescence (Figs. 19-26). Includes 6 species. deceptor Smith, 1863: Indonesia densistriata Stitz, 1938: Borneo lineata Mayr, 1862: Borneo, Indonesia, India, Nicobar Island, Krakatau Island pseudostriata Donisthorpe, 1943: New Guinea, Philippines striata Smith, 1857: Malaysia, Philippines, Borneo, Indonesia, China vermiculata Emery, 1898: Indonesia, Philippines, Sulawesi
- 3. melanarctos-group: Eyes located behind midlength of head. Frontal lobes broad, lateral margin nearly straight or sinuate, completely or partially concealing antennal fossae (Figs. 27-30). Mesosoma dorsum strongly convex, complete or interrupted by impressed metanotal groove (Figs. 31-34). Mesosoma usually constricted at metanotal groove. Petiole transverse, sides and upper margin spined and toothed. Dorsa of head and mesosoma abundantly bluntly spined with background retirugose; gaster abundantly bluntly spined, longitudinally striate or densely cribrate. Body surface with abundant hairs and pubescence (Figs. 35-38). Includes 4 species.

cherapunjiensis Bharti & Gul, 2012: India, China

melanarctos Smith, 1857: Singapore, Malaysia, Borneo, Thailand

pallipes Smith, 1857: Borneo, Philippines, Thailand

tritschleri Forel, 1901: Borneo, Indonesia

- nitida-group: Eyes located behind midlength of head. Frontal lobes broad, roundly laterally convex and concealing antennal fossae (Fig. 39). Mesosoma dorsum weakly convex and entire, without suture and groove (Fig. 47). Petiole transverse, sides spined and toothed. Body dorsum smooth and shiny (Fig. 58), sides cribrate with interstice retirugose. Body dorsum hairless (Fig. 47). Includes 1 species. nitida Smith, 1863: Indonesia
- serrata-group: Eyes located behind mid-5. length of head. Frontal lobes broad and triangular, laterally bluntly angled, concealing most of antennal fossae (Figs. 40-46). Mesosoma dorsum convex, entire or interrupted by impressed metanotal groove (Figs. 48-57). Mesosoma constricted at metanotal groove or not. Petiole transverse, sides and upper margin spined and toothed. Body surface densely cribrate with interstice coarsely retirugose. Body surface with abundant hairs and pubescence (Figs. 59-68). Includes 11 species. arfaki Donisthorpe, 1943: New Guinea australis Forel, 1901: Australia, New Guinea crenulata Donisthorpe, 1941: New Guinea dubitata Smith, F. 1862: Indonesia, Sulawesi maeandrina Stitz, 1938: New Guinea octodentata Stitz, 1911: New Guinea praetexta Smith, 1860: Indonesia rugosa André, 1892: Borneo serrata (Smith, 1859): Indonesia silvestrii Donisthorpe, 1936: New Guinea turneri Forel, 1901: Australia

KEY TO KNOWN SPECIES OF *ECHINOPLA* BASED ON WORKER & QUEEN CASTES

1 In full-face view, frontal lobes very narrow and suberect, such that antennal fossae exposed (Fig. 1). In lateral view, petiole nearly square, not narrowed dorsally, as high as gaster (Fig. 9). In dorsal view, petiole roughly trapezoidal, narrowed posteriorly, sides without spines or teeth (Fig. 18). Body surface shagreened (Fig. 1, 9, 18), not longitudinally striate, bluntly spined nor densely cribrate. Body black; mandibles, antennae, eyes and legs blackish brown (Indonesia) *E. mistura* (Smith, 1860)



Figs 1 – 8. Head, full-face view, of (1) *E. mistura* holotype worker, (2) *E. vermiculata* worker, (3) *E. vermiculata* type queen, (4) *E. pseudostriata* holotype worker, (5) *E. deceptor* holotype queen, (6) *E. striata* syntype worker, (7) *E. lineata* worker, (8) *E. lineata* type queen. Images from AntWeb (2014).

