

Three new species and one new record of *Liris* Fabricius (Hymenoptera: Crabronidae) from China, with a key to the Palaeartic species

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Three new crabronid species, *Liris claviformis* sp. n., *Liris clypefoveolatus* sp. n., and *Liris retirugosus* sp. n., from Yunnan, China, are described and illustrated, and one new record for China, *Liris agilis* (F. Smith) from Xinjiang, is reported. A key to the Palaeartic species is provided.

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1. Introduction

Liris Fabricius is a large cosmopolitan genus of the family Crabronidae. Richards (1928) and Beaumont (1961) revised the mediterranean species of *Liris*, respectively. Bohart and Menke (1976) listed 20 Palaeartic species. Kazenas (1978) provided a key to nine Palaeartic species of the genus. Pulawski listed 25 Palaeartic species of the genus in the electronic catalog of Sphecidae in April 2007, of which six species occur in Palaeartic, five in both Palaeartic and Oriental, nine in Palaeartic and Ethiopian, three in Palaeartic, Oriental and Australian, and two in Palaeartic, Oriental and Ethiopian regions. Ten Palaeartic species have been reported from China (Smith 1856, Bingham 1897, Cameron 1903, Dover 1926, Richards 1928, Gussakovskij 1938, Beaumont 1961, Bohart and Menke 1976, Tsuneki 1966, 1967, 1971, 1972, Pu 1986, Wu and

Zhou 1996, Porter *et al.* 1999, Pulawski 2007). During our study on the Chinese *Liris*, three new species and one new record from China were discovered.

Liris Fabricius is related to *Larra* Fabricius, and they share the following characters: lateral ocellus reduced, flat and small; frons just below medial ocellus with a transverse swelling extending from eye to eye and interrupted by medial frontal line, and a linear swelling along inner orbit which joins transverse swelling to form an M shape; fore wing with three submarginal cells; pronotum in angular in dorsal view, gaster without petiole. However, *Liris* can be differentiated from *Larra* by the following combination of characters: in female, last tarsomere angled in lateral view and surface parallel on apical half, pygidial plate in most species setose and with apically a transverse row of stout spinules; in male, lateral surface of propodeum impunctate and dull

