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## REVIEW OF JAPANESE MYRMELEONTIDAE (NEUROPTERA)

By SHIGEYUKI SEKIMOTO

*Abstract*

SEKIMOTO, S., 2014. Review of Japanese Myrmeleontidae (Neuroptera). *Ins. matsum.* n. s. 70: 1–87, 37 figs.

Japanese species of the family Myrmeleontidae are revised. The following 17 species are recognized: *Myrmeleon formicarius* Linnaeus, *M. bore* (Tjeder), *M. solers* Walker, *M. taiwanensis* Miller & Stange (new record from Japan), *Baliga micans* (McLachlan), *Dendroleon pupillaris* (Gerstaecker), *Gatzara jezoensis* (Okamoto), *Epacanthaclisis moiwana* (Okamoto), *Distoleon nigricans* (Okamoto), *Di. contubernalis* (McLachlan), *Di. bistrigatus* (Rambur), *Di. boninensis* Adams, *Neuroleon parvulus* (Okamoto) n. comb., *Paraglenurus japonicus* (McLachlan), *Pa. okinawensis* (Okamoto), *Pseudoformicaleo nubecula* (Gerstaecker) and *Synclisis japonica* (McLachlan). The male of *Di. boninensis* is recorded for the first time. All Japanese species of Myrmeleontidae are redescribed and illustrated, except for *M. taiwanensis* for which detailed male and female terminal structures were recently illustrated. A key to the tribes, genera and species of Japanese antlions is provided. In appendix, three new combinations are proposed for three Chinese species, *Baliga angustata* (Bao *et al.*), *B. coalita* (Yang) and *B. guangxiensis* (Bao *et al.*): all were formerly assigned to the genus *Hagenomyia* Banks.

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## INTRODUCTION

Myrmeleontidae (antlions) are the largest family of the order Neuroptera, comprising approximately 1500 species in 200 genera distributed throughout the world. They are especially abundant in the arid and semiarid areas of subtropical and tropical Africa, Asia, Australia and the Americas (Stange 2004). Adults are medium to large-sized (wingspans ranging from 30–170 mm) and some of them are the largest and most striking representatives of all the insects. The predatory larvae inhabit wide range of habitats and employ various predation strategies (Mansell 1999).

Taxonomic studies of Japanese Myrmeleontidae were mostly conducted in the late 19th to the middle 20th century (McLachlan 1867, 1875a; Gerstaecker 1893; Okamoto 1905, 1910; Nakahara 1913a, 1913b; Matsumura 1931; Kuwayama 1953, 1959, 1962, 1964, 1966; Adams 1959). To date, 17 species in nine genera have been recorded from Japan. However, some taxonomic problems still remain concerning the Japanese species. For example, Kuwayama (1953) recorded *Myrmeleon celebensis* from Japan based on specimens collected in Niigata. Later, Kuwayama (1959) recognized it as a misidentification and identified them as *Grocus solers*. However, Kuwayama (1959) did not provide any reasoning for this taxonomic treatment. His identification consequently remains unclear, and comparison of the holotype *M. solers* with the Japanese specimens is needed. Moreover, most of the early studies only used wing venation and external morphology for species delimitation and did not provide details of the terminal structures. As is the case for many other insect groups, male and female terminal structures are the most important characters for taxonomy and phylogenetics of Myrmeleontidae. It is therefore also necessary to examine terminal characters of the Japanese species of Myrmeleontidae to clarify their taxonomic status.

In the present paper, the Japanese species of Myrmeleontidae are revised. A total of 17 species assigned to 10 genera are recognized. Redescriptions and illustrations of all the Japanese species of Myrmeleontidae are provided, except for *M. taiwanensis*, which was recently described in detail (Miller *et al.* 1999). A key to the Japanese tribes, genera and species of Myrmeleontidae is also provided.

## MATERIALS AND METHODS

All specimens used in the present study were dried. For detailed examination of terminalia, the terminal segments of the abdomen were removed and placed in a 10% solution of KOH at room temperature for approximately 12–24 h. The macerated terminalia were then washed with distilled water and stained with aceto-fuchsin. Dissection and illustration was made in distilled water under a binocular stereoscopic microscope (Leica MZ12).

The following abbreviations were used in the redescrptions: B, body length; FW, forewing length; HW, hindwing length; Ta1–Ta5, first to fifth tarsomeres. All measurements are given in millimeters.

The following abbreviations were used in figure plates: ag, anterior gonapophyses; e, ectoproct; g, gonarcus; gp, gonapophyseal plates; lg, lateral gonapophyses; m, mediuncus; p, parameres; pg, posterior gonapophyses; pog, pair of gonapophyses; pp, pregenital plate; S7, sternite VII; S8, sternite VIII; S9, sternite IX; T7, tergite VII; T8,

tergite VIII; T9, tergite IX.

Depositories of specimens are abbreviated as follows: Natural History Museum, London, UK (BMNH); Smithsonian Institution National Museum of Natural History, Washington, D.C., USA (NMNH); National Institute of Agro-Environmental Sciences, Tsukuba, Ibaraki, Japan (NIAES); National Museum of Nature and Science, Tsukuba, Japan (NSMT); Laboratory of Systematic Entomology, Hokkaido University, Sapporo, Japan (SEHU); personal collection of Mr. I. Tabata, Fukuoka, Japan (TA). Unless specified, depository of the specimens examined is SEHU.

#### KEY TO TRIBES, GENERA AND SPECIES OF MYRMELEONTIDAE IN JAPAN

1. Large in size, forewing length approximately 50–60 mm; hindwing vein CuA uniting with posterior fork of MP2 shortly after MP2 fork; 3rd labial palpomere with elongate slit-like palpimacula; tibial spurs strongly curved; male tergite V and proximal half of tergite VI densely covered with appressed shiny silver pubescence .....  
..... (tribe Acanthaclisini, genus *Synclisis*) *Synclisis japonica*
- Small to medium in size, forewing length approximately 20–45 mm; hindwing vein CuA connected by crossveins to posterior fork of MP2 or not reaching fork; 3rd labial palpomere with oval palpimacula; tibial spurs usually not strongly curved; male tergite V and proximal half of tergite VI without appressed shiny silver pubescence ..... 2
2. Forewing vein 2A running in even curve toward 3A; forewing veins 2A and 3A separate, usually connected by 1–2 crossveins ..... (tribe Dendroleontini) 3
- Forewing vein 2A running close to 1A for a short distance, then bending at sharp angle toward 3A; forewing veins 2A and 3A fused ..... 5
3. Forewing costal area biareolate; femoral sense hair present in all legs; tibial spurs approximately as long as combined length of Ta1–Ta3 to Ta1–Ta4 in fore- and midlegs, approximately as long as combined length of Ta1–Ta2 to Ta1–Ta3 in hindleg; male ectoproct lobed postero-ventrally (Fig. 20A); female without a pair of gonapophyses below tergite IX (Fig. 21AB)..... (genus *Epacanthaclisis*) *Epacanthaclisis moiwana*
- Forewing costal area simple; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs approximately as long as or slightly longer than combined length of Ta1–Ta2 in all legs; male ectoproct simple, not lobed (Figs 16A, 18A); female with a pair of gonapophyses below tergite IX (Figs 17AB, 19AB) ..... 4
4. Larger in size, forewing length approximately 30–40 mm; pronotum pale brown (Fig. 2D); hindwing with large brown marking extending from proximal part of pterostigma to posterior margin (Fig. 2C); female anterior gonapophyses shorter than posterior gonapophyses (Fig. 17AB); female lateral gonapophyses without thickened hairs (Fig. 17AB) .....  
..... (genus *Dendroleon*) *Dendroleon pupillaris*
- Smaller in size, forewing length approximately 20–30 mm; pronotum whitish-yellow, with dark brown longitudinal midline (Fig. 2F); hindwing with small brown markings along posterior margin (Fig. 2E); female anterior gonapophyses approximately as long as or longer than posterior gonapophyses (Fig. 19AB); female lateral gonapophyses with thickened hairs (Fig. 19AB) ..... (genus *Gatzara*) *Gatzara jezoensis*
5. Hindwing presectoral area with only 1 crossvein; male without pilula axillaris .....  
..... (tribe Nemoleontini) 6
- Hindwing presectoral area with 3 or more crossveins; male usually with pilula axillaris .....  
..... (tribe Myrmeleontini) 13
6. Tibial spurs approximately as long as Ta1 in all legs ..... 7
- Tibial spurs much longer than Ta1 in all legs ..... 9
7. Forewing veins CuA2 and CuP+1A running parallel for long distance; Ta5 without dense



- short black bristles on ventral surface; male parameres distally fork-shaped (Fig. 34DE); female ectoproct simple, not lobed posteriorly in lateral view (Fig. 35A); female posterior gonapophyses short, not extending beyond tergite IX in lateral view (Fig. 35A) ..... (genus *Pseudoformicaleo*) *Pseudoformicaleo nubecula*
- Forewing veins CuA2 and CuP+1A not parallel; Ta5 with dense short black bristles on ventral surface; male parameres distally not fork-shaped (Figs 30EF, 32DE); female ectoproct slightly lobed posteriorly in lateral view (Figs 31A, 33A); female posterior gonapophyses long, extending beyond tergite IX in lateral view (Figs 31A, 33A) ..... (genus *Paraglenurus*) 8
  - 8. Larger in size, forewing length approximately 30–40 mm ..... *Paraglenurus japonicus*
  - Smaller in size, forewing length approximately 20–25 mm ..... *Paraglenurus okinawensis*
  - 9. Smaller in size, forewing length approximately 23 mm; tibial spurs slightly longer than combined length of Ta1–Ta3 in fore- and midlegs, approximately as long as combined length of Ta1–Ta2 in hindleg ..... (genus *Neuroleon*) *Neuroleon parvulus*
  - Larger in size, forewing length approximately 30–45 mm; tibial spurs approximately as long as or slightly longer than combined length of Ta1–Ta4 in fore- and midlegs, approximately as long as or slightly longer than combined length of Ta1–Ta3 in hindleg ..... (genus *Distoleon*) 10

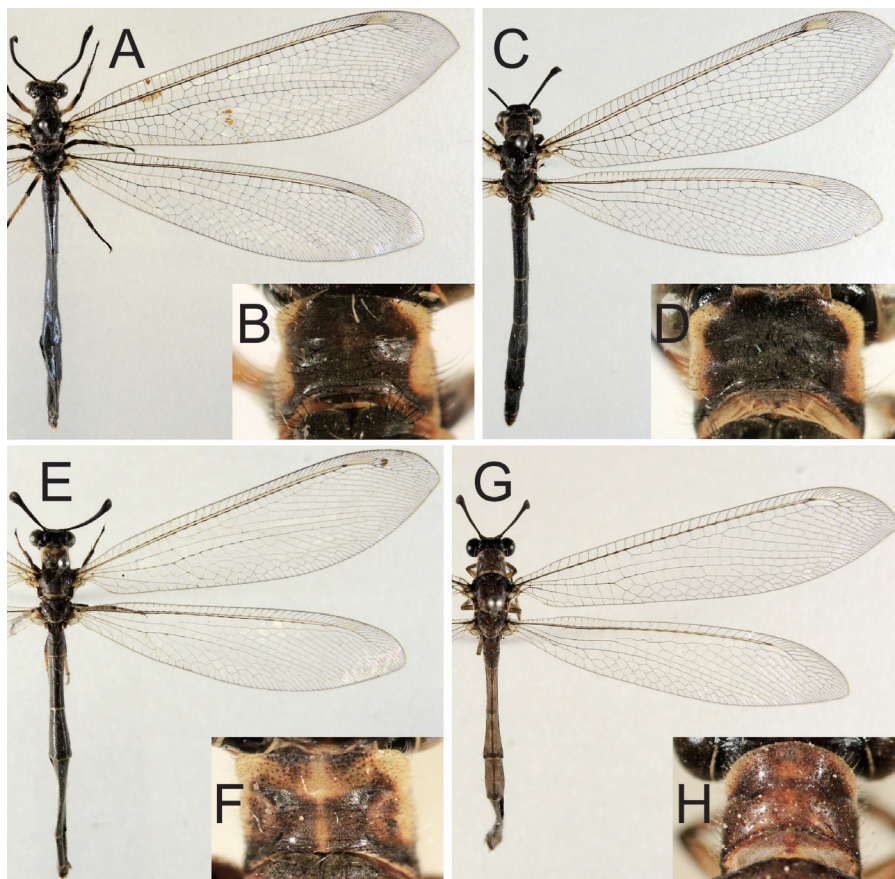


Fig. 1. Habitus and pronotum. A, B. *Myrmeleon formicarius*. C, D. *M. bore*. E, F. *M. solers*. G, H. *M. taiwanensis*.

10. 3rd labial palpomere dark brown; pterostigma of both wings with prominent proximal blackish-brown spot (Fig. 3A); hindwing rhegma area with distinct large dark grayish-brown marking (Fig. 3A) ..... *Distoleon nigricans*
- 3rd labial palpomere yellow to brown; pterostigma of both wings with rather faint proximal dark brown spot (Fig. 3C, E, G); hindwing rhegma area without distinct large dark grayish-brown marking (Fig. 3C, G) or with liner grayish-brown marking (Fig. 3E) ..... 11
11. Pronotum pale yellow, with pair of dark grayish-brown longitudinal stripes (Fig. 3F); hindwing rhegma area with liner grayish-brown marking (Fig. 3E) ..... *Distoleon bistrigatus*
- Pronotum brown to pale grayish-brown, with narrow yellow longitudinal midline and pair of yellow longitudinal stripes laterally (Fig. 3D, H); hindwing rhegma area sometimes with small grayish-brown marking, but not liner (Fig. 3C, G) ..... 12
12. Male hind femora and tibia with elongate hair-like setae; male pleural membrane between abdominal segments VII and VIII with small tubercle bearing 2–3 black setae (Fig. 26A) .....  
 ..... *Distoleon contubernalis*

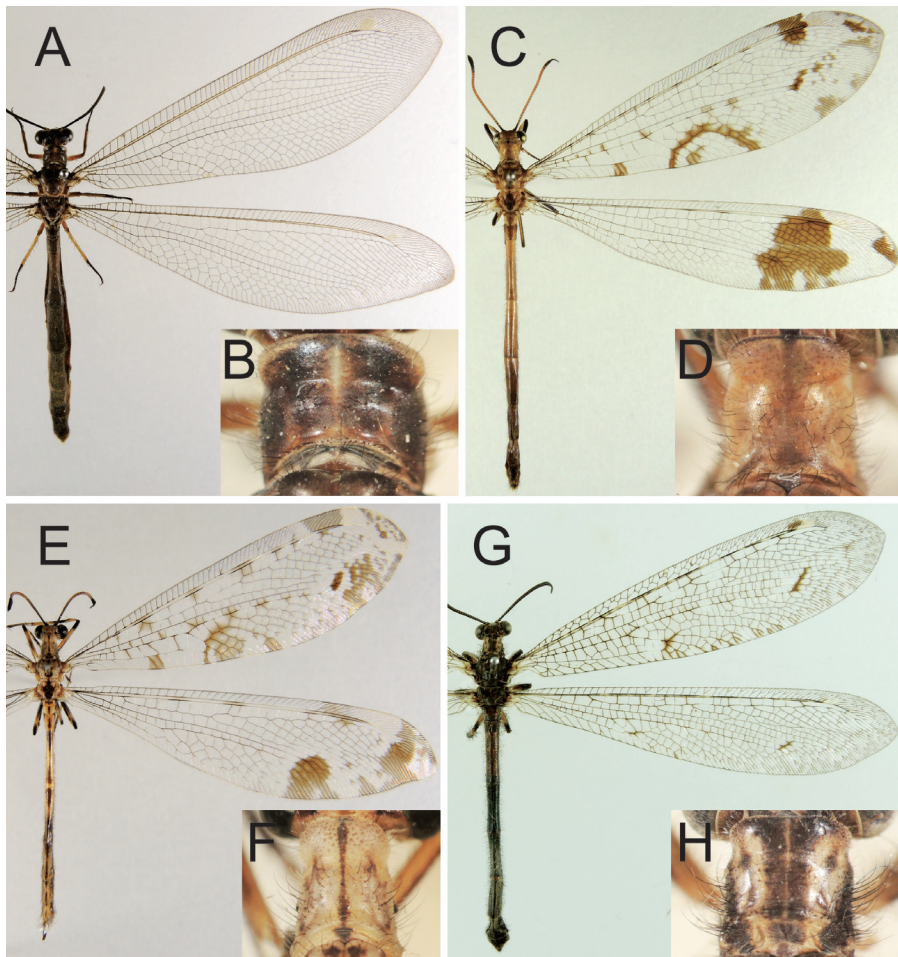


Fig. 2. Habitus and pronotum. A, B. *Baliga micans*. C, D. *Dendroleon pupillaris*. E, F. *Gatzara jezoensis*. G, H. *Epacanthaclisis moiwana*.