- In full-face view, frontal lobes laterally expanded, such that antennal fossae partly or completely concealed by frontal lobes (Figs. 2-8, 27-30, 39-46). In lateral view, petiole roughly conical, narrowed dorsally, much lower than gaster (Figs. 10-16, 31-34, 47-54). In dorsal view, petiole transverse, sides always spined or toothed (Figs. 19-25, 35-38, 58-65). Body surface more or less longitudinally striate (Figs. 19-26), bluntly spined (Figs. 35-38), or densely cribrate (Figs. 59-68), at least body sides densely cribrate (Fig. 47)......2





Figs 9 – **17.** Body, profile view, of (9) *E. mistura* holotype worker, (10) *E. vermiculata* worker, (11) *E. vermiculata* type queen, (12) *E. pseudostriata* holotype worker, (13) *E. deceptor* holotype queen, (14) *E. striata* syntype worker, (15) *E. lineata* worker, (16) *E. lineata* type queen, (17) *E. densistriata* worker (mesosoma only). Images 9-16 from AntWeb (2014), illustration 17 from Stitz (1938).

2 Head or mesosoma longitudinally striate (Figs.
2-8, 19-26)
- Head and mesosoma bluntly spined (Figs. 27-
30, 31-34) or densely cribrate (Figs. 40-46, 59-
68), or at least body sides densely cribrate (Fig.
47)







Figs 18 – 26. Body, dorsal view, of (18) *E. mistura* holotype worker, (19) *E. vermiculata* worker, (20) *E. vermiculata* type queen, (21) *E. pseudostriata* holotype worker, (22) *E. deceptor* holotype queen, (23) *E. striata* syntype worker, (24) *E. lineata* worker, (25) *E. lineata* type queen, (26) *E. densistriata* worker (mesosoma only). Images 18-25 from AntWeb (2014), illustration 26 from Stitz (1938).

podeum (Fig. 19). Body black (Indonesia, Philippines, Sulawesi......E. vermiculata Emery, 1898 - In full-face view, frons of head regularly longitudinally striate (Fig. 4). In dorsal view, humeral corners of pronotum bluntly angled. Petiole with a short spine on each side, distance between spine tips narrower than propodeum (Fig. 21). Body black (New Guinea, Philippines).....E. pseudostriata Donisthorpe, 1943 5 Gaster smooth, without longitudinal striation. In dorsal view, humeral corners of pronotum roundly angled. Petiole with a short spine on each side, distance between spine tips narrower than propodeum (Fig. 22). Body black (Indonesia)*E. deceptor* Smith, F. 1863 - Gaster not smooth, longitudinally striate. In dorsal view, humeral corners of propodeum forming an obtuse or right angle. Petiole with a long spine on each side, distance between spine tips as wide as or wider than propodeum (Figs. 23-26)......6 6 In dorsal view propodeum roughly rectangular, weakly widened posteriorly, anterior corners acutely toothed. Humeral corners of pronotum acutely toothed (Fig. 26). Body black (Borneo)E. densistriata Stitz, 1938 - In dorsal view propodeum roughly trapezoidal, strongly widened posteriorly, anterior corners without acute teeth. Humeral corners of pronotum bluntly toothed (Figs. 23-25).....7 7 In full-face view, head finely longitudinally striate, frons with about 70 striations between eyes (Fig. 6). Body dorsum with blackish standing hairs and sparse pubescence (Fig. 14, 23). Body black (Malaysia, Philippines, Borneo, Indonesia, China).....E. striata Smith, 1857 - In full-face view, head coarsely longitudinally striate, frons with about 50 striations between eyes (Fig. 7-8). Body dorsum with whitish standing hairs and dense pubescence (Fig. 15-16, 24-25). Body black (Borneo, Indonesia, India, Nicobar Island, Krakatau Island)..... *E. lineata* Mayr, 1862 8 Head and mesosoma bluntly spined with background retirugose (Figs. 27-38)9 - Head and mesosoma cribrate with interstice coarsely retirugose (Fig. 40-68), at least body sides densely cribrate (Fig. 47)12



Figs 27 – 30. Head, full-face view, of (27) *E. melanarctos* worker, (28) *E. pallipes* holotype worker, (29) *E. tritschleri* holotype worker, (30) *E. cherapunjiensis* holotype worker. Images from AntWeb (2014).