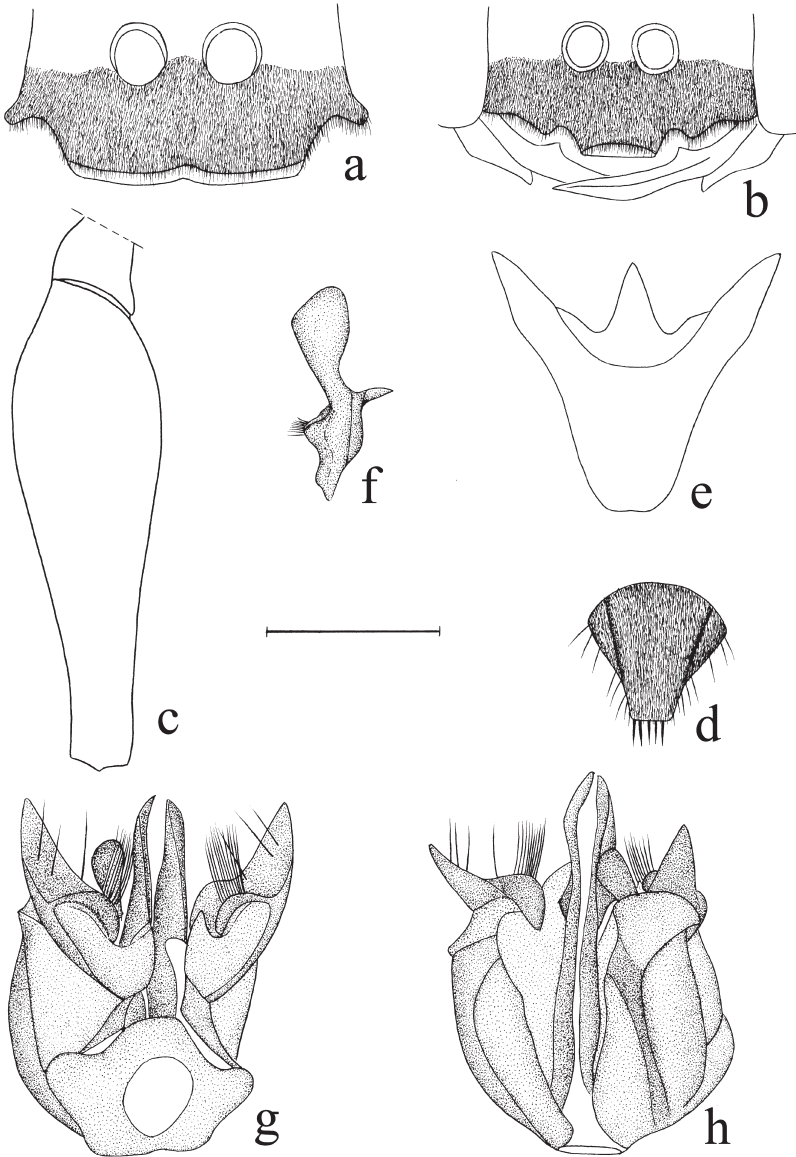


Fig. 1. *Liris claviformis* sp. n. a, c, d, ♀; b, e-h, ♂. – a. Frontal view of female clypeus. – b. Frontal view of male clypeus. – c. Hind femur of female. – d. Dorsal view of pygidial plate of female. – e. Sternum VIII of male. – f. Lateral view of volsella of male. – g. Frontal lateral view of paramere of male. – h. Dorsal lateral view of right paramere of male. Scale bar for a–d = 1.0 mm; for e–h = 0.49 mm.

or if shiny, then at most with sparse pinprick punctures, fore and hind femora excavated ventrally.

2. Material and methods

The material examined is deposited in Yunnan Agricultural University, Kunming (YNAU) and Institute of Zoology, Academia Sinica, Beijing (IZB), respectively. The specimens were observed and figured with the aid of an Olympus

stereomicroscope with an ocular micrometer. The ratios throughout the descriptions were measured using the same magnification. For the terminology, we mainly follow Bohart and Menke (1976).

3. Descriptions of new species

3.1. *Liris claviformis* sp. n. (Fig. 1)

Material examined. Holotype, ♀, China, Yunnan, Jinping County, Mengla 420 m a.s.l., 21.IV.1956,

Keren Huang. Paratype, 1♂, the same data as holotype. Deposited in IZB.

Description. Female. Body length 11.0 mm. Black; mandible except base dark ferruginous; palpi, tibial and tarsal spines, tegula, stigma, and wings veins dark brown; wings hyaline, apex dark. Setae on head and thorax long, silvery, and soft, those on lower frons and clypeus distinctly thicker and shorter, those on gaster shorter, posterior margins of gastral segments I–IV with bands of silvery pile, respectively.

Head. Frons and vertex alutaceous and sparsely punctuate, punctures more than one diameter apart. Least interocular distance longer than flagellomere I. Length of flagellomere I about $2.7 \times$ its apical width, shorter than flagellomere II. Flagellomeres IV–IX with elongate elliptic placoids extending over about $1/6$ the length of each segment, respectively. Lip of clypeus somewhat truncate and medially incised (Fig. 1a). Mandible basally with one tooth on inner margin.

Thorax. Pronotal collar and scutum densely punctuate, punctures less than one diameter apart, those on scutellum and metanotum sparser and more than one diameter apart; dorsum of propodeum with wide, shallow, and medial furrow, lateral carina, and dense, transverse and long rugae extending to lateral margin of propodeum and basally to mesopleural suture, intermixed with a few short, longitudinal rugae; lateral surface of propodeum densely, thinly and obliquely rugose; posterior surface of propodeum with medial furrow, side of furrow sparsely and transversely rugose. Length relation between abscissae of radial vein of fore wings: $5 < 2 < 3 < 1 < 4$. Hind femur (Fig. 1c) claviform, basally thickened, and gradually tapering toward apex.

Gaster. Pygidial plate (Fig. 1d) densely setose, apically truncate, and with 5 long and brown spinules; length of tergum I: width at posterior margin = 57: 100.