- Male hind femora and tibia without elongate hair-like setae; male pleural membrane between abdominal segments VII and VIII without small tubercle bearing black setae ..... *Distoleon boninensis*
- 13. Vertex dark brown to blackish-brown, coronal suture and posterior margin bordered with yellow; coxae pale yellow; female anterior gonapophyses longer than wide (Fig. 15AB) ..... (genus *Baliga*) *Baliga micans*

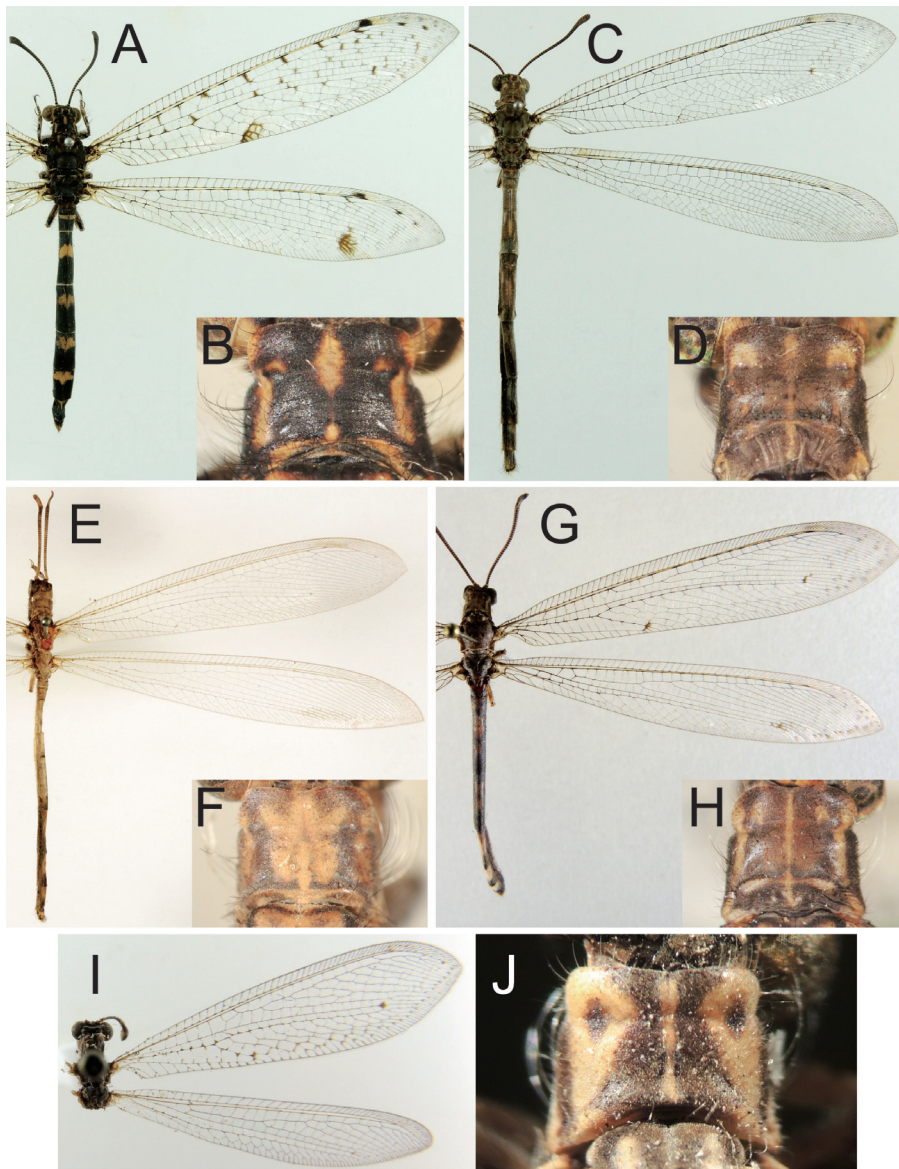


Fig. 3. Habitus and pronotum. A, B. *Distoleon nigricans*. C, D. *Di. contubernalis*. E, F. *Di. bistrigatus*. G, H. *Di. boninensis*. I, J. *Neuroleon parvulus*.

- Vertex completely black or shiny black; coxae dark grayish-brown to blackish-brown; female anterior gonapophyses much wider than long (Figs 7AB, 9AB, 11AB, 13AB) ..... (genus *Myrmeleon*) 14
- 14. Larger in size, forewing length approximately 40–45 mm; outer surface of mid tibia dark brown; male without pilula axillaris; male gonarcus with lateral arms (Fig. 6C); male mediuncus three-pronged ventrally in caudal view (Fig. 6CD) ..... *Myrmeleon formicarius*
- Smaller in size, forewing length approximately 25–30 mm; outer surface of mid tibia yellow; male with pilula axillaris; male gonarcus without lateral arms (Figs 8C, 10C, 12C); male mediuncus simple, not three-pronged in caudal view (Figs 8C, E, 10C, E, 12C, E) ..... 15
- 15. Pronotum with M-shaped yellow marking (Fig. 1F); wing veins and crossveins mostly pale ..... *Myrmeleon solers*
- Pronotum without M-shaped yellow marking (Fig. 1D, H); wing veins alternating dark brown and pale yellow, crossveins dark brown ..... 16

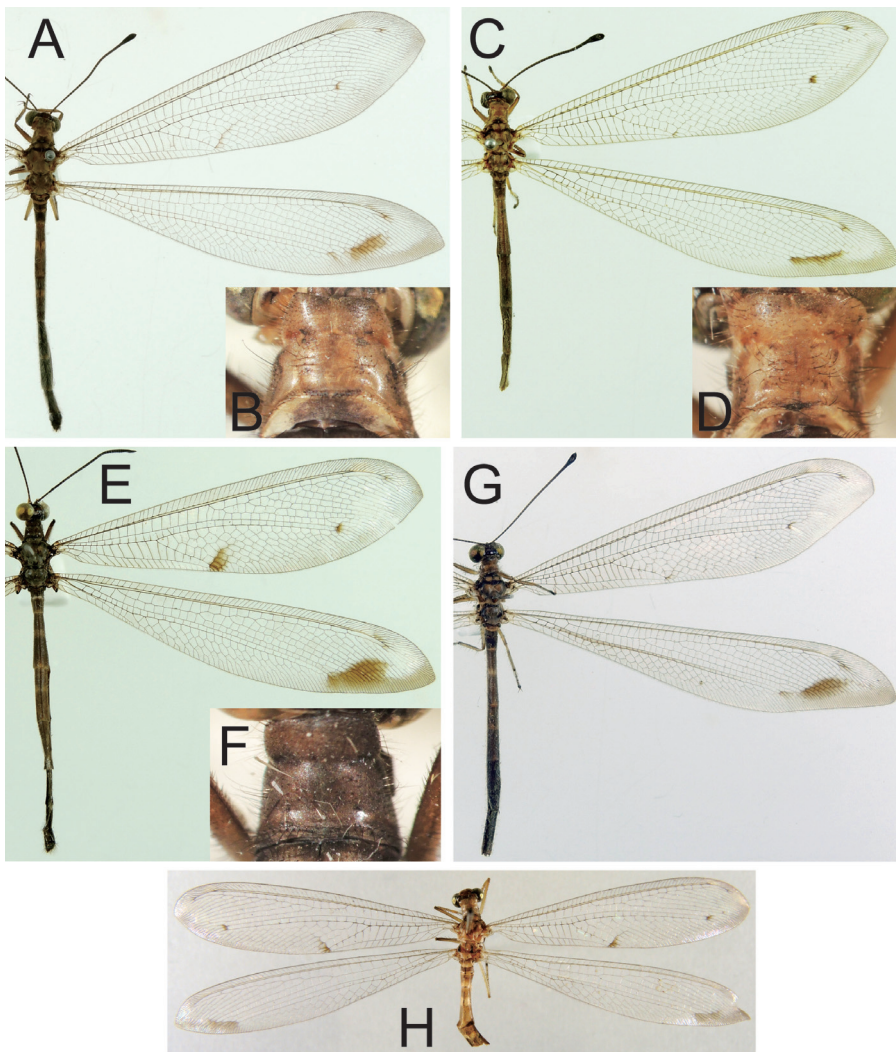


Fig. 4. Habitus and pronotum. A–G. *Paraglenurus japonicus*. H. *Pa. okinawensis*.

16. Antenna with slightly defined club; male ectoproct with hook-like projection along ventral margin (Fig. 8A); spermatheca long, slender, coiled (Fig. 9C) ..... *Myrmeleon bore*  
 –. Antenna with well defined club; male ectoproct simple, without hook-like projection along ventral margin (Fig. 12A); spermatheca short, slightly convolved (Fig. 13C) .....  
 ..... *Myrmeleon taiwanensis*

## SYSTEMATICS

### Family Myrmeleontidae

#### Subfamily Myrmeleontinae

#### Tribe Myrmeleontini

*Remarks.* According to Stange (2004) and Badano (2013), this tribe is characterized by combinations of the following character states: forewing vein CuP arising at or near basal crossvein; forewing vein 2A running close to 1A for short distance, then bending at sharp angle toward 3A; vein Rs arising distant from wing base in both wings; hindwing presectoral area with more than 4 crossveins.

This well-defined tribe comprises approximately 200 species in 10 genera (Stange *et al.* 2003). The larvae of this tribe build pitfall traps.

#### Genus *Myrmeleon* Linnaeus

*Myrmeleon* Linnaeus, 1767: 913. Type species: *Myrmeleon formicarius* Linnaeus, 1767 (as “*Myrmeleon formicarium* [sic] Linnaeus”), by subsequent designation by Latreille, 1810: 435.

(For further synonymies, see Stange, 2004: 306.)

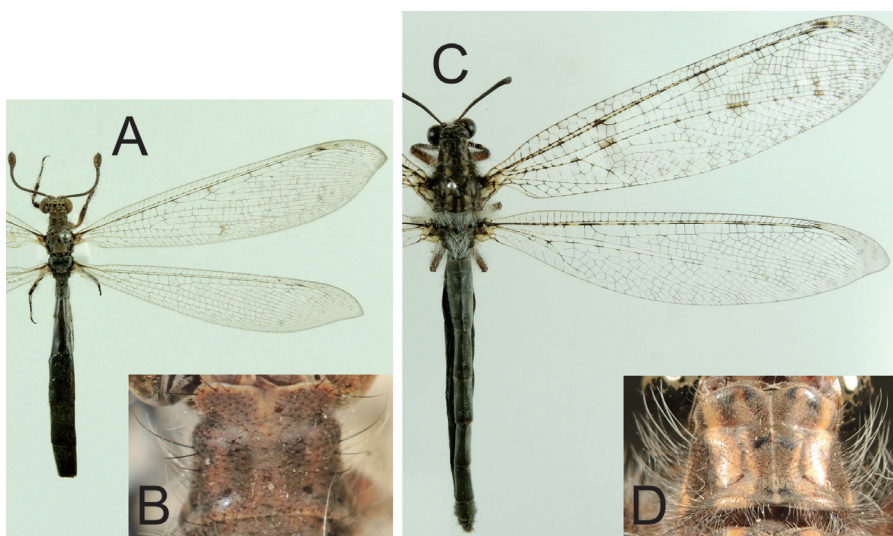


Fig. 5. Habitus and pronotum. A, B. *Pseudoformicaleo nubecula*. C, D. *Synclisis japonica*.



*Diagnosis.* Medium to large-sized antlions; wings narrow to moderately broad, hyaline, without marking; costal area of both wings simple, distal crossveins branched; forewing presectoral area with approximately 5–10 crossveins; forewing vein Rs arising almost opposite or beyond CuA fork; forewing veins 2A and 3A fused; hindwing presectoral area usually with 5 crossveins; hindwing vein Rs arising almost opposite or beyond MP2 fork; male usually with pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs usually approximately as long as Ta1; male ectoproct usually simple, sometimes expanded ventrally; gonarcus arched in dorsal view; mediuncus usually well developed; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses usually slender, sometimes very short; anterior gonapophyses rounded; gonapophyseal plates absent; spermatheca slender.

*Remarks.* This large cosmopolitan genus includes approximately 170 species (Stange 2004). The adults of *Myrmeleon* have a generally predominantly blackish-body and rather narrow wings. Some species with broader wings resemble species of *Baliga* Navás, 1912a but can be distinguished from them by the sparser wing venation (Fig. 1A, C, E, G), smaller body size, and shape of the female anterior gonapophyses (Figs 7AB, 9AB, 11AB, 13AB).

*Myrmeleon formicarius* Linnaeus  
(Figs 1AB, 6, 7)

*Hemerobius formicaleonis* Linnaeus, 1746: 222. nom. nud.

*Hemerobius formicarlynx* Linnaeus, 1758: 550. For further detail, see Oswald (2013).

*Myrmeleon formicarius* Linnaeus, 1767: 914; Kuwayama, 1959: 67; 1962: 388; 1964: 47; Aspöck *et al.*, 1980a: 291; Matura, 1987: 544; Aspöck *et al.*, 2001: 260; Krivokhatsky, 2011: 195; Hayashi, 2013: 190; Yoshitomi *et al.*, 2013: 5.

*Myrmeleon formicarium* [sic]: Fabricius, 1775: 312.

*Myrmeleon innotatus* Rambur, 1842: 406. Synonymized by Hagen, 1866b: 441.

*Myrmeleon formicarius immaculatum* Disconzi, 1865: 112. Synonymized by Hagen, 1866b: 439.

*Myrmeleon nigrivenosus* Okamoto, 1905: 116. Synonymized by Kuwayama, 1959: 67.

*Myrmeleon formicarius*: Okamoto, 1910: 298 (in part).

*Hagenomyia micans*: Baba, 1953: 11 [not *Hagenomyia micans* (McLachlan, 1875a)].

*Myrmeleon formicarius nigrilabrus* Steinmann, 1963: 216. Synonymized by Aspöck *et al.*, 1980a: 291.

*Myrmeleon formicarius formicarius* Steinmann, 1963: 216.

*Myrmeleon (Myrmeleon) formicarius*: Aspöck *et al.*, 1980a: 291.

(For further literature, see Kuwayama, 1962: 388; Aspöck *et al.*, 1980a: 291; 2001: 260; Krivokhatsky, 2011: 195.)

*Redescription.* Male. Head. Vertex strongly raised, rounded, completely shiny black, pair of dull grayish-black portions along posterior margin, with sparse short hyaline hairs; occiput shiny black, browner ventrally. Frons dull grayish-black dorsally, shiny black ventrally, with sparse short hyaline hairs; gena whitish-yellow, whitish-yellow line along ocular rim slightly interrupted by black dorsally; clypeus with dark brown to blackish-brown marking extending from frons to ventral 2/3, which sometimes emarginate ventrally, yellow laterally, whitish-yellow ventrally, with sparse erect long dark hairs. Antenna blackish-brown, shiny proximally, short, with slightly defined club,

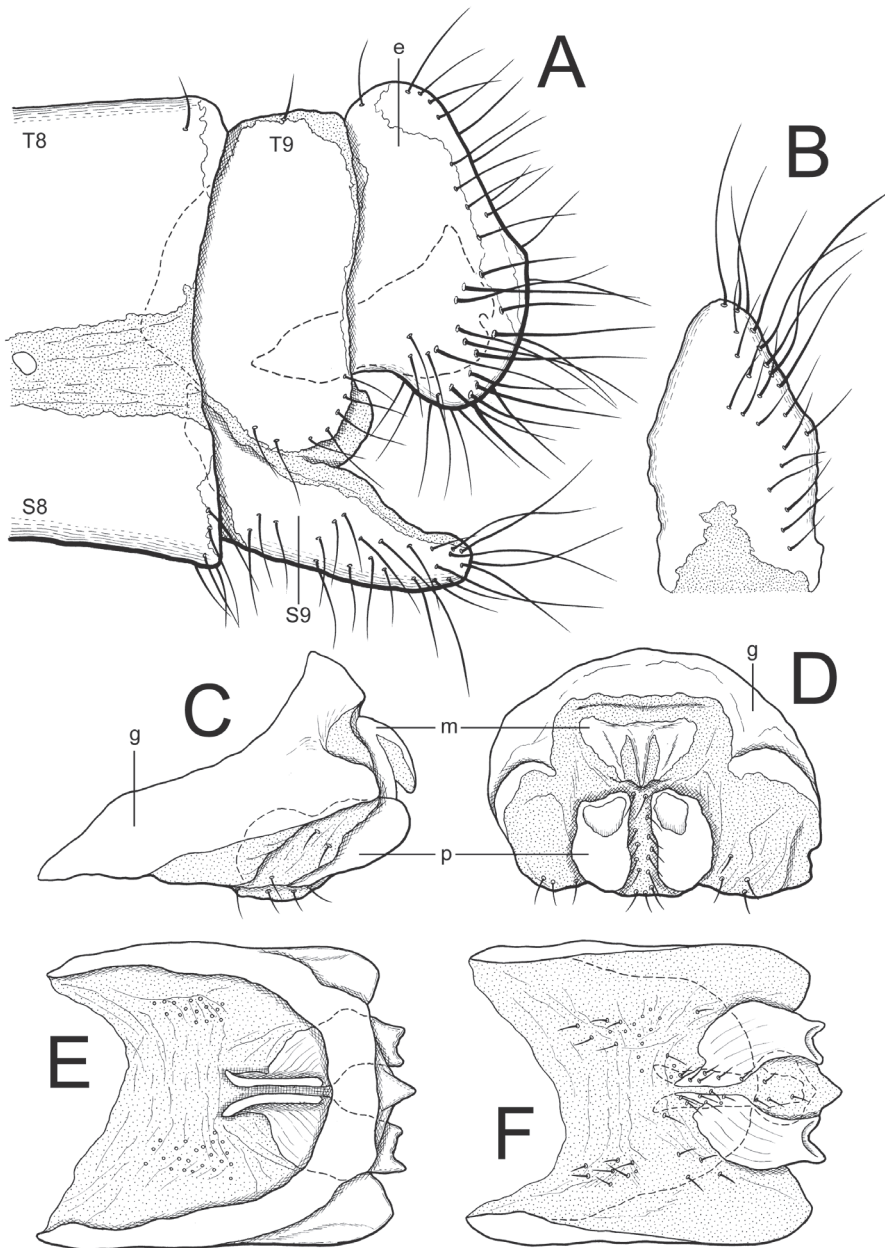


Fig. 6. Male terminalia of *Myrmeleon formicarius*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

covered with short dark hairs; scape dark brown anteriorly, yellow posteriorly; pedicel dark brown to blackish-brown; flagellum comprising approximately 35 flagellomeres. Mouthparts dark brown: labrum brown to dark brown, with several dark hairs; 1st and 2nd maxillary palpomeres yellow; 1st labial palpomere yellow, 2nd labial palpomere brown to blackish-brown; 3rd labial palpomere dark brown to blackish-brown, spindle-shaped, tapering to acute apex, with brown palpmacula on apical 1/3; submentum with long dark hairs.