9 In lateral view, dorsum of mesosoma strongly convex and forming a complete arch, not interrupted by impressed or notched metanotal groove (Figs. 31-32). In dorsal view, mesosoma slightly constricted at metanotal groove position (Figs. 35-36)......10 - In lateral view, dorsum of mesosoma almost straight, not forming a complete arch, interrupted by impressed or notched metanotal groove (Figs. 33-34). In dorsal view, mesosoma strongly constricted at metanotal groove position (Figs. 37-10 Dorsa of head, mesosoma and first gastral segment with well developed long blunt spines. Sides of head regularly longitudinally striate (Figs. 27, 31). In dorsal view each side of petiole with a long spine, longer than half the width of the node (Fig. 35). Body black; mandibular apices, last two segments of tarsi and gastral apex reddish brown; eyes blackish brown (Singapore, Malaysia, Borneo, Thailand).....

.....E. melanarctos Smith, 1857



Figs 31 – 34. Body, profile view, of (31) *E. melanarc*tos worker, (32) *E. pallipes* holotype worker, (33) *E.* tritschleri holotype worker, (34) *E. cherapunjiensis* holotype worker. Images from AntWeb (2014).

-- Dorsa of head and mesosoma with weakly developed short blunt spines, first gastral segment densely cribrate. Sides of head irregularly rugose (Fig. 28, 32). In dorsal view, each side of petiole with a short spine, shorter than half width of the node (Fig. 36). Body black; mandibles and antennae reddish brown; legs and gastral apex yellowish brown (Borneo, Philippines, Thailand)....... *E. pallipes* Smith, 1857



Figs 35 – 38. Body, dorsal view, of (35) *E. melanarc*tos worker, (36) *E. pallipes* holotype worker, (37) *E.* tritschleri holotype worker, (38) *E. cherapunjiensis* holotype worker. Images from AntWeb (2014).

distinctly break lateral outline of head (Fig. 30). In lateral view, dorsal outline of mesosoma indistinctly interrupted by narrowly notched metanotal groove (Fig. 34). Dorsa of head and mesosoma with short blunt spines. Sides of first gastral segment densely cribrate (Fig. 34, 38). Body black; mandibles and antennae reddish brown; legs yellowish brown (India, China)..... E. cherapunjiensis Bharti & Gul, 2012 12 Dorsa of head and mesosoma smooth and shining (Figs. 39, 58), sides of mesosoma and gaster densely elongately cribrate (Fig. 47). In dorsal view, propodeum wider than pronotum (Fig. 58). Body dorsum hairless (Fig. 47). Body black; flagella, palpi and tarsi yellowish brown (Indonesia).....E. nitida Smith, 1863 -- Dorsa of head and mesosoma densely cribrate (Figs. 40-46, 59-68). In dorsal view, propodeum as wide as or narrower than pronotum (Figs. 59-68). Body dorsum with abundant hairs (Figs. 48-





Figs 39 – 46. Head, full-face view, of (39) *E. nitida* holotype worker, (40) *E. silvestrii* holotype queen, (41) *E. dubitata* syntype worker, (42) *E. australis* syntype worker, (43) *E. praetexta* holotype worker, (44) *E. crenulata* holotype worker, (45) *E. serrata* holotype worker, (46) *E. turneri* type worker. Images from AntWeb (2014).





Figs 47 – 54. Body, profile view, of (47) *E. nitida* holotype worker, (48) *E. silvestrii* holotype queen, (49) *E. dubitata* syntype worker, (50) *E. australis* syntype worker, (51) *E. praetexta* holotype worker, (52) *E. crenulata* holotype worker, (53) *E. serrata* holotype worker, (54) *E. turneri* type worker. Images from AntWeb (2014).



Figs 55 – 57. Mesosoma, profile view, of (55) *E. mae-andrina* queen, (56) *E. octodentata* worker, (57) *E. ar-faki* worker. Illustrations from Stitz (1938).

14 In lateral view, dorsum of mesonotum straight. Posterodorsal corner of propodeum broadly rounded (Fig. 48). In dorsal view lateral teeth of mesonotum blunt, located at sides of scutellum. Posterior margin of scutum and posterior margin of scutellum nearly straight (Fig. 59). Body black; mandibles reddish brown; ocelli and legs yellowish brown; eyes blackish brown (New Guinea)E. silvestrii Donisthorpe, 1936 -- In lateral view, dorsum of mesonotum weakly convex. Posterodorsal corner of propodeum narrowly rounded (Fig. 55). In dorsal view lateral teeth of mesonotum acute, located at posterolateral corners of scutum. Posterior margin of scutum weakly concave, posterior margin of scutellum weakly convex (Fig. 66). Body black; antennae, tibiae and tarsi brown (New Guinea)E. maeandrina Stitz, 1938