Male. Body length 9.0 mm. Scape and legs somewhat dark ferruginous. Least interocular distance as long as combined length of pedicel and flagellomere I. Length of flagellomere I about $1.7 \times$ its apical width, shorter than II. Flagellomeres II–XI with placoids, on II–X extending over full length of each segment, on XI extending over $3/4$ length of the segment. Lip of cly-

peus truncate and not medially incised (Fig. 1b). Mid femur excavated ventrally, hind femur flat on inner side. Dorsum of propodeum more coarsely rugose than in female. Gaster without pygidial plate; length of tergum I : width at posterior margin = 73: 100. Length relation between abscissae of radial vein of fore wings: $5 < 2 < 3 < 1 < 4$. Sternum VIII, volsella, paramere, and penis valve as in Fig. 1e–h, respectively. Other characters similar as in female.

Etymology. The specific name derives from Latin word *claviformis*, with reference to the hind femur claviform, basally thickened, and gradually tapering toward apex, which is one of the recognition characters for the species.

Diagnosis. The new species can be distinguished from the related *L. philippinicus* Tsuneki (1982) and all other congeners of the genus by the following combination of characters: lip of clypeus truncate in male, mandible basally with one tooth on inner margin, long, silvery, and soft setae on head and thorax, those on lower frons and clypeus distinctly thicker and shorter in both sexes, hind femur claviform, basally thickened, and gradually tapering toward apex in both sexes, and different shape of the genitalia.

Distribution. China: Yunnan (Fig. 4).

3.2. *Liris clypefoveolatus* sp. n. (Fig. 2)

Material examined. Holotype, ♂, China, Yunnan, Dehongzhou City, Luxi County, West Outskirts of Fapa Town in Luxi City, 10.VIII.2005, Tingjing Li. Deposited in YNAU.

Description. Male. Body length 16.0 mm. Black; palpi, tegula, stigma and veins dark brown to black; wings dark, with purple luster. Setae on head, thorax, and gaster silvery.

Head. Frons and vertex densely punctuate, punctures less than one diameter apart. Least interocular distance longer than flagellomere I, shorter than combined length of pedicel and flagellomere I. Length of flagellomere I about $2.7 \times$ its apical width, as long as II. Flagellomeres III–IX with elongate elliptic placoids, on III about $1/5$ length of segment, on IV about half of segment, on IV–IX longer than half of each segment. Surface of clypeus (Fig. 2a) gradually excavated except base, lip truncate. Mandible not notched on