Thorax. Pronotum (Fig. 1B) broad, shorter than broad, blackish-brown, whitish-yellow lateral margins narrowed at anterior transverse furrow, posterior membrane with large dark brown portion at middle, with hyaline hairs and long dark hairs. Cervical sclerites brown to blackish-brown. Meso- and metanotum uniformly blackish-brown, with sparse hyaline and dark hairs; mesoprescutum with long dark hairs. Meso- and metapleuron blackish-brown, moderately covered with long hyaline hairs.

Legs. Yellow, short. Coxae dark grayish-brown to blackish-brown, moderately covered with long hyaline hairs. Femora moderately covered with short dark hairs, mixed with sparse long black setae; fore femur dark brown on distal 1/2, often distal 2/3, except for yellow anterior surface; mid- and hind femora dark brown on distal 1/2, often distal 2/3; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia dark brown, with longitudinal yellow stripe on anterior surface, with dense short brown hairs distally and ventrally; mid tibia dark brown, slightly yellow at proximal end; hind tibia dark brown at distal end and on ventral surface. Tibial spurs reddish-brown, short, slender, almost straight, approximately as long as or slightly shorter than Ta1. Tarsi uniformly dark brown to blackish-brown, sparsely covered with short dark hairs dorsally, short black setae ventrally; Ta1 approximately as long as combined length of Ta2–Ta3; Ta5 shorter than combined length of Ta1–Ta4. Claws reddish-brown, short, simple, curved, approximately 2/3 as long as tibial spurs.

Wings (Fig. 1A). Forewing subacute at apex; veins alternating dark brown and pale yellow, crossveins mostly dark brown, Sc finely alternating dark brown and pale yellow, R and CuA almost dark brown to blackish-brown, MP almost pale yellow; costal area simple, distal crossveins often branched; presectoral area with 8–13 crossveins and 0–4 irregular cells; Rs arising beyond CuA fork, with 8–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–2 cells before fusing with 1A; hypostigmatic cell short; pterostigma white to yellowish-white, with faint proximal pale brown spot, which sometimes indistinct; anterior Banksian line sometimes distinct, posterior Banksian line distinct. Hindwing shorter and narrower than forewing; acute at apex; presectoral area with 5–8 crossveins; Rs arising well beyond MP2 fork, with 10–13 branches from origin of Rs to hypostigmatic cell; hypostigmatic cell longer; pterostigma without proximal spot; anterior Banksian line indistinct, posterior Banksian line usually indistinct; male without pilula axillaris.

Abdomen. Shorter than hindwing, blackish-brown, posterior margin of tergites and sternites slightly bordered with yellow, densely covered with short dark hairs dorsally and laterally, hyaline hairs ventrally.

Terminalia (Fig. 6AB): anterior margin of tergite IX slightly produced anteriorly in lateral view, divided dorsally; sternite IX with tapered apex in ventral view, with long black setae posteriorly; ectoproct deep, smoothly rounded ventral margin produced ventrally in lateral view, with dense hyaline hairs posteriorly, long black setae ventrally.



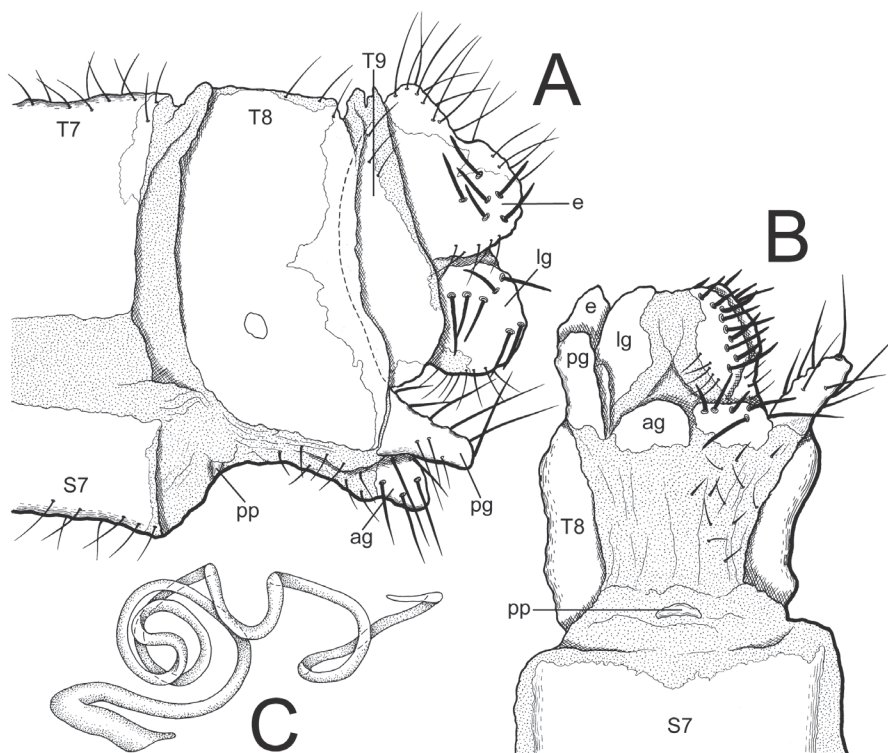


Fig. 7. Female terminalia of *Myrmeleon formicarius*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

Genitalia (Fig. 6C–F): gonarcus deep, arched, with short lateral arm produced posteriorly in lateral view; mediuncus small, slightly developed, brown, lightly sclerotized, three-pronged ventrally in caudal view; parameres rather large, slightly curved in ventral view.

*Length:* B, 31–35; FW, 36–39; HW, 34–37.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 7AB): tergite IX narrow in lateral view, divided dorsally; ectoproct slightly produced ventrally in lateral view, with long black fossorial bristles posteriorly; lateral gonapophyses rounded in lateral view, with long black fossorial bristles; posterior gonapophyses long, slender, with long black setae; anterior gonapophyses rounded, small, with long black setae; gonapophyseal plates absent; pregenital plate narrow, lightly sclerotized, present on membrane below anterior margin of tergite VIII in lateral view; spermatheca (Fig. 7C) long, slender, coiled.

*Length:* B, 32–37; FW, 38–44; HW: 37–42.

*Specimens examined.* [Hokkaido] 1♀, Sarobetsu, 8. viii. 1969, A. Nishiyama; 1♀, Utoro-Iwaobetsu, Shiretoko, 16. viii. 1953, T. Kumata; 2♂ (NSMT), Akabira, Hokkaido, 23. vii. 1954, K. Fujimoto; 1♀ (NSMT), Jozankei, Hokkaido, 17–18. vii. 1956, W. Nakahara; 1♀, Sapporo, 23. vii. 1982, M. Suwa; 1♀, Mt. Teine, Sapporo, 27. viii. 2003, T. Kanbe. [Honshu] 1♀ (NSMT), Futamata, Fukushima, 2. viii. 1961, Y. Kurosawa; 1♀ (NSMT), Aizuwakamatsu, 5. viii. 1960, M. Kano; 1♀ (NSMT), Shinjuku, Tokyo, 3. vii. 1963, Y. Kurosawa; 1♀ (NSMT), Nippara, Okutama, 15. v. 1957,

K. Fujimoto; 1♀ (NSMT), same locality, 25. vii. 1966, Y. Kurosawa; 1♂ (NSMT), Jimbayama, Kanagawa, 21. vi. 1956, K. Fujimoto; 1♀ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♀ 1ex (NSMT), Yashajin-Pass, Yamanashi, 25. vii. 1955, Y. Kurosawa *et* M. Kobayashi; 1♀ (NSMT), same locality, 27. vii. 1955, Y. Kurosawa *et* M. Kobayashi; 1♀ (NSMT), same locality, 8. viii. 1956, M. Kobayashi; 1♀ (NSMT), Azusayama, Kai Prov., 9. viii. 1953, M. Ogata; 1♂ (NSMT), Teishouji, Minamisaku, 6. vi. 1966, collector unknown; 1♀ (NSMT), Mt. Hiei, Kyoto, 28. viii. 1954, M. Ogata; 1♀, Mt. Wasamata, Kamnikitayama, Nara Pref., 9. viii. 1989 (Light Trap), M. Uenishi. [Shikoku] 1♀ (NSMT), Torigoeyama, Kagawa, viii. 1954, T. Hirao; 1♀, Mt. Zozu, Kagawa, 1. viii. 1988, H. Toshima; 1♂, Kankakei, Shodoshima, Kagawa, 7. vii. 1985, H. Toshima; 1♂, Takenokawa-rindo, Hongawa, Kochi, 7. vii. 1996, T. Beppu. [Kyushu] 2♀ (NSMT), Mt. Hikosan, Fukuoka, 21. vii. 1969, Y. Kurosawa.

*Distribution.* Japan (Hokkaido, Honshu, Sadogashima Is., Shikoku, Shodoshima Is., Kyushu); Korea(?), Sakhalin, Russian Far East, Tajikistan, Kyrgyzstan, Kazakhstan, Iran, Armenia, Turkey, Egypt, Europe.

*Remarks.* This species can be distinguished from other species of Japanese *Myrmeleon* by the coloration of mid tibia and, in males, by the absence of pilula axillaris, the presence of lateral arms of gonarcus (Fig. 6C), and the three-pronged mediuncus (Fig. 6CD). The pilula axillaris is regarded as an autapomorphy of the family Myrmeleontidae (Güsten 1996). Therefore, the lack of pilula axillaris in this species should be recognized as secondary loss.

*Myrmeleon bore* (Tjeder)  
(Figs 1CD, 8, 9)

*Myrmeleon formicarius*: Matsumura, 1904: 173 (not *Myrmeleon formicarius* Linnaeus, 1767).

*Myrmeleon formicarius*: Okamoto, 1910: 298 (in part); Baba, 1953: 6.

*Grocus bore* Tjeder, 1941: 74; Kuwayama, 1959: 67; 1962: 388.

*Myrmeleon bore*: Meinander, 1962: 71; Matsura, 1987: 544; Aspöck *et al.*, 2001: 262;

Krivokhatsky, 2011: 188; Hayashi, 2012: 203; 2013: 191; Yoshitomi *et al.*, 2013: 5.

*Morter bore*: Friheden, 1973: 32.

*Myrmeleon (Morter) bore*: Aspöck *et al.*, 1980a: 294.

(For further literature, see Kuwayama, 1962: 388; Aspöck *et al.*, 1980a: 294; 2001: 262; Krivokhatsky, 2011: 188.)

*Redescription.* Male. Head. Vertex strongly raised, rounded, completely shiny black, pair of dull grayish-black portions along posterior margin, with sparse short dark hairs; occiput shiny black, browner ventrally. Frons dull grayish-black dorsally, shiny black ventrally, with sparse short hyaline hairs; gena shiny black, whitish-yellow line along ocular rim interrupted by black dorsally; clypeus with dark brown marking extending from frons to ventral 2/3, which sometimes emarginate ventrally, whitish-yellow to yellow laterally and ventrally, with sparse erect long dark hairs. Antenna blackish-brown, shiny proximally, short, with slightly defined club, densely covered with short dark hairs; scape dark brown anteriorly, yellow posteriorly; pedicel with narrow distal yellow annulation; flagellum comprising approximately 30 flagellomeres. Mouthparts yellow: labrum with several dark hairs; cardo dark brown; stipes with dark brown spot at proximal end; 3rd, 4th and 5th maxillary palpomeres dark brown; 2nd labial palpomere dark brown; 3rd labial palpomere dark brown, spindle-shaped, tapering to acute apex,

with palpimacula; submentum dark brown with long brown hairs.

Thorax. Pronotum (Fig. 1D) broad, shorter than broad, blackish-brown, whitish-yellow to yellow anterior corners sometimes connected with pair of postero-lateral yellow spots at anterior transverse furrow, with hyaline hairs and long lateral dark hairs. Cervical sclerites blackish-brown. Mesonotum uniformly blackish-brown, with

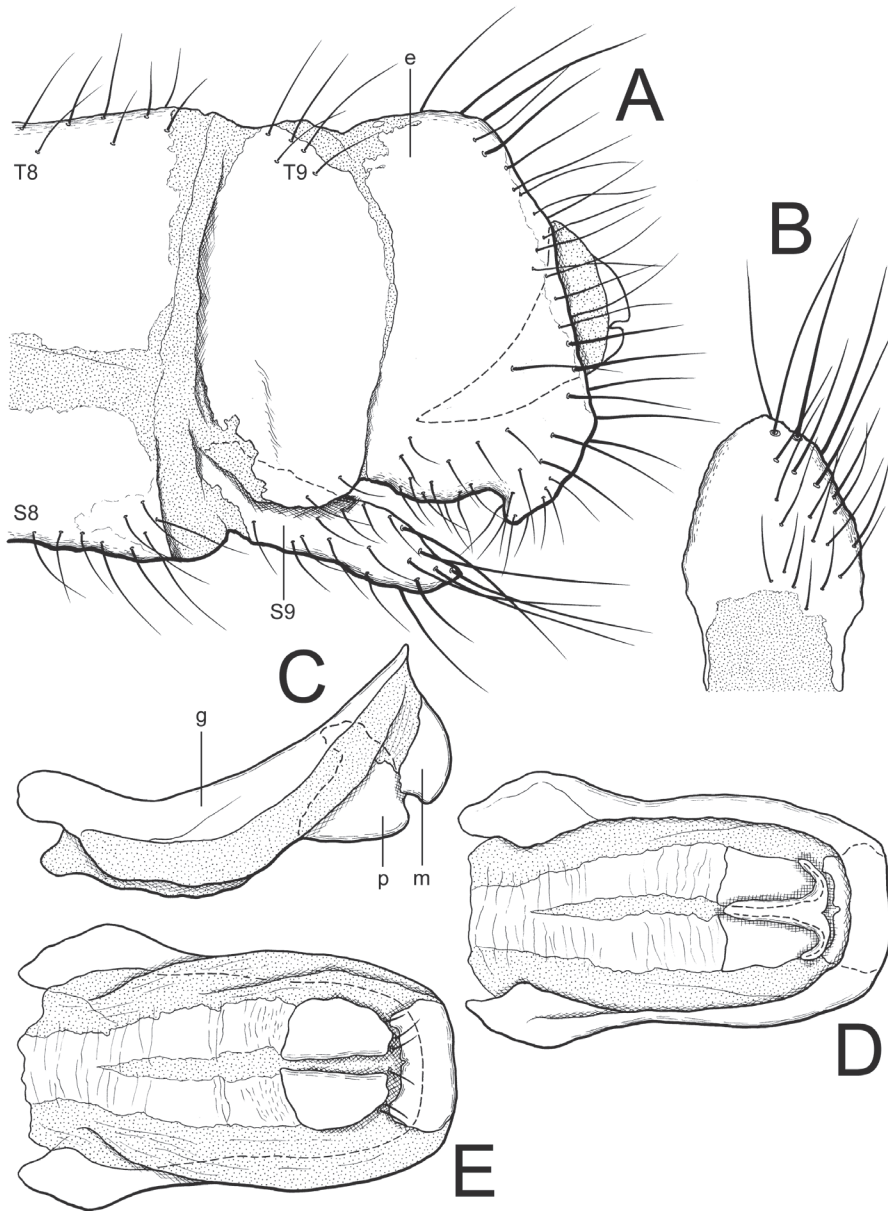


Fig. 8. Male terminalia of *Myrmeleon bore*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

sparse hyaline hairs; mesoprescutum with sparse long dark hairs. Metanotum uniformly blackish-brown, with pair of black markings at middle, with sparse hyaline hairs. Meso- and metapleuron blackish-brown, moderately covered with long hyaline hairs.