Figs 58 – 65. Body dorsal of (58) *E. nitida* holotype worker, (59) *E. silvestrii* holotype queen, (60) *E. dubitata* syntype worker, (61) *E. australis* syntype worker, (62) *E. praetexta* holotype worker, (63) *E. crenulata* holotype worker, (64) *E. serrata* holotype worker, (65) *E. turneri* type worker. Images from AntWeb (2014)





Figs 66 – 68. Mesosoma, dorsal view, of (66) *E. maeandrina* queen, (67) *E. octodentata* worker, (68) *E. arfaki* worker. Illustrations from Stitz (1938).

15 In lateral view, dorsal outline of mesosoma interrupted by impressed metanotal groove (Figs. -- In lateral view, dorsal outline of mesosoma entire, metanotal groove not impressed (Figs. 51-16 In lateral view, metanotal groove deeply impressed (Fig. 49). In dorsal view, petiole with a long spine on each side. Gaster shining, sparsely finely cribrate, interstice 2-3 times puncture diameter (Fig. 60). Body black; mandibles, antennae, tibiae and tarsi blackish brown; palpi, femora and last two tarsal segments brownish yellow (Indonesia, Sulawesi).....E. dubitata Smith, 1862 -- In lateral view, metanotal groove weakly impressed (Fig. 50). In dorsal view, petiole with more than one spine or tooth on each side. Gaster not shining, densely finely cribrate, interstice about as wide as puncture diameter (Fig. 61)..17 17 In dorsal view, petiole with four teeth on each side. Humeral corners of pronotum bluntly angled, anterior and lateral margins of promesonotum entire (Fig. 61). Body black; mandibles, antennae and legs brownish yellow; eyes and gastral apex yellowish brown (Australia, New Guinea).....E. australis Forel, 1901 -- In dorsal view, petiole with three stout spines on each side. Humeral corners of pronotum toothed, anterior and lateral margins of promesonotum weakly finely crenulate. Body black with bronze shimmer (Borneo)E. rugosa André, 1892 18 In dorsal view mesosoma strongly constricted between mesonotum and propodeum (Figs. 67-- In dorsal view mesosoma weakly constricted between mesonotum and propodeum (Figs. 62-19 Metanotal groove present, but not impressed. Sides of promesonotum entire (Figs. 56, 67). Body black; antennae and legs reddish (New Guinea)..... E. octodentata Stitz, 1911 -- Metanotal groove absent. Sides of promesonotum serrate (Figs. 57, 68). Body black (New Guinea)..... E. arfaki Donisthorpe, 1943 20 In dorsal view, mesosoma slightly narrowed posteriorly, propodeum about as broad as prono--- In dorsal view, mesosoma strongly narrowed posteriorly, propodeum distinctly narrower than 21 In full-face view, head abundantly cribrate, punctures on head roughly circular, interstice smooth and shining, wider than punctures diameter (Fig. 43). In lateral view, dorsum of mesosoma weakly convex, dorsum of gaster lacking standing hairs and pubescence (Fig. 51). In dorsal view, gaster abundantly cribrate, interstice about as broad as puncture diameter (Fig. 62). Body black; mandibles and femora blackish brown; antennae, tibiae and tarsi brownish yellow (Indonesia).....E. praetexta Smith, 1860 -- In full-face view, head densely cribrate, punctures on head elongate elliptical, interstice dull, narrower than puncture diameter (Fig. 44). In lateral view, dorsum of mesosoma strongly convex, dorsum of gaster with abundant standing hairs and pubescence (Fig. 52). In dorsal view, gaster densely cribrate, interstice narrower than puncture diameter (Fig. 63). Body black; apices of mandibles and last tarsal segments blackish brown (New Guinea).....E. crenulata Donisthorpe, 1941