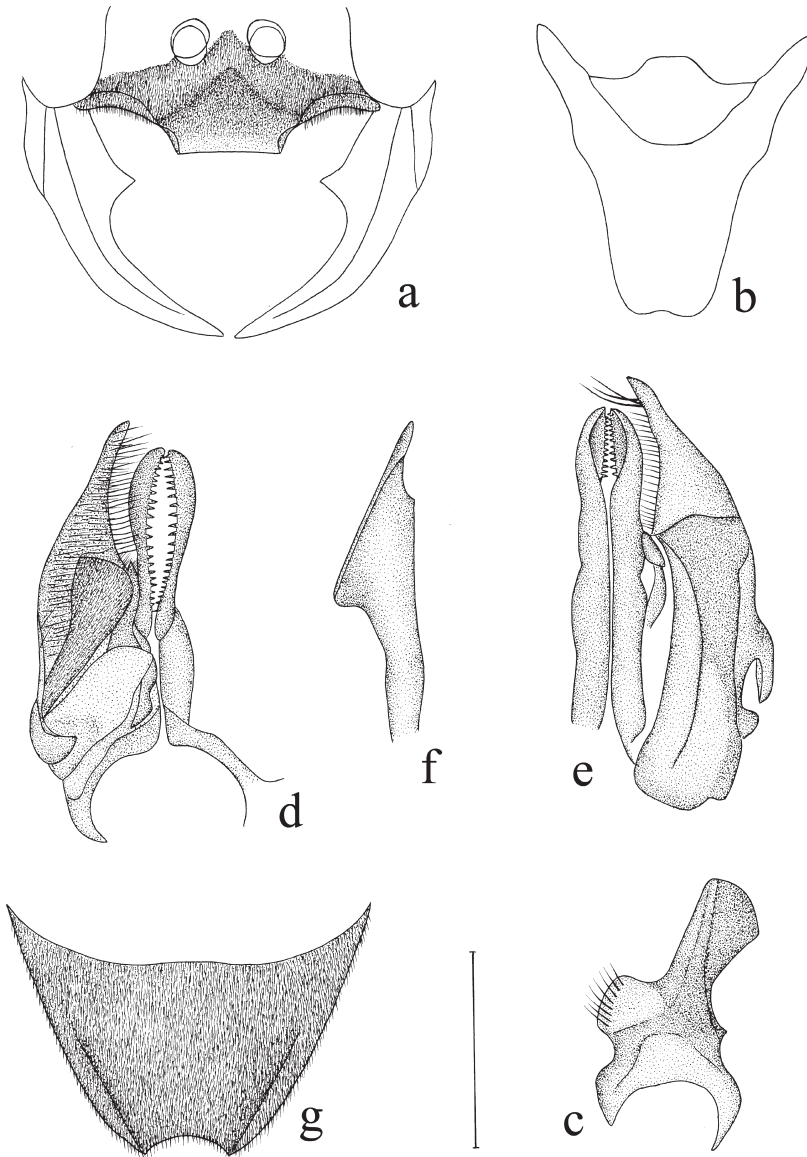


Fig. 2. *Liris clypefoveolatus* sp. n. ♂. – a. Frontal view of clypeus. – b. Sternum VIII. – c. Lateral view of volsella. – d. Inside view of left paramere. – e. Dorsal view of left paramere. – f. Lateral view of penis valve. – g. Dorsal view of pygidial plate. Scale bar for a = 2.06 mm; for b, d–g = 1.0 mm; for c = 0.64 mm.

outer margin, and basally with one large triangular tooth on inner margin.

Thorax. Pronotal collar and scutum densely punctuate, punctures less than one diameter apart, scutellum and metanotum sparsely punctuate, punctures about one diameter apart; upper portion of metapleuron obliquely rugose, lower portion densely punctuate; dorsum of propodeum without lateral carina, with evanescent medial carina, and long transverse rugae extending to mesopleural suture and covering lateral surface of propodeum; posterior surface of propodeum

with medial furrow, side of furrow transversely rugose. Length relation between abscissae of radial vein of fore wing: $2 < 5 < 3 < 1 < 4$.

Gaster. Pygidial plate (Fig. 2g) setose, apex concave; length of tergum I: width at posterior margin = 58: 100. Sternum VIII, volsella, right paramere, and penis valve as in Fig. 2b–f, respectively.

Female. Unknown.

Etymology. The name, *clypefoveolatus*, derived from Latin *clype-* (= clypeus) and Latin *foveolatus* (= sunken, depressed), refers to the