Legs. Yellow, short. Coxae dark grayish-brown to blackish-brown, moderately covered with long hyaline hairs. Femora moderately covered with short dark hairs, mixed with sparse long black setae; fore femur dark brown distally and ventrally; mid- and hind femora dark brown on distal 1/2; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia largely dark brown, with dense short brown setae distally and ventrally; mid tibia dark brown at distal end, with dark brown longitudinal stripe on anterior surface; hind tibia dark brown at distal end and on ventral surface. Tibial spurs reddish-brown, short, slender, almost straight, approximately as long as or slightly longer than Ta1. Tarsi dark brown to blackish-brown, outer surfaces of Ta1–Ta4 sometimes yellow, Ta5 darker, sparsely covered with short dark hairs dorsally, short black setae ventrally; on fore- and mid tarsi Ta1 approximately as long as combined length of Ta2–Ta3, on hind tarsus Ta1 approximately as long as combined length of Ta2–Ta4; Ta5 shorter than combined length of Ta1–Ta4. Claws reddish-brown, short, simple, slightly curved, approximately 2/3 as long as tibial spurs.

Wings (Fig. 1C). Short, narrow. Forewing subacute at apex: veins alternating dark brown and pale yellow, crossveins dark brown, CuP+1A pale dark brown; costal area simple, distal crossveins often branched; presectoral area with 6–9 crossveins and 0–4 irregular cells; Rs arising beyond CuA fork, with 7–10 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 3A mostly fused with 2A; hypostigmatic cell short; pterostigma white, with faint proximal brown spot; anterior Banksian line usually indistinct, posterior Banksian line distinct. Hindwing shorter and narrower than forewing; much acute at apex; presectoral area with 5 crossveins; Rs arising beyond MP2 fork, with 8–11 branches from origin of Rs to hypostigmatic cell; hypostigmatic cell longer; pterostigma without proximal spot; anterior Banksian line absent, posterior Banksian line distinct; male with pilula axillaris.

Abdomen. Shorter than hindwing, blackish-brown, posterior margin of tergites and sternites slightly bordered with yellow, densely covered with hyaline hairs.

Terminalia (Fig. 8AB): tergite IX narrow in lateral view, divided dorsally; sternite IX with rather tapered apex in ventral view, with long black setae posteriorly; ectoproct deep, with hook-like projection along ventral margin in lateral view, with dense hyaline hairs posteriorly, long black setae ventrally. Genitalia (Fig. 8C–E): gonarcus shallow, arched; mediuncus black, well sclerotized, almost rectangular in caudal view; parameres with short hairs between mediuncus; ventral membrane sometimes lightly sclerotized and pale brown.

*Length:* B, 22–27; FW, 23–30; HW, 21–27.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent. Terminalia (Fig. 9AB): tergite IX narrow in lateral view, divided dorsally; ectoproct simple in lateral view, with long black fossorial bristles posteriorly; lateral gonapophyses rounded in lateral view, with long black fossorial bristles; posterior gonapophyses rather short, with long black setae; anterior gonapophyses rounded, small, with long black setae; pregenital plate triangular, lightly sclerotized, close to posterior margin of sternite VIII in ventral view; spermatheca (Fig. 9C) long, slender, coiled.

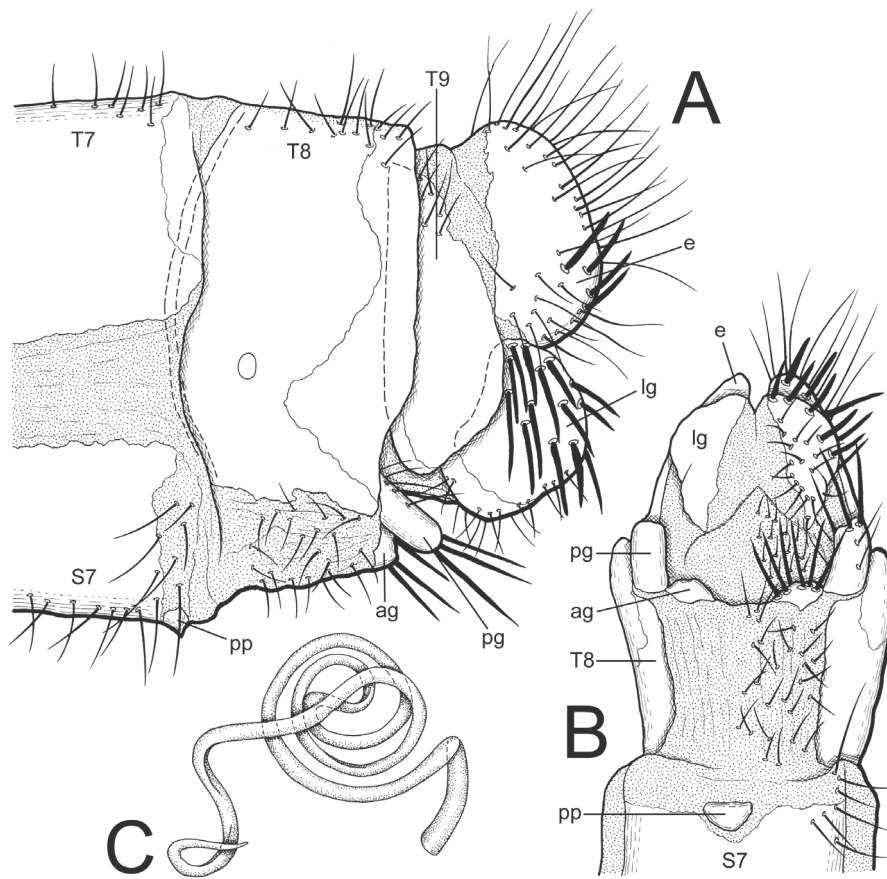


Fig. 9. Female terminalia of *Myrmeleon bore*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

*Length:* B, 23–31; FW, 24–34; HW, 22–31.

*Specimens examined.* [Hokkaido] 1♂ 1♀, Nozuka-cho, Shakotan, 27. v. 2004 (larvae collected: 1♂, emerged 2. vii. 2004; 1♀, emerged 29. vii. 2004), S. Sekimoto; 3♀, same locality, 11. vi. 2004 (larvae collected: 1♀, emerged 28. vii. 2004; 1♀, emerged 7. viii. 2004; 1♀, emerged 8. viii. 2004), S. Sekimoto; 1♂ 2♀, same locality, 16. vii. 2004 (larvae collected: 1♂, emerged 14. viii. 2004; 2♀, emerged 10. viii. 2004), S. Sekimoto; 4♂ 3♀, Nishikawa-cho, Shakotan, 27. v. 2004 (larvae collected: 2♂, emerged 27. vi. 2004; 1♂, emerged 4. vii. 2004; 1♂, emerged 10. vii. 2004; 1♀, emerged 27. vi. 2004; 1♀, emerged 3. vii. 2004; 1♀, emerged 8. vii. 2004), S. Sekimoto; 1♂ 4♀, same locality, 11. vi. 2004 (larvae collected: 1♂, emerged 28. vii. 2004; 1♀, emerged 26. vii. 2004; 1♀, emerged 28. vii. 2004; 1♀, emerged 1. viii. 2004; 1♀, emerged 8. viii. 2004), S. Sekimoto; 1♀, Hamanaka-cho, Yoichi, 11. vi. 2004 (larva collected: 1♀, emerged 7. viii. 2004), S. Sekimoto; 2♂ 2♀, Zenibako, Otaru, 8. v. 2004 (larvae collected: 1♂, emerged 3. vii. 2004; 1♂, emerged 7. vii. 2004; 1♀, emerged 8. vii. 2004; 1♀, emerged 26. vii. 2004), S. Sekimoto; 5♂ 5♀, same locality, 18. vi. 2004 (larvae collected: 1♂, emerged 30. vii. 2004; 1♂, emerged 31. vii. 2004; 1♂, emerged 7. viii. 2004; 2♂, emerged 10. viii. 2004; 1♀, emerged 28. vii. 2004; 2♀, emerged



30. vii. 2004; 2♀, emerged 10. viii. 2004), S. Sekimoto; 1♂ 1♀, same locality, 27. vi. 2004 (larvae collected: 1♂, emerged 4. viii. 2004; 1♀, emerged 20. vii. 2004), S. Sekimoto; 7♂ 2♀, Nokanan, Higashikawa, 27. v. 2004 (larvae collected: 1♂, emerged 27. vi. 2004; 3♂, emerged 28. vi. 2004; 1♂, emerged 30. vi. 2004; 1♂, emerged 1. vii. 2004; 1♂, emerged 3. vii. 2004; 1♀, emerged 28. vi. 2004; 1♀, emerged 4. vii. 2004), T. Kanbe; 1♂, Tomuraushi, Hokkaido, 24–27. viii, 1954, C. Watanabe *et al.*; 4♀, Sarobetsu, 10. viii. 1965, T. Kumata *et al.*; 1♀, Minamisyokanbetsu-so, 550m, Syokanbetsu Park, 4. viii. 1984, T. Kumata; 2♀, same locality, 20. vii. 1984, M. Suwa; 1♀ (NSMT), Mt. Petegari, 400m, Hidaka, Hokkaido, 28. vii. 1971, R. Ishikawa; 1♀ (NSMT), same locality, 30. vii. 1971, R. Ishikawa. [Honshu] 1♂ (NSMT), Kushiishiyama, Ajigasawa, Nishitsugaru-gun, Aomori, 6. viii. 1986, A. Abe; 1♀ (NSMT), Akaishi-dam, Ajigasawa, Nishitsugaru-gun, Aomori, 11. viii. 1986, A. Abe; 1♀ (NSMT), Sakata, Yamagata, 31. vii. 1956, K. Shirahata; 1♀ (NSMT), same locality, viii. 1956, K. Shirahata; 1♀ (NSMT), Higashiyama, Aizuwakamatsu, 23. viii. 1957, M. Kohno; 1♀ (NSMT), Mito, Ibaraki, 21. viii. 1933, T. Tani; 1♀ (NSMT), Kyu Karuizawa, Gunma, 26–27. vii. 1955, H. Kobayashi; 1♀ (NSMT), Mt. Haruna, Gunma, 24. vii. 1956, K. Fujimoto; 1♀ (NSMT), Karuizawa, Gunma, 29. viii. 1971, Y. Kurosawa; 1♂ (NSMT), Kinuta, Setagaya, Tokyo, 28. vii. 1966, Y. Kurosawa; 1♀ (NSMT), Senami, Niigata, 27. viii. 1964, Y. Kurosawa; 1♂, Sasaguchihama, N-Echigo, 2. viii. 1966, K. Baba; 1♀, Echizen-hama, Niigata, 3. ix. 2004 (larva collected: 1♀, emerged 18. xi. 2004), S. Sekimoto; 1♂, Muramatsu-hama, Niigata, 9. ix. 2004 (larva collected: 1♂, emerged 10. xii. 2004), S. Sekimoto; 1♂, Matsuhama, Niigata, 6. ix. 2004 (larva collected: 1♂, emerged 10. xi. 2004), S. Sekimoto; 1♂, Kakuda-hama, Niigata, 3. ix. 2004 (larva collected: 1♂, emerged 24. xi. 2004), S. Sekimoto; 2♀ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♂ 4♀ (NSMT), Yuzawa, Echigo, 16. vii. 1962, K. Fujimoto; 1♀ (NSMT), Itoigawa, Kotaki-gawa Riv., 280m, South hoot of Mt. Myojo-san, Niigata, 11. vii. 1983, M. Owada & T. Naito; 1♂ (NSMT), Itoigawa, Kotaki, Mt. Myojo-san, Niigata, 16. vii. 1988, M. Owada; 1♀ (NSMT), Kakuma, Shinano, 8–10. viii. 1956, K. Fujimoto; 1♀ (NSMT), Darugamine, Himeji, 12. vii. 1955, K. Nishimura. [Shikoku] 1♂ (NSMT), Matsuyama, Shikoku, vii. 1964, collector unknown.

*Non-Japanese specimens examined.* [South Korea] 1♂ (NSMT), Hyeoi-rhi, 850m, near Taebaeg, Gangweon-do, 23. viii. 1984, T. Yamasaki. [Europe] 1♂, Dozzich, Kärnten, 22. vii. 1975, H. Hölzel; 1♀, Waiolisch, Carinthia, 2. viii. 1970, H. Hölzel.

*Distribution.* Japan (Hokkaido, Kunashiri Is., Okushiri Is., Honshu, Sadogashima Is., Shikoku, Kyushu); Korea, China, Sakhalin, Russian Far East, Uzbekistan, Europe.

*Remarks.* This species closely resembles *M. formicarius* in having a similar pronotum color pattern, but *M. bore* can be easily distinguished from the latter by the coloration of mid tibia and, in males, by the presence of pilula axillaris, the hook-like projection of the ectoproct, and the structures of genitalia (Fig. 8A–E).

*Myrmeleon solers* Walker  
(Figs 1EF, 10, 11)

*Myrmeleon solers* Walker, 1853: 367; Stange, 2004: 336; Hayashi, 2012: 202; 2013: 191; Yoshitomi *et al.*, 2013: 8.

*Myrmeleon acer solers*: van der Weele, 1909: 46.

*Myrmeleon acer* Walker: Adams, 1959: 18 (in part).

*Grocus solers*: Kuwayama, 1959: 68; 1962: 389; Higuma, 1979: 91.

*Myrmeleon celebensis*: Kuwayama, 1953: 39 (not *Myrmeleon celebensis* McLachlan, 1875b); Baba, 1953: 9.

(For further literature, see Kuwayama, 1962: 389.)

*Redescription.* Male. Head. Vertex strongly raised, rounded, completely black, often brownish along posterior margin, with sparse short hyaline hairs; occiput black dorsally, brown ventrally. Frons dull grayish-black dorsally, shiny dark brown ventrally, sometimes pair of faint yellowish spots developed at middle, with sparse short hyaline hairs; gena whitish-yellow, whitish-yellow line along ocular rim slightly interrupted

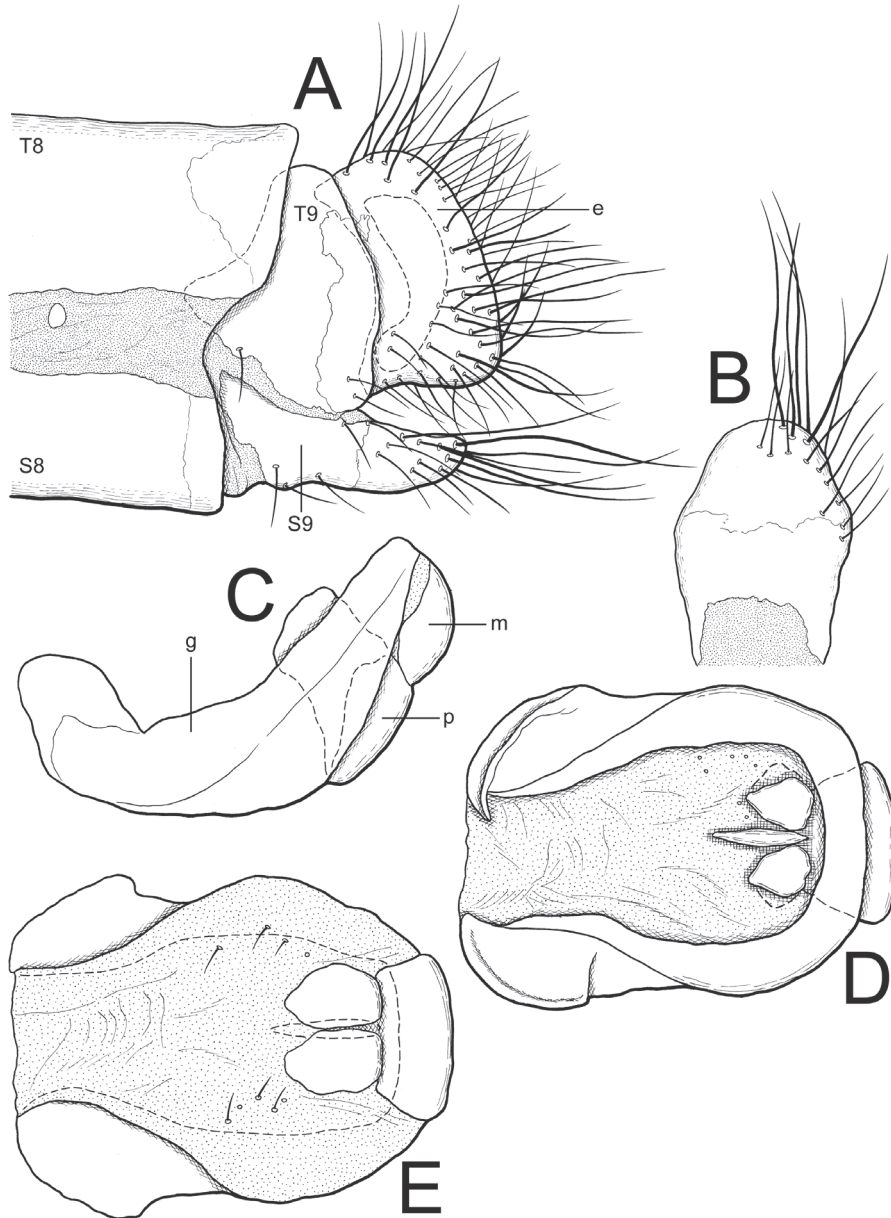


Fig. 10. Male terminalia of *Myrmeleon solers*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

by dark brown dorsally; clypeus pale yellow to pale brown, with pair of short vertical dark brown extension extending from frons to ventral 2/3, whitish-yellow ventrally, with sparse erect long dark hairs. Antenna dark brown, shiny proximally, darker distally, short, with well defined club, densely covered with short dark hairs; scape dark brown anteriorly, yellow posteriorly; pedicel dark brown, with narrow distal yellow annulation; flagellum comprising approximately 30 flagellomeres, proximal first flagellomere yellow proximally. Mouthparts yellow to pale brown: labrum with several dark hairs; 4th and 5th maxillary palpomeres dark brown; 2nd labial palpomere brown; 3rd labial palpomere dark brown, spindle-shaped, tapering to acute apex, with palpimacula on distal 1/3; submentum dark brown with long brown hairs.