22 In full-face view, head densely elongately cribrate, interstice much narrower than puncture diameter (Fig. 45). In lateral view, dorsum of mesosoma strongly convex, propodeal declivity steeply sloped. Dorsum of mesosoma with sparse standing hairs, dorsum of gaster without pubescence (Fig. 53). In dorsal view, gaster densely elliptically cribrate, interstice narrower than puncture diameter (Fig. 64). Body black; mandibles, antennae and legs brownish yellow (Indonesia)... *E. serrata* (Smith, 1859) -- In full-face view, head densely circularly cribrate, interstice about as broad as puncture diameter (Fig. 46). In lateral view, dorsum of mesosoma weakly convex, propodeal declivity nearly vertical. Dorsum of mesosoma with abundant standing hairs, dorsum of gaster with dense pubescence (Fig. 54). In dorsal view, gaster densely finely cribrate, interstice about as broad as puncture diameter (Fig. 65). Body black; mandibles yellowish red; antennae and legs yellowish brown (Australia)*E. turneri* Forel, 1901

REPORTS OF CHINESE SPECIES

Echinopla striata Smith, 1857 New Record in China

(Figs. 6, 14, 23, 69-73)

Echinopla striata Smith, 1857: 80 (w.) WEST MALAYSIA.

Polyrhachis aciculatus Smith, 1858: 70, pl. 4, figs. 17, 18 (w.) PHILIPPINES. Combination in *Echinopla*: Emery, 1900: 721 (footnote). Variety of *striata*: Emery, 1925: 211. Currently subspecies of *striata*: Bolton, 1995: 184.

Echinopla striata var. *goramensis* Emery, 1887: 241 (w.) INDONESIA (Goram I.). Currently subspecies of *striata*: Bolton, 1995: 184.

Echinopla striata subsp. *gibbosa* Karavaiev, 1927: 51 (w.) INDONESIA (Ambon I.). Currently subspecies of *striata*: Bolton, 1995: 184.

The following redescription of syntype worker is based on AntWeb Images.

Syntype worker (Figs. 6, 14, 23): TL 6.8, HL 1.55, HW 1.76, CI 114, SL 1.44, SI 82, ED 0.35, PW 1.70, MSL 2.47, PL 0.55, PH 0.58, DPW 1.48, LPI 105, DPI 272.

In full-face view, head roughly trapezoidal, narrowed anteriorly and broader than long, posterior margin moderately convex, posterior corners rounded, lateral margins weakly convex. Mandibles with five teeth on the masticatory margin. Anterior margin of clypeus weakly convex. Frontal lobes narrow and elevated, lateral margin straight, posterior corner broadly rounded, concealing half of antennal fossae. Antennae 12-segmented, scapes surpassing posterior corners, flagella weakly incrassate toward apex. Eyes convex, situated well behind midlength of head. In lateral view, dorsum of mesosoma interrupted by impressed metanotal groove, laterally marginated, promesonotal suture present, promesonotum weakly convex, propodeum strongly convex. Petiole low, narrowed dorsally and roughly conical, acutely toothed on the summit. Gaster elongate ovate, dorsum moderately convex.

In dorsal view, mesosoma strongly constricted at metanotal groove, promesonotal suture present and anteriorly arched, metanotal groove straight. Promesonotum narrowing posteriorly, slightly wider than propodeum, anterior margin of pronotum moderately convex, humeral corners bluntly angled, lateral margins of promesonotal suture notched, anterior and lateral margins crenulate. Propodeum widening posteriorly, posterior corners rounded, lateral and posterior margins crenulate. Petiole transverse, about as broad as propodeum, each side with a strong posteriorly bent spine, dorsal margin with several short teeth. Gaster ovate, narrowed posteriorly.

Head, mesosoma and gaster longitudinally striate, frons with about 70 striations between eyes. Sides of mesosoma irregularly rugose, sides of mesothorax reticulate. Body dorsum with abundant erect long hairs and decumbent pubescence. Scapes and tibiae with abundant suberect hairs and decumbent pubescence. Body black, eyes grayish brown.

Workers form China (Figs. 69-73): TL 4.9-6.4, HL 1.40-1.50, HW 1.47-1.63, CI 105-114, SL 1.27-1.43, SI 82-88, ED 0.33-0.35, PW 1.30-1.53, MSL 1.77-2.33, PL 0.50-0.53, PH 0.40-0.50, DPW 1.20-1.37, LPI 75-94, DPI 225-256 (three workers measured). The Chinese specimens well conform to the syntype worker of *E. striata*, but body relatively smaller; in lateral view, metanotal groove relatively deeply impressed, propodeum less convex, petiole relatively lower, pilosity on body dorsum relatively sparser and shorter. In dorsal view, propodeum of two worker with regular longitudinal striations, of another worker with regular circular striations. Three workers from China were observed:

1 worker, China: Yunnan Province, Mengla County, Shangyong Town, Manzhuang Village, N 21°25.884', E 101°40.944', 900 m, collected from a canopy sample in the semievergreen monsoon forest, 14.VIII.1997, Yunfeng He leg., No. A97-1596; 1 worker, with same data as No. A97-1596, but N 21°25.718', E 101°41.169', 960 m, 24.III.2012, Zhenghui Xu leg., No. A12-395.