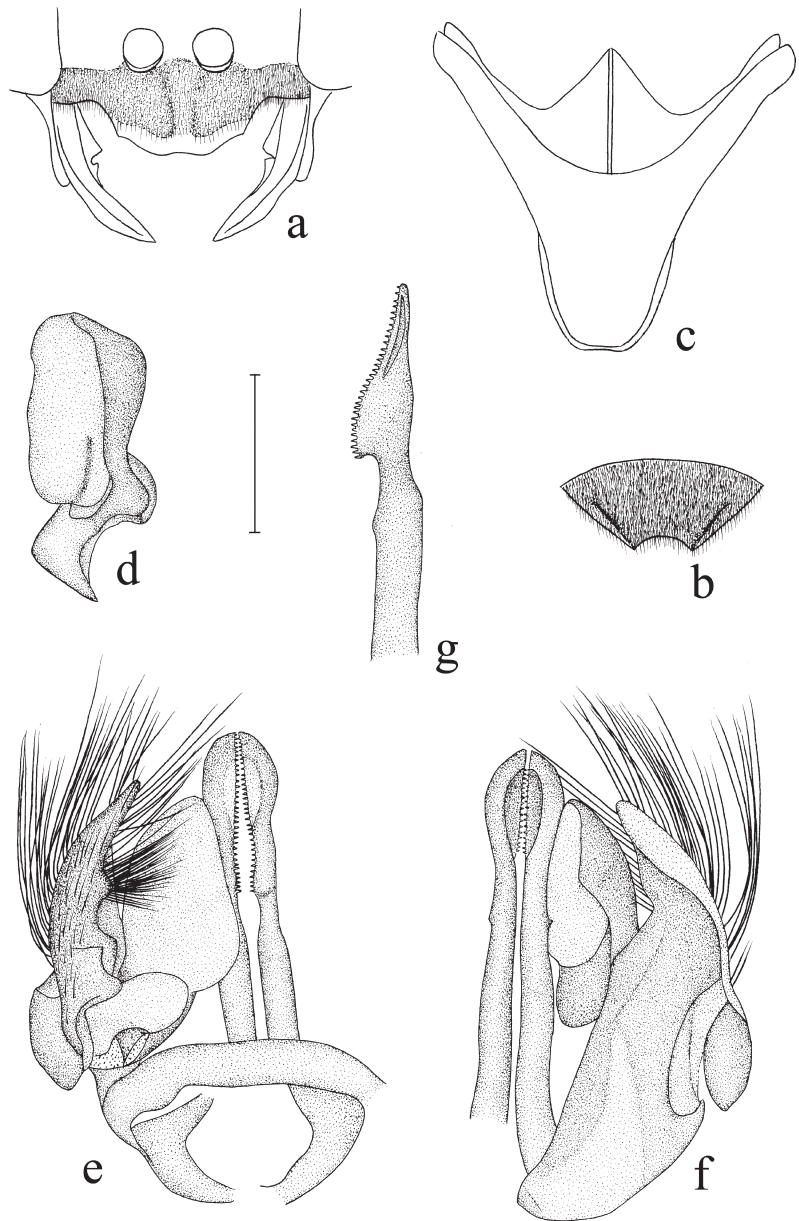


Fig. 3. *Liris retirugosus* sp. n. ♂. – a. Frontal view of clypeus. – b. Dorsal view of pygidial plate. – c. Sternum VIII. – d. Lateral view of volsella. – e. Inside view of left paramere. – f. Dorsal view of left paramere. – g. Lateral view of penis valve. Scale bar for a–b = 1.0 mm; for c–g = 0.49 mm.

clypeus except base gradually excavated in male, which is one of the recognition characters for the species.

Diagnosis. This new species can be distinguished from a related *L. aurulentus* (Fabricius 1787) (re-described by Tsuneki 1967: 27) and other congeners of the genus by the combination of the following characters: surface of clypeus gradually excavated except base and lip truncate, mandible basally with one large triangular tooth

on inner margin, transverse and long rugae on dorsum of propodeum extending to mesopleural suture and covering lateral surface of propodeum, and different shape of the genitalia.

Distribution. China: Yunnan (Fig. 4).

3.3. *Liris retirugosus* sp. n. (Fig. 3)

Material examined. Holotype, ♂, China, Yunnan, Simao City, Jingdong County, Jinping Town,

Western Mountain, 1.V.2005, Chunju Liu, deposited in YNAU. Paratypes, 1♂, same data as holotype; 1♂, China, Yunnan, Baoshan City, Tengchong County, Jietou Town, Datang Village, 15.VII.2006, Rui Zhang, deposited in YNAU; 1♂, China, Yunnan, Hekou County 200 m a.s.l., 12.VI.1956, B. Bobofu; 1♂, China, Yunnan, Jinghong City, Menghai County, Menglongbannasong, 27.IV.1958, Fuji Pu, deposited in IZB.

Description. Male. Body length 9.0–12.0 mm. Black; mandible apically ferruginous; palpi, tegula, stigma and veins dark brown; tibial and tarsal spines pale brown; wings hyaline, pale brown, apically dark. Setae on head, thorax and gaster silvery, those on lower frons, clypeus, and gena shorter, thicker, and denser; posterior margins of gastral segments I–III with bands of silvery pile, setae on gastral tergum VII (Fig. 3b) dense and brown.

Head. Frons and vertex densely punctuate, punctures less than one diameter apart. Least interocular distance nearly as long as combined length of pedicel and flagellomere I. Length of flagellomere I about $1.9 \times$ its apical width, as long as II. Flagellomeres II–XI with placoids, on II–X extending over full length of each segment, on X extending over $3/4$ length of the segment. Clypeus (Fig. 3a) with a medial longitudinal ridge, lip rounded and medially incised. Mandible basally with two teeth on inner margin.

Thorax. Scutum densely and largely punctuate, punctures distinctly less than one diameter apart; mesopleuron and metapleuron longitudinally and obliquely rugose, respectively; dorsum of propodeum longitudinally rugose, with medial carina covering about $2/3$ length of dorsum, without lateral carina; lateral surface of propodeum coarsely and obliquely rugose; posterior surface of propodeum with medial furrow, side of furrow sparsely and transversely rugose. Length relation between abscissae of radial vein of fore wings: $2 < 5 < 3 < 1 < 4$.