Thorax. Pronotum (Fig. 1F) broad, shorter than broad, dark grayish-brown, yellow anterior and lateral margins forming M-shaped yellow marking, which including pair of dark grayish-brown spots along anterior margin, narrow longitudinal yellow midline connected with M-shaped marking at anterior transverse furrow, with hyaline hairs. Cervical sclerites dark grayish-brown. Meso- and metanotum uniformly dark grayish-brown, yellow along posterior margin of meso- and metascutellum, with sparse hyaline hairs. Meso- and metapleuron dark grayish-brown, moderately covered with hyaline hairs.

Legs. Yellow, short. Coxae dark grayish-brown, moderately covered with hyaline hairs; fore coxa dark brown on outer surface, yellow on inner surface. Femora sparsely covered with short dark hairs, mixed with sparse long black setae; fore femur dark brown distally and ventrally; mid femur mostly dark brown, yellow at proximal end and on postero-dorsal surface; hind femur dark brown on distal 1/2, except for yellow postero-dorsal surface; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae sparsely covered with short dark hairs, mixed with sparse long black setae; fore tibia largely dark brown, with longitudinal yellow stripe on anterior surface, with dense short brown setae distally and ventrally; mid tibia dark brown at distal end and on anterior and ventral surfaces; hind tibia dark brown at distal end and on ventral surface. Tibial spurs reddish-brown, short, slender, almost straight, approximately as long as Ta1. Tarsi brown, outer surfaces of Ta1–Ta4 yellow with brown distal end, Ta5 dark brown at distal end, sparsely covered with short dark hairs dorsally, short black setae present ventrally; on fore- and mid tarsi Ta1 approximately as long as combined length of Ta2–Ta3, on hind tarsus Ta1 approximately as long as combined length of Ta2–Ta4; Ta5 slightly shorter than combined length of Ta1–Ta4. Claws reddish-brown, short, simple, curved, approximately 2/3 as long as tibial spurs.

Wings (Fig. 1E). Short. Forewing subacute at apex; veins and crossveins mostly pale, rather darkish on posterior margin and apically, Sc and R finely alternating dark brown and pale yellow, except for pale yellow proximal portion of Sc and distal portion of R, proximal portion of MP and proximal 1/2 of CuA alternating dark and pale; costal area simple, distal crossveins often branched; presectoral area with 7–9 crossveins and 0–2 irregular cells; Rs arising almost opposite or slightly beyond CuA fork, with 9–12 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–2 cells before fusing with 1A; hypostigmatic cell short; pterostigma white, sometimes with proximal small dark spot; anterior Banksian line absent, posterior Banksian line distinct. Hindwing shorter and narrower than forewing; Sc and R pale dark brown proximally, MP1 pale, proximal 1/2 of MP2 almost pale dark; presectoral area with 5 crossveins; Rs arising beyond MP2 fork, with 10–11 branches from origin of Rs to hypostigmatic cell;



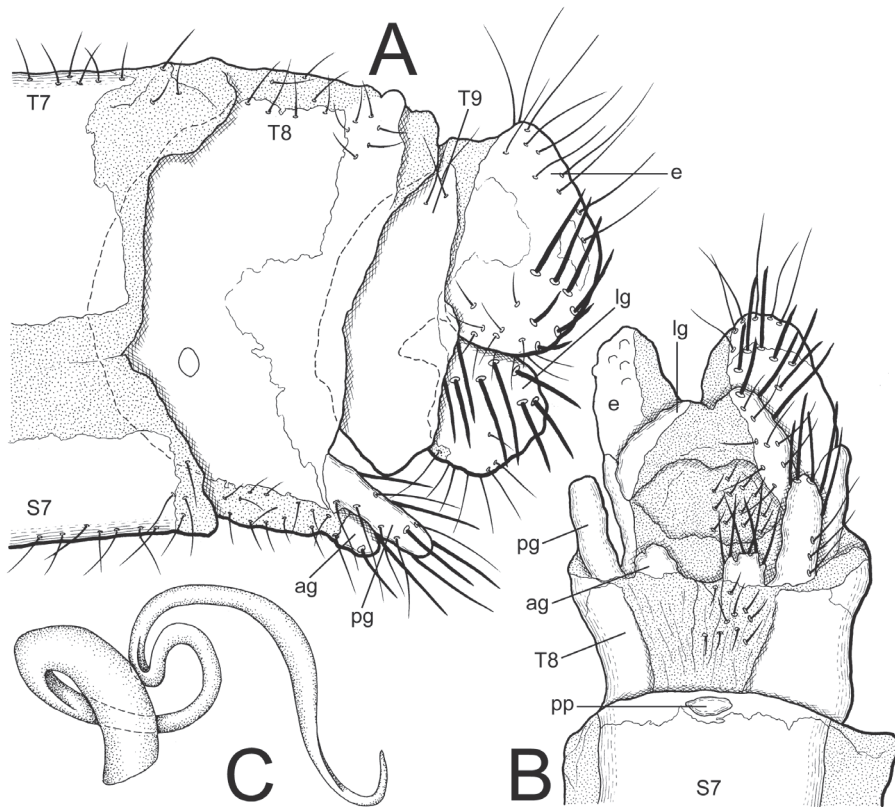


Fig. 11. Female terminalia of *Myrmeleon solers* A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

hypostigmatic cell longer; anterior Banksian line absent, posterior Banksian line distinct; male with pilula axillaris.

Abdomen. Shorter than hindwing, dark grayish-brown, posterior margin of tergites and sternites slightly bordered with yellow, densely covered with hyaline hairs.

Terminalia (Fig. 10AB): anterior margin of tergite IX produced anteriorly at middle in lateral view, divided dorsally; sternite IX with round apex in ventral view, with long black setae posteriorly; ectoproct deep, round ventral margin slightly produced ventrally in lateral view, with dense hyaline hairs posteriorly, long black setae ventrally. Genitalia (Fig. 10C–E): gonarcus rather deep, each anterior end with rounded lobe in lateral view; mediuncus black, well sclerotized, almost rectangular in caudal view; parameres small.

*Length:* B, 23–24; FW, 24–25; HW, 23–24.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent. Terminalia (Fig. 11AB): tergite IX narrow in lateral view, divided dorsally; ectoproct simple in lateral view, with long black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with long black fossorial bristles; posterior gonapophyses long, slender, with long black setae; anterior gonapophyses small, rounded, with long black setae; gonapophyseal plates absent; pregenital plate

lightly sclerotized, close to posterior margin of sternite VIII in ventral view; spermatheca (Fig. 11C) short.

*Length:* B, 24–25; FW, 26–27; HW, 24–26.

*Specimens examined.* Holotype ♂ (BMNH), *Myrmeleon solers* Walker. Verbatim label data: “type”; “china”; “44 20” [written on the back of the above-mentioned label]; “solers”. Other specimens. [Kyushu] 2♂ (TA), Misatomatsubara, Okagaki, Fukuoka, 7. viii. 1990 (larvae collected: 1♂, emerged 30. vii. 1990; 1♂, emerged 2–3. viii. 1990), I. Tabata; 4♀, same locality, 28. vii. 2001, S. Tsukaguchi.

*Distribution.* Japan (Honshu, Kyushu); China.

*Remarks.* This species is similar to *M. bore* in general appearance but can be easily distinguished from it by the color pattern of the pronotum (Fig. 1F), the pale and dense wing venation and, in males, by the absence of ventral projection of the ectoproct (Fig. 10A) and, in females, by the short and not coiled spermatheca (Fig. 11C).

Kuwayama (1953) reported *M. celebensis* based on specimens collected from Niigata. In his taxonomic review of the genera *Myrmeleon* and *Grocus* of Japan (Kuwayama 1959), he recognized it as misidentification and identified them as *Grocus solers* without any comment. It was therefore necessary to compare the Japanese specimens with the holotype of *M. solers*. I compared the holotype of *M. solers* with the above-listed six specimens collected in Fukuoka. As a result, it could be confirmed that the external features of these specimens are in complete agreement with the holotype and also with the redescription given by Kuwayama (1953) based on the specimens collected in Niigata. These specimens were thus confidently identified as *M. solers*.

New (1985a: Fig. 95, p. 59) provided an illustration of the pronotum pattern of the holotype of *M. solers*, but his illustration is not accurate. Although the pronotum of the holotype is broken, and the coloration is rather indistinct due to exudation of oil, I confirmed the anterior M-shaped yellow marking which was not illustrated in New (1985a).

In Japan, the distribution of this species is restricted to the sea-shore of the Japan Sea coast of Honshu (Niigata Prefecture and Tottori Prefecture) and Kyushu (Fukuoka Prefecture).

*Myrmeleon taiwanensis* Miller & Stange  
(Figs 1GH, 12, 13)

*Grocus acer*: Kuwayama, 1964: 48 [not *Grocus acer* (Walker, 1853)].

*Myrmeleon taiwanensis* Miller & Stange in Miller *et al.*, 1999: 69; Stange *et al.*, 2003: 123; Stange, 2004: 336.

*Myrmeleon acer*: Yoshitomi *et al.*, 2013: 8 (not *Myrmeleon acer* Walker, 1853).

See Millar & Stange in Miller *et al.* (1999) for a description of general morphology. In the following, only complementary information and redescription of terminalia are provided.

*Redescription.* Wings (Fig. 1G). Forewing presectoral area with 8 crossveins, without irregular cells; Rs arising beyond CuA fork, with 7–9 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused; hypostigmatic cell short; anterior Banksian line absent, posterior Banksian line distinct. Hindwing presectoral area with 5 crossveins; Rs arising beyond MP2 fork, with 7–9

branches from origin of Rs to hypostigmatic cell; anterior Banksian line absent, posterior Banksian line distinct; male with pilula axillaris.

*Redescription of male terminalia.* Terminalia (Fig. 12AB): tergite IX almost oval in lateral view, divided dorsally; sternite IX with rather rounded apex in ventral view, with long black setae posteriorly; ectoproct deep, rather broadened ventrally, with dense hyaline hairs posteriorly, long black setae ventrally. Genitalia (Fig. 12C–E): gonarcus rather shallow, crescent-shaped in lateral view, arched in dorsal view; mediuncus black, well sclerotized, almost rectangular in caudal view; parameres small, with ventral short

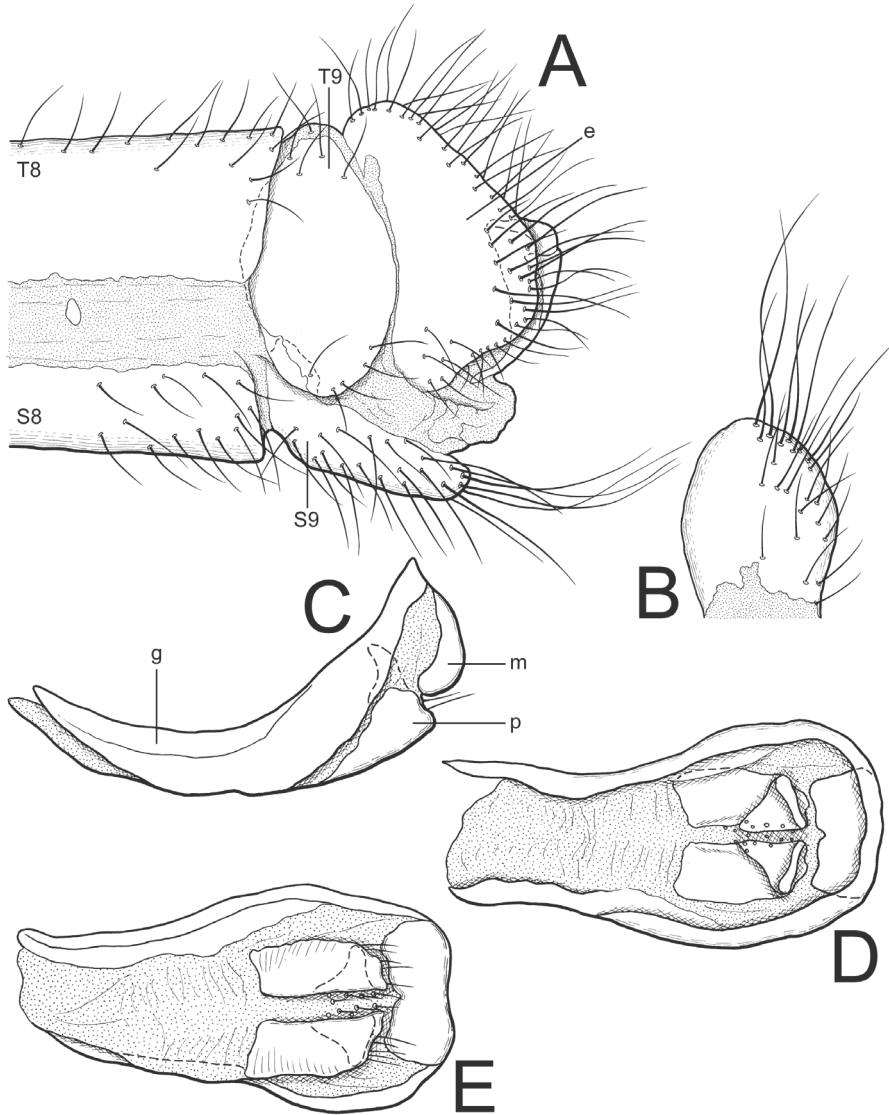


Fig. 12. Male terminalia of *Myrmeleon taiwanensis*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

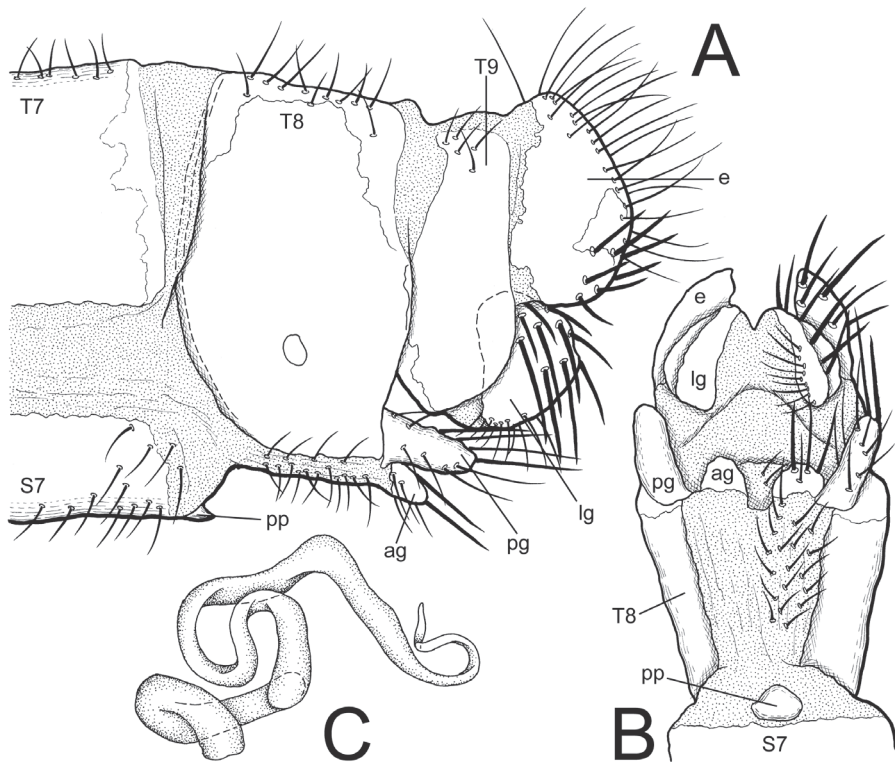


Fig. 13. Female terminalia of *Myrmeleon taiwanensis*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

hairs.

*Length:* B, 21–23; FW, 23–24; HW, 21–22.

*Redescription of female terminalia.* Terminalia (Fig. 13AB): tergite IX narrow in lateral view, divided dorsally; ectoproct simple in lateral view, with long black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with long black fossorial bristles; posterior gonapophyses long, slender, with long black setae; anterior gonapophyses rounded, small, with long black setae; pregenital plate triangular, close to posterior margin of sternite VIII in ventral view; spermatheca (Fig. 13C) short, slightly convoluted.

*Length:* B, 22; FW, 25–26; HW, 23–24.

*Specimens examined.* [Ryukyus] 1♀, Okinawa, no date, S. Sakaguchi; 2♂ 2♀, Iriomote, Yaeyama, Okinawa Pref., 30. xii. 2004 (larvae collected: 1♂, emerged 11. iii. 2005; 1♂, emerged 18. iii. 2005; 1♀, emerged 16. iii. 2005; 1♀, emerged 21. iii. 2005), O. Takahashi.

*Distribution.* Japan (Okinawajima Is., Iriomotejima Is.); Taiwan.