1 worker, China: Yunnan Province, Mengla County, Mengla Town, Bubang Village, N 21°35.996', E 101°35.108', 700 m, collected in valley rainforest, 15.IX.2005, Jingxin Liu leg., No. A05-1517.

Distribution: Malaysia, Indonesia, Philippines, China.



Figs 69 – **73.** Chinese worker of *Echinopla striata*: (69) Body in lateral view, (70) Body in dorsal view, (71) Head in full-face view, (72) Mandible in dorsal view, (73) Petiole in posterior view.

Echinopla cherapunjiensis Bharti & Gul, 2012 (Figs 30, 34, 38, 74 – 78)

Echinopla cherapunjiensis Bharti & Gul, 2012: 53, figs. 1-3 (w.) INDIA

For a full description of the species see Bharti & Gul (2012) (Figs. 30, 34, 38). The species was recorded in Yunnan Province, China previously by Liu et al. (2015). Here we report more observations of materials from Tibet and Guangxi Regions, and Yunnan Province of China.

Workers from China (Figs. 74-78): TL 5.7-6.8, HL 1.40-1.63, HW 1.47-1.77, CI 102-

111, SL 1.30-1.50, SI 84-91, ED 0.30-0.37, PW 1.37-1.67, MSL 2.00-2.40, PL 0.37-0.50, PH 0.57-0.67, DPW 0.77-0.97, LPI 113-155, DPI 171-223 (14 workers measured). Well conform to the holotype worker, but in lateral view, metanotal groove very narrowly notched, in dorsal view promesonotal suture and metanotal groove present, narrow but visible.

Gyne from China: TL 7.7, HL 1.67, HW 1.73, CI 104, SL 1.57, SI 90, ED 0.43, PW 1.90, MSL 3.13, PL 0.53, PH 0.67, DPW 0.93, LPI 125, DPI 175 (1 gyne measured). Similar to holotype worker, but body larger, head with three distinct ocelli. In lateral view, dorsum of mesosoma slightly convex and sloping down posteriorly, mesonotum massive with distinct tegulae, declivity of propodeum concave. In dorsal view, mesosoma narrowed posteriorly, weakly constricted at metanotal groove, each side of mesonotum with a rounded tooth at mesonotal suture. Humeral corners of pronotum rounded. Scutum rectangular, with a pair of longitudinal furrows, anterior margin strongly convex, posterior margin almost straight. Scutellum transverse and roughly rhombic, both anterior and posterior margins moderately convex. Metanotum very short and transverse, posteriorly arched. Propodeum widening posteriorly, much broader than long, posterior corners rounded. Mesonotum densely irregularly retirugose, without short blunt spines.

Material examined: Seventeen workers and one gyne from China were observed:

7 workers, China: Tibet Region, Medog County, Beibeng Town, Beibeng Village, N 29°14.598', E 95°10.197', 670 m, collected on the plants in valley rainforest, 24.V.2008, Zhenghui Xu leg., No. A08-1284.

1 worker, China: Guangxi Region, Fangchenggang City, Fangcheng District, Shiwandashan Mountain, Banba Town, N 21°40.398', E 107°39.111', 187 m, broadleaf forest, 14.VII.2006, Li Feng leg., No. A06-1220.

1 worker, China: Yunnan Province, Mengla Town, Bubang Village, N21°35.996', E101°35.108', 730m, collected from a canopy sample in the valley rainforest, 17.VIII.1997, Guang Zeng leg., No. A97-2142; 2 workers, with same data as No. A97-2142, but 700 m, collected in valley rainforest, 02.V.2005, Jingxin Liu leg., No. A05-1515; 1 worker, with same data as No. A97-2142, but 700 m, collected in valley rainforest, 15.IX.2005, Jingxin Liu leg., No. A05-1516; 1 worker, with same data as No. A97-2142 but N 21°36.780', E 101°34.800', 580 m, rainforest, hand collection, July 2012, Chris J. Burwell leg., No. A12-1821; 1 worker, with same data as No. A97-2142, but N 21°36.960', E 101°34.740', 739 m, rainforest, hand collection, July 2012, Chris J. Burwell leg., No. A12-1822.