Gaster. Pygidial plate (Fig. 3b) setose, apically concave, and its maximal width distinctly greater than length; length of tergum I: width at posterior margin = 89: 100. Sternum VIII, volsella, right paramere, and penis valve as in Fig. 3c–g, respectively.

Female. Unknown.

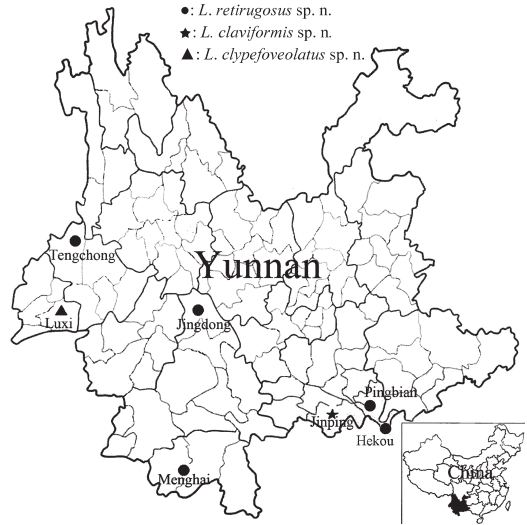


Fig. 4. Localities where the three new species of *Liris* have been recorded in Yunnan, China.

Etymology. The name, *retirugosus*, derived from Latin *ret-* (= reticulate, net-shaped) and Latin *rugosus* (= with rugae), refers to the dorsum of propodeum reticularly rugose, which is one of the recognition characters for the species.

Diagnosis. This new species can be distinguished from a related *L. silvicola* (Williams 1928), and other congeners of the genus by the following combination of characters: lip of clypeus rounded and medially incised, tibial and tarsal spines pale brown, dorsum of propodeum reticularly rugose, and different shape of the genitalia.

Distribution. China: Yunnan (Fig. 4).

4. Key to the species of *Liris* from Palearctic region

4.1. Females

Females of *L. maidli* Arnold, *L. iriomotensis* Tsuneki, *L. clypefoveolatus* sp. n., and *L. retirugosus* sp. n. are unknown.

1. Mandible not notched on outer margin 2
- Mandible distinctly notched on outer margin 5
2. Setae on head and thorax appressed and golden; legs largely ferruginous 3