*Remarks.* Although Kuwayama (1964) recorded *Grocus acer* based on one female collected in Okinawa, this species has not been collected in Japan since then. I obtained four specimens collected in Iriomotejima Island and confirmed that they agree with the above-mentioned female specimen identified as *G. acer* by Kuwayama. Then,

by comparing these Japanese specimens with the holotype of *Myrmeleon acer*, the following considerable differences between the Japanese specimens and the holotype were confirmed: the Japanese specimens have rather narrower wings than the holotype; the pronotum of the Japanese specimens is slightly pale at each anterior corner, but that of the holotype is wholly pale anteriorly; mid femur of the Japanese specimens is dark brown only on distal 1/2, but that of holotype is largely dark brown. Therefore, I concluded that these Japanese specimens are not *M. acer*. Instead, external features of these specimens agree with the original description of *Myrmeleon taiwanensis* from Taiwan so that the Japanese specimens were determined as this species. This is the first record of *M. taiwanensis* from Japan.

#### Genus *Baliga* Navás

*Baliga* Navás, 1912a: 110. Type species: *Myrmeleon asakurae* Okamoto, 1910 (as “*Myrmeleon asakurai* [sic] Okamoto”), by original designation.

(For further synonymies, see Stange, 2004: 296.)

*Diagnosis.* Medium to large-sized antlions; wings narrow to broad, hyaline, without marking; costal area of both wings simple, distal crossveins branched; forewing presectoral area usually with approximately 5–10 crossveins; forewing vein Rs arising almost opposite or slightly beyond CuA fork; forewing veins 2A and 3A fused at same point; hindwing presectoral area usually with 5 crossveins; hindwing vein Rs arising almost opposite or slightly beyond MP2 fork; male usually with pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs approximately as long as Ta1; male ectoproct usually simple, sometimes with ventral projection; gonarcus arched in dorsal view; mediuncus usually developed; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses slender, longer than anterior gonapophyses; anterior gonapophyses long, shorter than posterior gonapophyses; gonapophyseal plates absent; spermatheca long, coiled.

*Remarks.* The genus *Baliga* consists of 19 species distributed in Asia (17 species), Palau (1) and Australia (1). All were previously assigned to the genus *Hagenomyia* Banks, 1911, and recently transferred to *Baliga* by Stange (2004). According to Stange (2004), this genus can be distinguished from *Hagenomyia* by the length of the female anterior gonapophyses (shorter than posterior gonapophyses in *Baliga*, but as long as posterior gonapophyses in *Hagenomyia*). Some *Baliga* species with narrow wings resemble with those of *Myrmeleon* but differ from them by the denser wing veins (Fig. 2A), larger body size, and condition of the female anterior gonapophyses (Fig. 15AB).

#### *Baliga micans* (McLachlan) (Figs 2AB, 14, 15)

*Myrmeleon micans* McLachlan, 1875a: 176; Okamoto, 1910: 299.

*Baliga micans*: Navás, 1912a: 111.

*Myrmeleon (Myrmeleon) micans*: Nakahara, 1913a: 528.

*Hagenomyia micans*: Okamoto, 1914: 250; Kuwayama, 1962: 387; 1964: 47; Matura, 1987: 545; Krivokhatsky, 1997: 637.

*Glenuroides japonicus*: Baba, 1953: 13 [not *Glenuroides japonicus* (McLachlan, 1867)].



*Baliga micans*: Stange, 2004: 297; Hayashi, 2013: 191; Yoshitomi *et al.*, 2013: 5.  
(For further literature, see Kuwayama, 1962: 387.)

*Redescription*. Male. Head. Vertex strongly raised, rounded, dark brown to blackish-brown, coronal suture and posterior margin bordered with yellow, shallowly bilobed by coronal suture anteriorly, with sparse short pale hairs; occiput pale yellow, brown to dark brown along dorsal margin, with dark marking at middle. Frons dark brown to blackish-brown, with sparse short pale brown hairs; gena dark brown to blackish-brown anteriorly, whitish-yellow posteriorly; clypeus whitish-yellow, with sparse erect long pale brown hairs. Antenna blackish-brown, shiny proximally, long, with slightly defined club, densely covered with short dark hairs; scape dark brown anteriorly, yellow posteriorly; pedicel dark brown with distal yellow annulation; flagellum comprising approximately 35–40 flagellomeres. Mouthparts whitish-yellow to yellow; labrum with several brown hairs; 5th maxillary palpomere darker; 3rd labial palpomere spindle-shaped, tapering to acute apex, with brown circular palpmacula on distal 1/3; submentum with long brown hairs.

Thorax. Pronotum (Fig. 2B) broad, approximately as long as broad, dark brown to dark grayish-brown, whitish-yellow antero-laterally, yellow longitudinal midline extending from anterior margin to transverse furrow, posterior pair of yellow to pale brown spots sometimes almost indistinct, with pale brown hairs and long dark hairs. Cervical sclerite dark brown. Mesonotum dark grayish-brown, darker anteriorly, paler posteriorly, sparsely covered with long pale brown hairs; mesoprescutum with sparse long dark hairs. Metanotum dark grayish-brown, with pair of yellow to pale brown spots at middle, with sparse pale brown hairs. Meso- and metapleuron dark brown on dorsal half, pale yellow on ventral half, moderately covered with long pale brown hairs.

Legs. Yellow, short. Coxae pale yellow, moderately covered with long pale brown hairs. Femora sometimes dark brown at distal end, moderately covered with short dark hairs, mixed with sparse long black setae; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia slightly dark brown at proximal and distal end, dark on anterior surface; mid tibia dark on anterior surface; hind tibia dark brown at proximal and distal end, dark on ventral surface. Tibial spurs reddish-brown, short, slender, almost straight, approximately as long as or slightly longer than Ta1. Tarsi uniformly reddish-brown to dark brown, sparsely covered with short brown hairs dorsally, dense short black setae present ventrally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as or slightly shorter than combined length of Ta1–Ta4. Claws reddish-brown, short, simple, slightly curved, approximately 2/3 as long as tibial spurs.

Wings (Fig. 2A). Forewing without marking, subacute at apex; veins and crossveins mostly dark brown, Sc and R pale yellow, sometimes Sc slightly alternating with pale dark and pale yellow; costal area simple, distal crossveins often branched; presectoral area with 6–10 crossveins and 0–4 irregular cells; Rs arising almost opposite or slightly beyond CuA fork, with 8–16 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–2 cells before fusing with 1A; 3A fused with 2A at same point; hypostigmatic cell short; pterostigma white, oval, prominent; anterior Banksian line absent, posterior Banksian line distinct. Hindwing approximately as long as forewing, narrower than forewing; much acute at apex; presectoral area with 4–7 crossveins; Rs arising slightly beyond MP2 fork, with 10–16 branches from origin of Rs to hypostigmatic cell; pterostigma much smaller; anterior Banksian line absent, posterior

Banksian line distinct; male with pilula axillaris

Abdomen. Shorter than hindwing, tergites brown to dark brown, sternites pale whitish-yellow to dark brown, densely covered with pale brown hairs.

Terminalia (Fig. 14AB): tergite IX narrow in lateral view, divided dorsally; sternite

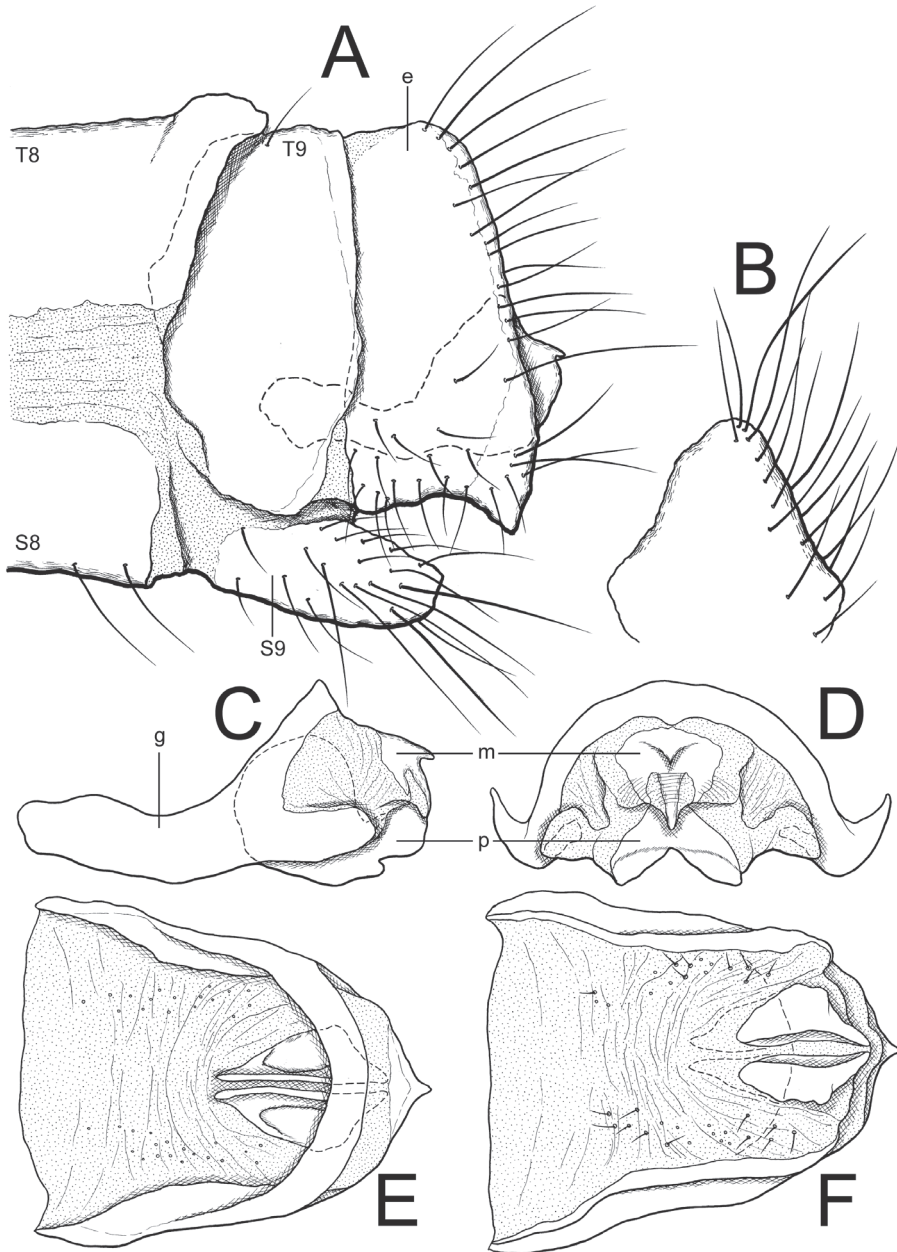


Fig. 14. Male terminalia of *Baliga micans*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

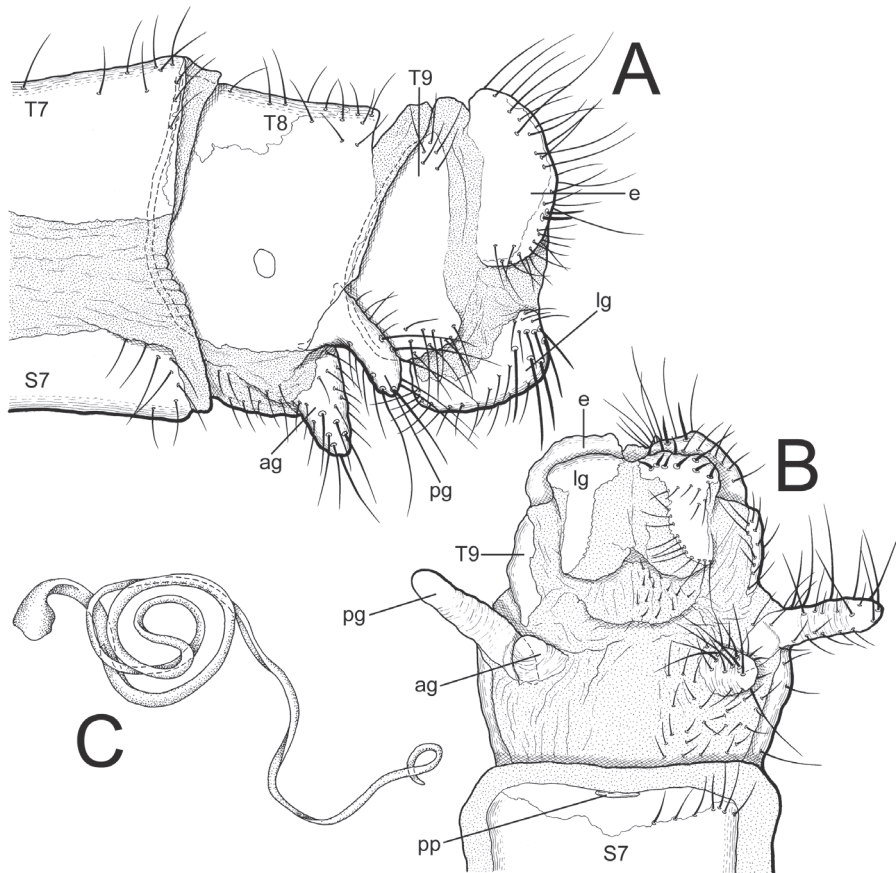


Fig. 15. Female terminalia of *Baliga micans*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

IX with tapered apex, almost triangular in ventral view, with long black setae posteriorly; ectoproct deep, with posteroventral projection tapered ventrally in lateral view, with dense hyaline hairs posteriorly, long black setae ventrally. Genitalia (Fig. 14C–F): gonarcus deep, arched, with lateral arms in lateral view; mediuncus small, brown, lightly sclerotized, with posterodorsal projection in lateral view, three-pronged ventrally in caudal view; parameres triangular in ventral view.

*Length:* B, 32–36; FW, 36–41; HW, 36–41.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent. Terminalia (Fig. 15AB): tergite IX narrow, oval in lateral view, divided dorsally; ectoproct simple in lateral view, with long black fossorial bristles posteriorly; lateral gonapophyses long in lateral view, with long black fossorial bristles posteriorly; posterior gonapophyses long, slender, with long black setae; anterior gonapophyses long, shorter than posterior gonapophyses, with long black setae; gonapophyseal plates absent; pregenital plate narrow, lightly sclerotized, present along posterior margin of sternite VIII in ventral view; spermatheca (Fig. 15C) long, slender, coiled.



*Length:* B, 31–38; FW, 36–44; HW, 36–44.

*Specimens examined.* [Hokkaido] 1♀, Hokkaido Univ., Sapporo, 10. viii. 2004, S. Sekimoto; 1♂ 2♀, Mt. Maruyama, Sapporo, 7. x. 2004 (larvae collected: 1♂, emerged 18. xii. 2004; 2♀, emerged 28. xi. 2004), S. Sekimoto. [Honshu] 2♀, Meya-dam, Nishimeya, Aomori, 8. ix. 1989, T. Nakamura; 1♀, same locality, 19. viii. 1989, T. Nakamura; 1♂ (NSMT), Noda, Iwate, 27. vi. 1955, K. Oda; 1♀ (NSMT), Mito, Ibaraki, 20. viii. 1933, T. Tani; 1♂ (NSMT), Higashi-Matsuyama, Saitama, 25. viii. 1969, K. Suga; 1♂ (NSMT), Shimoshakujii, Tokyo, 29. viii. 1934, H. Sato; 1♀ (NSMT), Akabane, 11. ix. 1958, M. K.; 1♂ (NSMT), Ueno, Tokyo, 4. viii. 1957, Y. Kurosawa; 1♀ (NSMT), Mejiro, Tokyo, 15. vii. 1952, W. Nakahara; 1♂ (NSMT), same locality, 18. vii. 1952, W. Nakahara; 1♂ 1♀ (NSMT), Kinuta, Tokyo, 13. vii. 1958, Y. Kurosawa; 1♂ (NSMT), Tachikawa, 18. vii. 1935, collector unknown; 1♂ (NSMT), Kunitachi, Tokyo, 8. viii. 1954, T. Sugimura; 1♂ 1♀ (NSMT), Mt. Takao, 19. viii. 1920, K. K.; 1♀ (NSMT), Oodarumi, Mt. Takao, Tokyo, 19. ix. 1971, Y. Kurosawa; 1♂, Yogyoji-temple, Fujisawa, Kanagawa, 25. vii. 2005, S. Sekimoto; 1♂ 2♀ (NSMT), Haizawa-onsen, Kisoagematsu, 30. viii. 1967, collector unknown; 1♀, Matsumoto, Nagano, 27. vii. 1973, S. Takagi; 1♂, Mt. Myoken, Hyogo, 20. vii. 1996, collector unknown; 1♀, Mt. Rokko, Kobe, Hyogo, 8. viii. 1984, S. Tsukaguchi; 1♂, Tentakuji, Inagawa-cho, Kawabe-gun, Hyogo-ken, 29. vii. 1985, S. Tsukaguchi; 1♂ (NSMT), Arima, 13. viii. 1933, E. Abe. [Shikoku] 1♀, Dogadaira, Komino, Miki, Kagawa, 23. viii. 1983, H. Tushima; 1♂ (NSMT), Matsuyama, Shikoku, 12. vii. 1964, collector unknown; 1♀ (NSMT), Kochi, 3. viii. 1939, K. Hashimoto. [Tsushima] 1♀ (NSMT), Izuhara, Tsushima, 14. viii. 1965, A. Urata. [Kyushu] 1♀, Shiroyama, Kagoshima, 14. vii. 1976, S. Tsukaguchi; 1♂, Kirishimajingu, Kagoshima Pref., 16. vii. 1976, S. Tsukaguchi; 1♂, Nishinootome, Tanegasima, 13. vi. 1965, T. Kumata.