1 worker, China: Yunnan Province, Mengla County, Menglun Town, Menglun Village, N 21°56.118', E 101°14.932', 680 m, rainforest, 5.III.1996, Yongchao Du leg., No. A96-582; 1 worker, with same data as No. A96-582, but 700 m, collected on the plant in valley rainforest, 30.XI.2012, Fangfang Xu leg., No. A12-1823.

1 worker, China: Yunnan Province, Jinghong City, Yunjinghong Town, Mandian Village, N 22°07.555', E 100°40.625', 650 m, collected on the plant in valley rainforest, 12.V.2009, Jingxin Liu leg., No. A09-2370.

1 queen, China: Yunnan Province, Mengla County, Shangyong Town, Manzhuang Village, N 21°25.174', E 101°41.033', 1000 m, collected from a ground sample in the semi-evergreen monsoon forest, 22.III.2012, Congfeng Luo leg., No. A12-151.

Distribution: India, China.



Figs 74 – **78.** Chinese worker of *Echinopla cherapunjiensis*: (74) Body in lateral view, (75) Body in dorsal

view, (76) Head in full-face view, (77) Mandible in dorsal view, (78) Petiole in posterior view

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REFERENCES

- André, E. 1892. Voyage de M. Chaper à Bornéo. Catalogue des fourmis et description des espèces nouvelles. Mémoires de la Société Zoologique de France 5: 46-55.
- AntBase.Net 2015. University of Ulm, Germany. Available from: http://www.antbase.net (Accessed 1 April 2014).
- AntWeb 2014. California Academy of Sciences, San Francisco, California, USA. Available from: http:// www.antweb.org (Accessed 1 April 2014).
- AntWiki 2015. Available from: http://www.antwiki. org/wiki/Echinopla_species_by_Country (Accessed 7 April 2015)

- Bharti, H. & Gul, I. 2012. Echinopla cherapunjiensis sp. n. (Hymenoptera, Formicidae) from India. Vestnik Zoologii 46(4): 52-54.
- Bolton, B. 1975. A revision of the ant genus *Leptog-enys* Roger in the Ethiopian region, with a review of the Malagasy species. Bulletin of the British Museum (Natural History) (Entomology) 31: 235-305.
- Bolton, B. 1994. Identification guide to the ant genera of the world. Cambridge, Mass.: Harvard University Press, 222 pp.
- Bolton, B. 1995. A new general catalogue of the ants of the world. Cambridge, Mass.: Harvard University Press, 504 pp.
- Bolton, B. 2014. An online catalog of the ants of the world. Available from: http://www.antcat. org/. Retrieved on 1 January 2014.
- Burwell, C. J. & Nakamura, A. 2011. Distribution of ant species along an altitudinal transect in continuous rainforest in subtropical Queensland, Australia. Memoirs of the Queensland Museum – Nature 55: 391-411.
- Donisthorpe, H. 1932. On the identity of Smith's types of Formicidae (Hymenoptera) collected by Alfred Russell Wallace in the Malay Archipelago, with descriptions of two new species. Annals and Magazine of Natural History (10)10: 441-476.
- Donisthorpe, H. 1936a. A new study of *Mesoxena mistura* Smith. Proceedings of the Royal Entomological Society of London. Series B 5: 119-120.
- Donisthorpe, H. 1936b. Five new species of ant (Formicidae) from various localities. Annals and Magazine of Natural History (10)18: 524-530.
- Donisthorpe, H. 1941. A new species of *Echinopla* (Hym., Formicidae), with some notes on the genus. Entomologist 74: 115-116.
- Donisthorpe, H. 1943. Descriptions of new ants, chiefly from Waigeu Island, N. Dutch New Guinea. Annals and Magazine of Natural History (11)10: 167-176.
- Emery, C. 1887. Catalogo delle formiche esistenti nelle collezioni del Museo Civico di Genova. Parte terza. Formiche della regione Indo-Malese e dell'Australia. [part]. Annali del Museo Civico di Storia Naturale 24 (2)4: 209-240.
- Emery, C. 1896. Saggio di un catalogo sistematico dei generi *Camponotus*, *Polyrhachis* e affini. Memorie della Reale Accademia delle Scienze dell'Istituto di Bologna (5)5:363-382.
- Emery, C. 1898. Descrizioni di formiche nuove malesi e australiane. Note sinonimiche. Rendiconti delle Sessioni della Reale Accademia delle Scienze dell'Istituto di Bologna (n.s.) 2: 231-245.