- Setae on head and thorax silvery; legs largely black 4
- 3. Wings dark, with purple luster. Japan, South Asia, China (Yunnan, Taiwan)
 - L. aurulentus* (Fabricius)
- Wings yellow and only apical portion dark. Africa, Egypt, Iraq, Mediterranean
 - L. haemorrhoidalis* (Fabricius)
- 4. Sternum of gastral II at base distinctly protuberant; mandible and antennae black. Arabia, Mediterranean
 - L. gibbosus* Kohl
- Sternum of gastral II not protuberant; mandible and antennae partly ferruginous. Arabia, Central Asia, Egypt, Israel, Mediterranean, Pakistan
 - L. braueri* Kohl
- 5. Mesonotum and mesopleuron shining and punctuate 6
 - Mesonotum and mesopleuron coriaceous or rugose 9
- 6. Mesopleuron sparsely punctuate. Africa, China (Jiangsu), Southwestern and Central Asia, Southwestern Europe
 - L. nigricans* (Walker)
- Mesopleuron finely and densely punctuate 7
- 7. Gaster with four bands of silvery pile. China (Yunnan, Taiwan), Japan, Philippines, Thailand
 - L. albopilosus* Tsuneki
- Gaster with three bands of silvery pile 8
- 8. Lateral surface of propodeum coarsely reticulate. China (Yunnan, Taiwan), Japan, Korea, Thailand
 - L. festinans japonicus* (Kohl)
- Lateral surface of propodeum punctuate or obliquely rugose, not reticulate. Egypt, Europe
 - L. festinans praetermissus* (Richards)
- 9. Tarsal claw toothed; hind tibia somewhat bent. Cyprus, Greece, Israel, Western Europe
 - L. inopinatus* de Beaumont
- Tarsal claw not toothed; hind tibia distinctly straight 10
- 10. Fore wing with dark and truncate band; length of third submarginal cell somewhat greater than its height. Central Africa, Mediterranean, Zimbabwe
 - L. miscophoides* Arnold
- Fore wing without dark and truncate band; length of third submarginal cell distinctly greater than its height 11
- 11. Lip of clypeus truncate or somewhat protrudent medially; pygidial plate densely punctuate, and asetose or partly and sparsely
 - setose 12
 - Lip of clypeus with medial incision (Fig. 1a); pygidial plate sparsely punctuate, and densely setose 16
 - 12. Lip of clypeus truncate; pygidial plate only asetose basally 13
 - Lip of clypeus medially more or less protrudent, pygidial plate asetose or mostly asetose 14
 - 13. Pile on gaster ferruginous; wings dark, with purple luster. Europe, North Africa, Pakistan
 - L. atratus* (Spinola)
 - Pile on gaster silvery; wings light. Egypt, Israel, Sudan
 - L. cleopatra* de Beaumont
 - 14. Pygidial plate apically, sparsely and largely punctuate; lateral surface of propodeum not rugose. Algeria, Central Asia
 - L. opalipennis* (Kohl)
 - Pygidial plate apically and densely punctuate; lateral surface of propodeum rugose 15
 - 15. Apical portion of fore wing dark; lip of clypeus dark ferruginous; length of pygidial plate about 2 × its maximal width. Burma, Europe, India, Malaysia, Mongolia, Morocco
 - L. niger* (Fabricius)
 - Apical portion of fore wing light; lip of clypeus black; length of pygidial plate about 1.5 × its maximal width. Egypt, Gambia, Mauritania, Mediterranean, Oman
 - L. agilis* (F. Smith)
 - 16. Setae on head and thorax golden, gaster with three golden bands of pile. India, Indonesia, Japan, Sri Lanka
 - L. deplanatus* (Kohl)
 - Setae on head and thorax and pile on gaster silvery 17
 - 17. Hind femur (Fig. 1c) basally thickened, gradually tapering toward apex. China (Yunnan)
 - L. claviformis* sp. n.
 - Hind femur not gradually tapering toward apex 18
 - 18. Hind femur ferruginous 19
 - Hind femur black 20
 - 19. Hind tibia ferruginous; wings distinctly yellow. Mediterranean, Africa
 - L. solstitialis* (F. Smith)
 - Hind tibia black; wings pale yellow. China (Yunnan and Taiwan), Fiji, Iraq, Japan, Mediterranean, South Asia
 - some specimens of *L. subtessellatus* (F. Smith)

20. Carina on hind tibia curved; gaster with four bands of pile 21
 – Carina on hind tibia straight; gaster with three bands of pile 22
21. Lateral surface of propodeum coarsely rugose. Africa, Egypt, Mediterranean
L. memnonius (F. Smith)
 – Lateral surface of propodeum distinctly smooth. Mediterranean, Yemen
L. trivittatus (W.F. Kirby)
22. Wings strongly dark, with purplish lustre, three bands of pile on gaster brown, and ill defined; setae of pygidial plate brown. Japan, China (Taiwan, Yunnan)
L. surusumi Tsuneki
 – Wings light, without purplish lustre; pile on gaster lvery 23
23. Front and mid femora ventrally without pile. Central Asia, Egypt, Israel, Sudan
L. subfasciatus (Walker)
 – Front and mid femora ventrally with silvery pile 24
24. Lateral surface of propodeum reticulate. Burma, China (Guangxi), India, Indonesia, Japan
L. tristis (F. Smith)
 – Lateral surface of propodeum obliquely rugose 25
25. Anterior bevel of clypeus somewhat near median area, impunctate and polished. Japan, China (Taiwan), Malaysia, Philippines, Thailand
L. difficilis Tsuneki
 – Anterior bevel of clypeus away from median area, with transverse series of punctures below, or sparsely punctate
 some specimens of *L. subtessellatus* (F. Smith)
- #### 4.2. Males
- Male of *L. gibbosus* is unknown.
1. Mandible not notched on outer margin 2
 – Mandible distinctly notched on outer margin 5
2. Wings yellow and apically dark; hind tarsomere II dilated
L. haemorrhoidalis (Fabricius)
 – Wings dark, with purple luster; hind tarsomere II not dilated 3
3. Surface of clypeus gradually excavated except base, lip truncate (Fig. 2a). China (Yunnan)
L. clypefoveolatus sp. n.
 – Surface of clypeus not gradually excavated, lip rounded 4
4. Setae on head and thorax appressed and golden; legs largely ferruginous
L. aurulentus (Fabricius)
 – Setae on head and thorax silvery; legs largely black
L. braueri Kohl
5. Mesonotum and mesopleuron shining and obviously punctate 6
 – Mesonotum and mesopleuron coriaceous or rugose 9
6. Lip of clypeus medially toothed 7
 – Lip of clypeus not medially toothed 8
7. Apex of gastral sternum IV and whole of gastral sternum V–VI with distinct long setae, the setae longer than those on other portions
L. nigricans (Walker)
 – Apex of gastral sternum IV and whole of gastral sternum V–VI without distinctly long setae
L. albopilosus Tsuneki
8. Lip of clypeus somewhat rounded
L. festinans japonicus (Kohl)
 – Lip of clypeus truncate
L. festinans praetermissus (Richards)
9. Hind femur ferruginous 10
 – Hind femur black 11
10. Hind tibia ferruginous
L. solstitialis (F. Smith)
 – Hind tibia black
 some specimen of *L. subtessellatus* (F. Smith)
11. Hind femur excavated ventrally so as to leave a projecting angle near the base 12
 – Hind femur not excavated ventrally to leave a projecting angle near the base 17
12. Gaster with four bands of silvery pile 13
 – Gaster with three bands of silvery pile 14
13. Hind femur more strongly excavated; front and mid femora nearly asetose
L. memnonius (F. Smith)
 – Hind femur less strongly excavated; front and mid femora densely setose
L. trivittatus (W.F. Kirby)
14. Gastral sternum V laterally with long fringe of setae
L. subfasciatus (Walker)
 – Gastral sternum V laterally without long fringe of setae 15