*Distribution.* Japan (Hokkaido, Honshu, Sadogashima Is., Shikoku, Kyushu, Tsushima Is., Tanegashima Is., Okinawajima Is.); Korea, China, Vietnam.

*Remarks.* This species closely resembles *B. asakurae* (Okamoto, 1910) from Taiwan in general appearance but clearly differs from it by the color pattern of the pronotum (Fig. 2B), the coloration of wing membrane and veins, and the size of pterostigma (Fig. 2A).

### Tribe Dendroleontini

*Remarks.* According to Stange (2004) and Stange (2008), this tribe is characterized by the following character states: forewing vein 2A running in even curve from base to hind margin; hindwing vein Rs arising before MP fork; hindwing presectoral area with 1 crossvein (rarely 2 or 3).

This tribe is considered as an ancient lineage of the family because the larvae of the tribe represent an early stage in the transition from the arboreal habits (plesiomorphy) to the highly specialized psammophily (Mansell 1999).

### Genus *Dendroleon* Brauer

*Dendroleon* Brauer, 1866: 42. Type species: *Myrmeleon pantherinus* Fabricius, 1787, by subsequent designation by Hagen, 1873: 394.  
(For further synonymies, see Stange, 2004: 83.)

*Diagnosis.* Medium to large-sized antlions; antenna long; pronotum longer than broad; wings moderately broad, hyaline, attractively marked with shades of brown; costal area of both wings simple, distal crossveins branched; forewing presectoral

area usually with 4 crossveins; forewing vein Rs arising usually well before CuA fork; forewing veins 2A and 3A separate, usually connected by 1–2 crossveins; hindwing presectoral area usually with 1 crossvein; hindwing vein Rs arising well before MP2 fork; male with pilula axillaris; legs long, slender; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs usually approximately as long as combined length of Ta1–Ta2; male ectoproct simple, without postero-ventral lobe; gonarcus somewhat hooded; mediuncus large, situated between parameres; parameres usually broad, plate-shaped; female ectoproct simple; a pair of gonapophyses present below tergite IX; lateral gonapophyses present; posterior gonapophyses long, slightly curved; anterior gonapophyses shorter than posterior gonapophyses; gonapophyseal plates well developed; spermatheca short.

*Remarks.* The genus *Dendroleon* is one of the most widely distributed genera and contains 21 species (Stange 2004, 2008; Wan *et al.* 2004; Wang & Wang 2008; Zhan *et al.* 2012). According to Stange (2008), this genus is characterized by the following character states: vein Rs arising near base in both wings; forewing vein CuP arising at or near basal crossvein; relatively unmodified forewing vein 2A; lobe-like anterior gonapophyses; presence of male pilula axillaris. These are mostly plesiomorphic so that monophyly of the genus is not warranted.

The adults of *Dendroleon* resemble *Gatzara* Navás, 1915 and *Nepsalus* Navás, 1914c, but can be distinguished from them by the length of the female anterior gonapophyses (Stange 2004: shorter than posterior gonapophyses in *Dendroleon*, but approximately as long as or longer than posterior gonapophyses in *Gatzara* and *Nepsalus*). In wing characters, this genus is also similar to *Layahima* Navás, 1912b, but can be easily distinguished from it by the more slender legs, the presence of male pilula axillaris, and length of the female anterior gonapophyses (Fig. 17AB) (Wan *et al.* 2004, 2006).

*Dendroleon pupillaris* (Gerstaecker)  
(Figs 2CD, 16, 17)

*Glenurus (Dendroleon) pupillaris* Gerstaecker, 1893: 120.

*Glenurus pupillaris*: Matsumura, 1900a: 17.

*Glenurus japonicus*: Matsumura, 1904: 174 (not *Glenurus japonicus* McLachlan, 1867).

*Dendroleon japonicus*: Okamoto, 1910: 279 [not *Dendroleon japonicus* (McLachlan, 1867)].

*Dendroleon pupillaris*: Okamoto, 1914: 249; Baba, 1953: fig. 9C; Kuwayama, 1962: 382; Stange, 2004: 86; Hayashi, 2013: 194; Yoshitomi *et al.*, 2013: 2.

(For further literature, see Kuwayama, 1962: 382.)

*Redescription.* Male. Head. Vertex moderately raised, slightly rounded, pale brown, dark brown along lateral margin, slightly bilobed by coronal suture, with sparse short dark hairs; occiput yellow. Frons yellow, with broad transverse shiny dark brown band at middle, with sparse short dark hairs; gena mostly brown; clypeus yellow, with sparse erect long dark hairs. Antenna long, dark brown proximally, pale reddish-brown medially, blackish-brown distally, with slightly defined club, densely covered with short dark hairs; scape and pedicel dark brown; flagellum comprising approximately 30–35 flagellomeres. Mouthparts yellow; labrum with several brown hairs; maxillary palpus yellow to pale brown; 3rd labial palpomere spindle-shaped, tapering to acute apex, with brown

circular palpimacula at middle; submentum with long dark hairs.

Thorax. Pronotum (Fig. 2D) slender, longer than broad, pale brown, slightly darker along posterior margin, moderately covered with long dark hairs and short pale brown hairs. Cervical sclerites dark brown. Meso- and metanotum pale brown, with dark brown

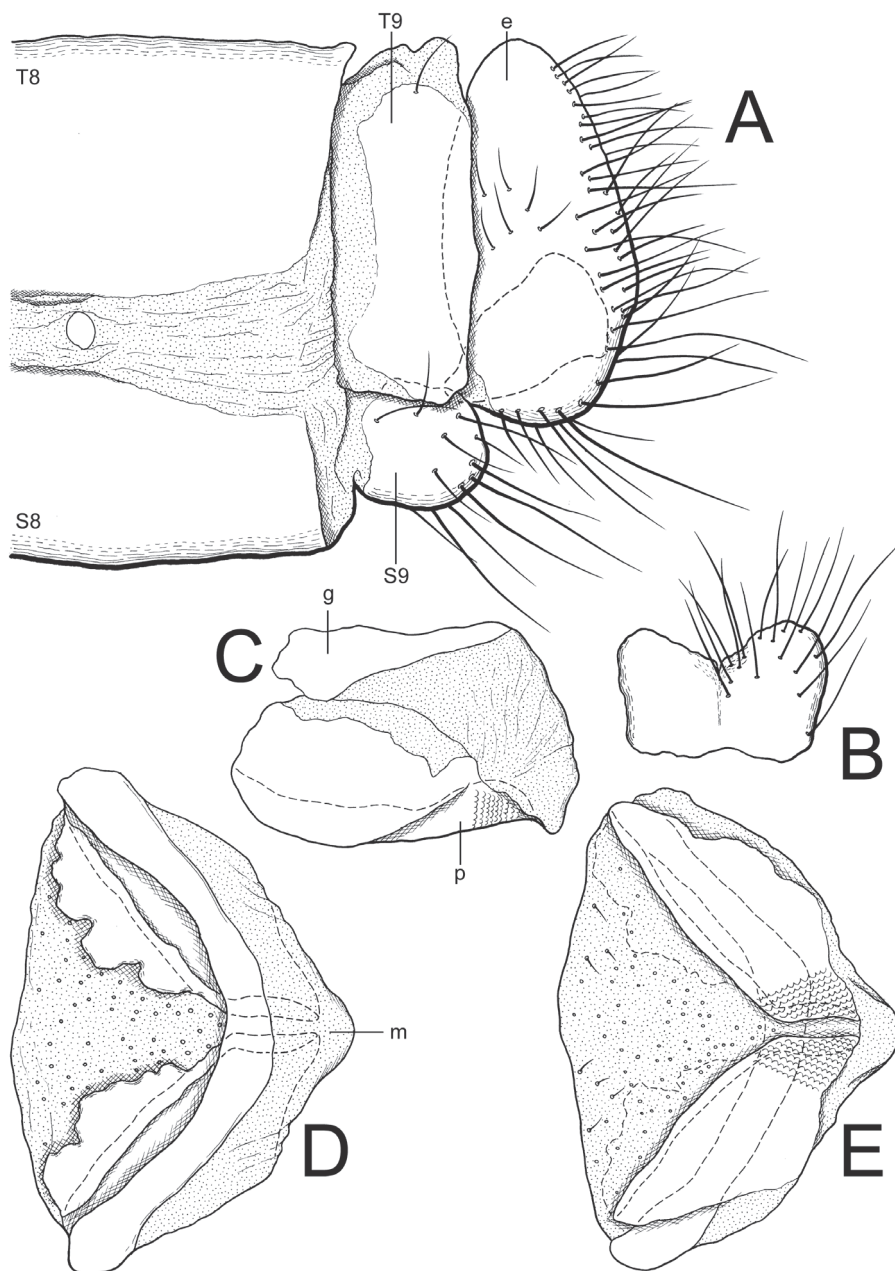


Fig. 16. Male terminalia of *Dendroleon pupillaris*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

longitudinal middle stripe extending from mesoscutellum to metascutellum, with sparse dark hairs. Meso- and metapleuron pale yellow, with broad dark brown longitudinal middle stripe, moderately covered with long dark and pale yellow hairs.

Legs. Yellow, long, slender. Coxae pale yellow, densely covered with long pale yellow hairs; fore coxa brown on outer surface; mid- and hind coxae with dark brown portion dorsally. Femora densely covered with short dark hairs, mixed with sparse long black setae; fore femur dark brown distally and dorsally; mid femur largely dark brown, yellow at proximal end; hind femur dark brown distally, with dark brown longitudinal stripe on anterior and posterior surfaces; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae densely covered with short dark hairs, mixed with sparse long black setae; fore tibia slightly dark brown at proximal end, with dark brown band near proximal end; mid tibia slightly dark brown at proximal and distal ends, with dark brown band near proximal end; hind tibia slightly brown at proximal and distal ends. Tibial spurs pale brown proximally, reddish-brown distally, long, slender, slightly curved distally, approximately as long as or slightly longer than combined length of Ta1–Ta2. Tarsi dark brown, Ta1 and Ta2 yellow, densely covered with short dark hairs; Ta1 approximately as long as combined length of Ta2–Ta4, Ta5 shorter than combined length of Ta1–Ta4. Claws pale brown proximally, reddish-brown distally, long, slender, simple, almost straight, approximately 1/3 as long as tibial spurs.

Wings (Fig. 2C). Forewing attractively marked with shades of brown, rather rounded at apex; veins and crossveins alternating with pale white and brown areas; membrane marked with shades of brown, large semicircular brown band extending from anastomosis of CuA2 and CuP+1A to middle of posterior margin, small brown spots scattered from rhexma area to apical area, some linear brown spots in subcostal cell; costal area simple, distal crossveins sometimes branched; presectoral area with 3–4 crossveins and 0–3 irregular cells; Rs arising well before CuA fork, with 9–14 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–4 cells before fusing with 1A; 2A and 3A separate, connected by 1–2 crossveins; hypostigmatic cell long; pterostigma white, with proximal prominent brown spot; anterior Banksian line distinct, posterior Banksian line absent. Hindwing approximately as long as forewing, narrower than forewing; large brown marking extending from proximal part of pterostigma to posterior margin; small brown marking at apex; presectoral area with 1 crossvein; Rs arising well before MP fork, with 9–13 branches from origin of Rs to hypostigmatic cell; hypostigmatic cell longer; anterior Banksian line distinct, posterior Banksian line absent; male with pilula axillaris.

Abdomen. Shorter than hindwing, pale brown, darker distally, densely covered with dark hairs.

Terminalia (Fig. 16AB): tergite IX narrow in lateral view, divided dorsally; sternite IX short in lateral view, bilobed posteriorly in ventral view; ectoproct deep, elongate oval, simple in lateral view. Genitalia (Fig. 16C–E): gonarcus smoothly arched; mediuncus prominent; parameres broad, flattish, well sclerotized posteriorly.

*Length*: B, 26–30; FW, 30–34; HW, 30–34.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent. Terminalia (Fig. 17AB): tergite IX narrow, small in lateral view, divided dorsally; ectoproct simple, oval in lateral view, without fossorial bristles; a pair of gonapophyses present below tergite IX; lateral gonapophyses slightly defined, without fossorial bristles; posterior gonapophyses long, slender, finger-

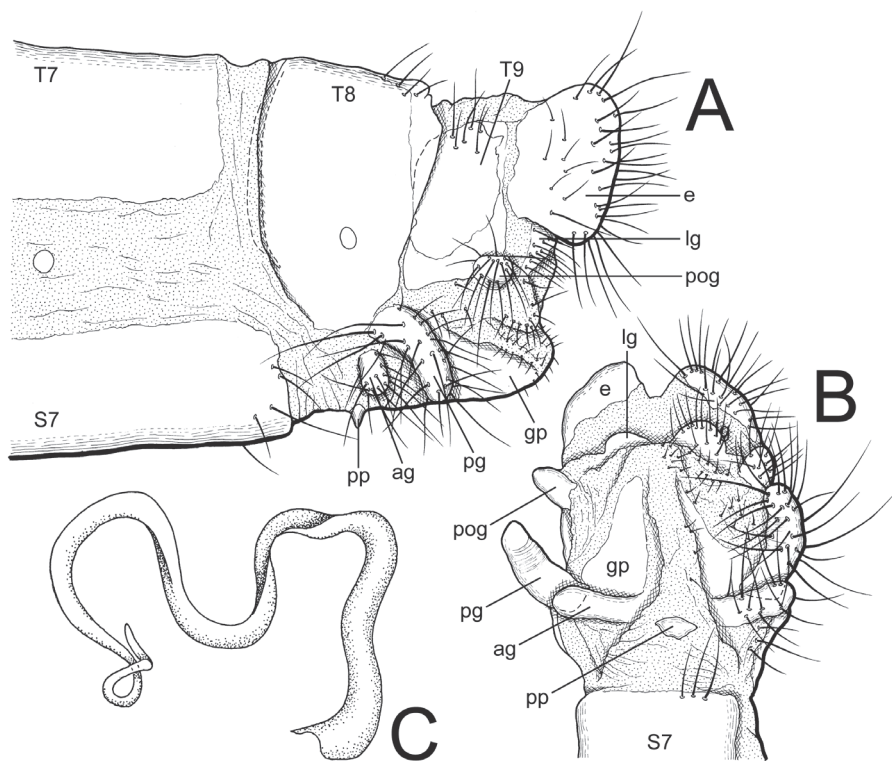


Fig. 17. Female terminalia of *Dendroleon pupillaris*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

like, slightly curved, with long dark hairs; anterior gonapophyses short, shorter than posterior gonapophyses, with long dark hairs; gonapophyseal plates arched in lateral view, broadened anteriorly in ventral view; pregenital plate small, triangular, present on membrane below tergite VIII in lateral view; spermatheca (Fig. 17C) short, tube-shaped.

*Length:* B, 25–31; FW, 31–39; HW, 31–39.

*Specimens examined.* 2♀ (NSMT), no other data. [Hokkaido] 1♀, Maruyama, Sapporo, 11. viii. 1926, Uchida; 1♂, same locality, 8. viii. 2002, T. Kanbe. [Honshu] 1♂, Nishimeya, Aomori, 16. ix. 1988, T. Nakamura; 1♀ (NSMT), Miyagi, viii. 1934, T. Tanaka; 1♂ (NSMT), Higashiyama, Aizuwakamatsu, Fukushima, 1. viii. 1956, M. Kono; 1♀ (NSMT), Katsuta, Ibaraki, 14. viii. 1931, T. Tani; 1♀ (NSMT), Kairakuen, Mito, Ibaraki, 22. vii. 1934, T. Tani; 1♂, Tokyo, no data, S. Matsumura; 1♀ (NSMT), Inokashira, 20. ix, year and collector unknown; 1♀, Hikawa, Ogochi, 17. viii. 1933, S. Matsumura; 1♀ (NSMT), Mt. Takao, 4. vii. 1954, H. Hirai; 1♀ (NSMT), Kanagawa, vi. 1958, Muranaka; 1♂ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♀ (NSMT), Karuizawa, 26. viii. 1971, Shimomura; 1ex, Gifu, no other data; 1♂, Tentakuji, Inagawa, Hyogo, 19. vii. 1984, S. Tsukaguchi; 1♀ (NSMT), Kyushogan, Tottori, vi. 1955, K. Nishimura; 1♂, Mt. Hohki-daisen, Tottori, 23. vii. 1958, H. Toshima. [Shikoku] 1ex, Iyo, Arakawa, no data, S. Matsumura; 1♀, Mt. Ohtaki, Kagawa, 8. viii. 1958, H. Toshima.

*Distribution.* Japan (Hokkaido, Honshu, Sadogashima Is., Shikoku, Kyushu).