- Emery, C. 1900. Formiche raccolte da Elio Modigliani in Sumatra, Engano e Mentawei. Annali del Museo Civico di Storia Naturale Giacomo Doria (Genova) (2)20(40): 661-722.
- Emery, C. 1925. Hymenoptera. Fam. Formicidae. Subfam. Formicinae. Genera Insectorum 183: 1-302.
- Forel, A. 1901. Formiciden des Naturhistorischen Museums zu Hamburg. Neue Calyptomyrmex-, Dacryon-, Podomyrma- und Echinopla-Arten. Mitteilungen aus dem Naturhistorischen Museum in Hamburg 18: 43-82.
- Karavaiev, V. 1927. Ameisen aus dem Indo-Australischen Gebiet. III. Zbirnyk Prats' Zoolohichnoho Muzeyu 3: 3-52 [= Trudy. Ukrains'ka Akademiya Nauk. Fizichno-Matematichnoho Viddilu 7: 3-52].
- Liu, C, Guénard, B, Garcia, F.H., Yamane, S., Blanchard, B., Yang, D.-R., Economo, E. 2015. New records of ant species from Yunnan, China. ZooKeys 477: 17-78.
- Mayr, G. 1862. Myrmecologische Studien. Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien 12: 649-776.
- Smith, F. 1857. Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. Journal and Proceedings of the Linnean Society of London. Zoology 2: 42-88.
- Smith, F. 1858. Catalogue of hymenopterous insects in the collection of the British Museum. Part VI. Formicidae. London: British Museum, 216 pp.
- Smith, F. 1859. Catalogue of hymenopterous insects collected by Mr. A. R. Wallace at the islands of Aru and Key. Journal and Proceedings of the Linnean Society of London. Zoology 3: 132-158.
- Smith, F. 1860. Catalogue of hymenopterous insects collected by Mr. A. R. Wallace in the islands of Bachian, Kaisaa, Amboyna, Gilolo, and at Dory in New Guinea. Journal and Proceedings of the Linnean Society of London. Zoology 5(17b) (suppl. to vol. 4): 93-143.

- Smith, F. 1862. Catalogue of hymenopterous insects collected by Mr. A. R. Wallace in the islands of Ceram, Celebes, Ternate, and Gilolo. Journal and Proceedings of the Linnean Society of London. Zoology 6: 49-66.
- Smith, F. 1863. Catalogue of hymenopterous insects collected by Mr. A. R. Wallace in the islands of Mysol, Ceram, Waigiou, Bouru and Timor. Journal and Proceedings of the Linnean Society of London. Zoology 7: 6-48.
- Stitz, H. 1911. Australische Ameisen. (Neu-Guinea und Salomons-Inseln, Festland, Neu-Seeland). Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin 1911: 351-381.
- Stitz, H. 1938. Neue Ameisen aus dem indo-malayischen Gebiet. Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin 1938: 99-122.
- Taylor, R. W. 1992. Nomenclature and distribution of some Australian and New Guinean ants of the subfamily Formicinae (Hymenoptera: Formicidae). Journal of the Australian Entomological Society 31: 57-69.
- Wheeler, W. M. 1911. A list of the type species of the genera and subgenera of Formicidae. Annals of the New York Academy of Sciences 21: 157-175.
- Xu, Z. 2002. A study on the biodiversity of Formicidae ants of Xishuangbanna Nature Reserve. Kunming, Yunnan Province: Yunnan Science and Technology Press, 181 pp.
- Xu, Z., Chu, J., Zhang, C. & Yu, N. 2011 Ant species and distribution pattern in Gongbo Nature Reserve in Southeastern Tibet. Sichuan Journal of Zoology, 30(1): 118-123.

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