15. Dorsum of propodeum reticulate, lateral surface coarsely and obliquely rugose; lip of clypeus (Fig. 3a) rounded, with medial incision
Liris retirugosus sp. n.
- Dorsum of propodeum transversely rugose, lateral surface not coarse; lip of clypeus somewhat rounded, with indistinct medial incision 16
16. Fore femur somewhat excavated ventrally, paramere of the male genitalia slender
L. difficilis Tsuneki
- Fore femur strongly excavated ventrally, paramere of the male genitalia stout
some specimens of *L. subtessellatus* (F. Smith)
17. Hind femur grooved ventrally 18
- Hind femur not grooved ventrally 19
18. Wings strongly dark; hind femur angled ventrally and basally
L. atratus (Spinola)
- Wings apically dark; hind femur not angled ventrally and basally
L. cleopatra de Beaumont
19. Marginal cell of fore wing apically truncate and enlarged 20
- Marginal cell of fore wing apically not truncate and enlarged 21
20. Fore wing with dark and truncate band; length of third submarginal cell somewhat greater than its height
L. miscophoides Arnold
- Fore wing without dark and truncate band; length of third submarginal cell distinctly greater than its height
L. maidli (Arnold)
21. Lip of clypeus truncate (Fig. 1b); hind femur claviform, thickened at base, gradually tapering toward apex
L. claviformis sp. n.
- Lip of clypeus round or protrudent; hind femur not gradually tapering toward apex 22
22. Gaster with four bands of pile
L. inopinatus de Beaumont
- Gaster with three bands of pile 23
23. Wings strongly dark, with purplish lustre; setae on frons and clypeus pale yellow
L. surusumi Tsuneki
- Wings light, without purplish lustre; setae on frons and clypeus not silvery 24
24. Pronotum thick, not transversely carinate on top, medially raised nearly to level of scutum. Japan
L. iriomotensis Tsuneki
- Pronotum normal 25

25. Lip of clypeus dull
L. niger (Fabricius)
- Lip of clypeus shining 26
26. Each of antennal segment short; propodeum somewhat rugose
L. opalipennis (Kohl)
- Each of antennal segment long; propodeum distinctly rugose
L. agilis (F. Smith)

5. First record of *Liris agilis* (F. Smith), 1856 from China

Material examined. 2♀♀ 6♂♂, China, Xinjiang, Shihezi City, Fukang County, Cainanyoutian Desert, 3.VI.2006, Tingjing Li; 1♂, China, Xinjiang, Tianshan, 6.VII.2005, Jianxin Cui. Deposited in YNAU.

Distribution. China (Xinjiang), Egypt, Gambia, Mauritania, Mediterranean, Oman.

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