*Remarks.* Wang & Wang (2008) described *Dendroleon motuoensis* Wang & Wang



from Tibet, China. According to Wang & Wang (2008), this species resembles *De. pupillaris* but differs from the latter by the following character states: *De. pupillaris* has much smaller and less dispersed spots on forewing, whereas those of *De. motuoensis* are much larger and more dispersed; the eye-shaped mark of *De. pupillaris* presents a continuous and rather distinct semicircular marking, whereas *De. motuoensis* presents an intermittent and indistinct semicircular marking; in *De. pupillaris*, a spot located behind the hindwing C-shaped mark is very small and indistinct, whereas the spot of *De. motuoensis* is large and distinct; pronotum of *De. pupillaris* is trapeziform, whereas, in *De. motuoensis*, the anterior 1/3 of pronotum has an indistinct furrow with anterior part quadrate. However, states of these characters are highly variable and also observed in Japanese *De. pupillaris*. Moreover, external features of Japanese specimens of *De. pupillaris* agree with the original description of *De. motuoensis*. Therefore, they might represent same species, and this possibility has to be tested based on type materials. As pointed out by Wang & Wang (2008), these two species are isolated geographically (*De. pupillaris* is widely distributed in Japan, but *De. motuoensis* is found only in Tibet). Japan and Tibet are located at the eastern and western ends of the Sino-Japanese Region (Good 1953). Some relict insects are known to show the Sino-Japanese distributional pattern (e.g., Sano & Akimoto 2005; Büsse *et al.* 2012). It would therefore not be surprising if *De. pupillaris* is also distributed in Tibet.

In having the brown patterned wings, this species is similar to *Gatzara jezoensis* (Okamoto, 1910) but can be easily distinguished from it by the larger body size, the color pattern of the pronotum (Fig. 2D), the larger brown marking of hindwing (Fig. 2C), and, in males, by the posteriorly bilobed sternite IX (Fig. 16B), and, in females by the longer posterior gonapophyses and the absence of thickened hairs on the lateral gonapophyses (Fig. 17AB).

This species is very similar to *Dendroleon pantherinus* (Fabricius, 1787) and *De. similis* Esben-Petersen, 1923 but is different from them in the wing pattern (Fig. 2C).

#### Genus *Gatzara* Navás

*Gatzara* Navás, 1915: 385. Type species: *Gatzara jubilaea* Navás, 1915, by original designation and monotypy.

*Diagnosis.* Medium to large-sized antlions; antenna long; pronotum longer than broad; wings moderately broad, hyaline, marked with shades of brown; costal area of both wings simple, distal crossveins branched; forewing presectoral area with usually 3–4 crossveins; forewing vein Rs arising before CuA fork; forewing veins 2A and 3A separate, usually connected by 1–2 crossveins; hindwing presectoral area usually with 1 crossvein; hindwing vein Rs arising well before MP2 fork; male with pilula axillaris; legs long, slender; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs usually approximately as long as combined length of Ta1–Ta2; male ectoproct simple, without postero-ventral lobe; gonarcus somewhat hooded; mediuncus large, situated between parameres; parameres usually broad, plate-shaped; female ectoproct simple; a pair of gonapophyses present below tergite IX; lateral gonapophyses present; posterior gonapophyses long; anterior gonapophyses approximately as long as or longer than posterior gonapophyses; gonapophyseal plates well developed; spermatheca short.

*Remarks.* The genus *Gatzara* comprises 11 species described from India (3 species),

China (5), Vietnam (1), Taiwan (1) and Japan (1) (Stange 2004; Wang *et al.* 2012).

The adults of *Gatzara* very closely resemble *Dendroleon* but can be distinguished from it by the length of the female anterior gonapophyses (Stange 2004: approximately as long as or longer than the posterior gonapophyses in *Gatzara*, whereas shorter than the posterior gonapophyses in *Dendroleon*) and the presence of dense thickened setae on the female lateral gonapophyses. These differences in female terminalia are probably related to the egg-laying habit on bare rock (Stange *et al.* 2003). Moreover, Stange (2008) pointed out that the larvae of both genera are different morphologically and biologically. According to Stange (2008), the larvae of *Gatzara* lack the specialized patch of setae at the middle of the mesoscutum, and mandible has secondary setae bearing teeth. They live on lichen covered bare rock surface and use lichen as camouflage. On the other hand, the larvae of *Dendroleon* have the specialized patch of setae on the middle of the mesoscutum, and their mandible lacks secondary setae bearing teeth. The larvae live under rock overhangs or in caves with fine dust.

In having elongate female anterior gonapophyses, this genus is similar to *Nepsalus* but is different from it in the wing shape (Stange *et al.* 2003: forewing is strongly emarginated along posterior margin and hindwing is greatly broadened near the middle in *Nepsalus*, but not so highly modified in *Gatzara*).

*Gatzara jezoensis* (Okamoto)  
(Figs 2EF, 18, 19)

*Glenurus jezoensis* Matsumura, 1908: 41. nom. nud.

*Dendroleon jezoensis* Okamoto, 1910: 280, figs. 5, 5a; Baba, 1953: 18; Baba & Edashige, 1954: 51; Kuwayama, 1962: 383; 1966: 138; Stange, 1976: 294; Krivokhatsky, 2011: 100.

*Gatzara jezoensis*: Miller *et al.*, 1999: 52; Stange, 2004: 91; Hayashi, 2013: 194; Yoshitomi *et al.*, 2013: 2.

(For further literature, see Kuwayama, 1962: 383.)

*Redescription.* Male. Head. Vertex slightly raised, whitish-yellow to pale brown, with pair of shiny dark brown spots on each postero-lateral corner, with sparse short dark hairs; occiput yellow. Frons yellow, with broad transverse shiny dark brown band at middle, with moderate dark hairs; gena mostly brown to dark brown; clypeus yellow, with sparse erect long dark hairs. Antenna long, dark brown proximally, pale reddish-brown medially, blackish-brown distally, with slightly defined club, densely covered with short dark hairs; flagellum comprising approximately 35 flagellomeres. Mouthparts yellow; labrum with several brown hairs; maxillary palpus yellow to brown; 3rd labial palpomere dark brown, spindle-shaped, tapering to acute apex, with brown circular palpimacula at middle; submentum with long dark hairs.

Thorax. Pronotum (Fig. 2F) slender, much longer than broad, whitish-yellow, dark brown longitudinal midline sometimes interrupted at anterior transverse furrow, pair of faint dark longitudinal stripes on each side of midline extending from anterior transverse furrow to posterior margin, which often almost indistinct, anterior surface densely spotted with pale dark brown, lateral margin bordered with dark brown stripe, moderately covered with long dark hairs and short pale yellow hairs. Cervical sclerites dark brown. Mesonotum whitish-yellow, with sparse dark hairs; mesoprescutum with 2 pairs of dark brown spots, one at each antero-lateral surface, the other at middle; mesoscutum with

dark brown spot at middle, pair of posteriorly curved dark brown stripes on each anterior surface, pair of small dark brown spot above each wing base; mesoscutellum with broad median dark brown stripe, which sometimes connected with median dark spot of mesoscutum anteriorly; mesopostnotum with narrow dark brown midline. Metanotum whitish-yellow, almost hairless: metascutum with large dark brown marking at middle, sometimes pair of longitudinal dark brown stripes extending from anterior margin to median dark brown marking; metascutellum mostly dark brown. Meso- and metapleuron pale yellow, with broad longitudinal dark brown stripe, moderately covered with long dark and pale yellow hairs.

Legs. Yellow, long, slender. Coxae pale yellow, moderately covered with long dark hairs; fore coxa dark brown on outer surface; mid- and hind coxae with dark brown portion dorsally. Femora moderately covered with short dark hairs, mixed with sparse long black setae; fore femur dark brown distally, with longitudinal dark brown stripe on dorsal surface; mid- and femora largely dark brown, yellow at proximal end, with yellow ring near distal end; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia slightly dark brown at proximal end, with dark brown band at middle, with dense short pale brown setae distally; mid- and hind tibiae slightly dark brown at proximal and distal ends, with dark brown band near proximal end. Tibial spurs pale brown proximally, reddish-brown distally, long, slender, slightly curved distally, approximately as long as or slightly longer than combined length of Ta1–Ta2. Tarsi pale, each tarsomere brown distally, Ta3 to Ta5 darker, densely covered with short dark hairs, mixed dense short black setae on ventral surface of Ta5, Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 much shorter than combined length of Ta1–Ta4. Claws pale brown proximally, reddish-brown distally, long, slender, simple, almost straight, approximately 1/3 as long as tibial spurs.

Wings (Fig. 2E). Forewing rather round at apex; veins and crossveins mostly brown with some pale white areas, except for almost brown MP; membrane marked with shades of brown, brown marking at anastomosis of CuA2 and CuP+1A, dark brown spot of rhegma area sometimes fused with larger outer brown marking, irregular small brown spots near apex, some liner spots in subcostal cell; costal area simple, distal crossveins branched; presectoral area with 3–5 crossveins and 0–2 irregular cells; Rs arising well before CuA fork, with 8–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–2 cells before fusing with 1A; 2A and 3A separate, connected by 1 crossvein; hypostigmatic cell long; pterostigma white, with proximal brown band; anterior Banksian line well developed, posterior Banksian line absent. Hindwing approximately as long as forewing, narrower than forewing; posterior margin slightly falcate near apex; brown markings present only on distal 1/3; presectoral area with 1 crossvein; Rs arising well before MP fork, with 9–11 branches from origin of Rs to hypostigmatic cell; anterior Banksian line well developed, posterior Banksian line absent; male with pilula axillaris.

Abdomen. Shorter than hindwing, moderately covered with dark hairs proximally, denser distally, whitish-yellow to pale brown, darker distally, tergite I with median dark brown spot, tergite II dark brown laterally, sometimes connected with median dark brown spot posteriorly, tergite III to VI with two triangular brown markings anteriorly and posteriorly.

Terminalia (Fig. 18AB): tergite IX narrow in lateral view, divided dorsally; sternite



IX rounded along posterior margin in ventral view; ectoproct deep, elongate oval, simple in lateral view. Genitalia (Fig. 18C–F): gonarcus smoothly arched; mediuncus prominent; parameres broad, flattish, well sclerotized posteriorly.

*Length:* B, 18–23; FW, 22–27; HW, 22–26.

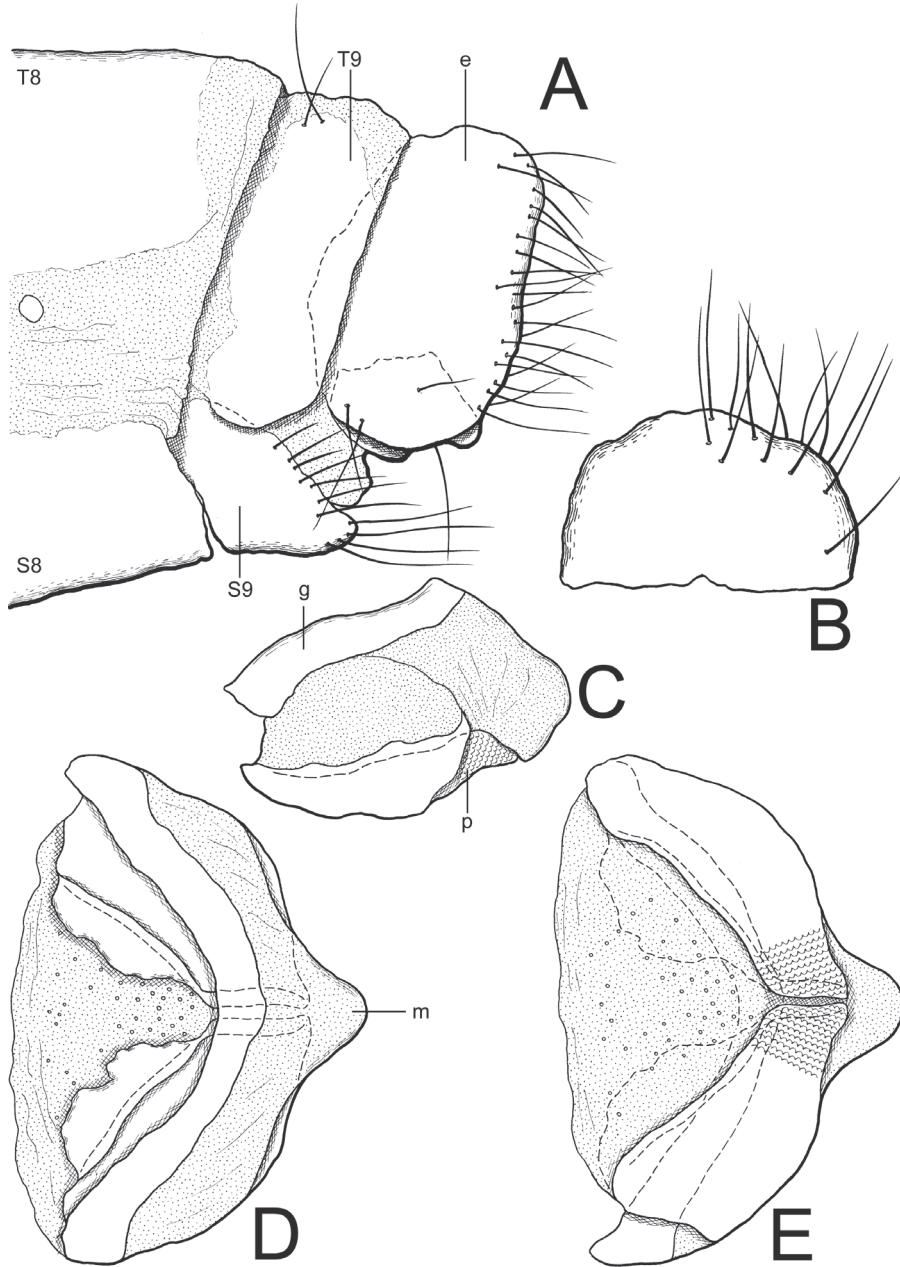


Fig. 18. Male terminalia of *Gatzara jezoensis*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

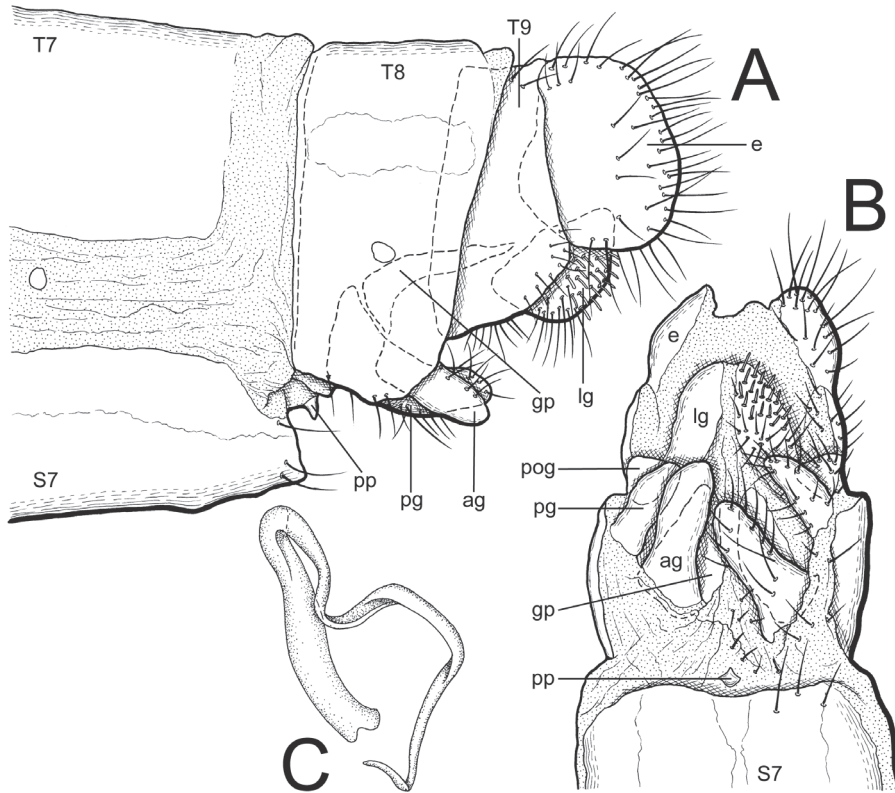


Fig. 19. Female terminalia of *Gatzara jezoensis*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent. Terminalia (Fig. 19AB): tergite IX narrow in lateral view, divided dorsally; ectoproct oval in lateral view, without fossorial bristles; a pair of gonapophyses present below tergite IX; lateral gonapophyses rounded in lateral view, with dense brown thickened setae; posterior gonapophyses long, finger-like; anterior gonapophyses long, finger-like, approximately as long as posterior gonapophyses; gonapophyseal plates arched in lateral view; pregenital plate small, triangular, present on membrane below tergite VIII in lateral view; spermatheca (Fig. 19C) short, tube-shaped.

*Length:* B, 23–24; FW, 27–31; HW, 27–31.

*Specimens examined.* Lectotype ♂ (SEHU), *Gatzara jezoensis* (Okamoto). Verbatim label data: “3/IX/1904 / Nikko”; “*Dendroleon / jezoensis / (MATS.) n. sp. / det H. OKAMOTO / COTYPE 1910*”; “Lecto-type / *Dendroleon / jezoensis OKAM / (MATS.) / det. KUWAYAMA ‘65*”. [Hokkaido] 1♂, Jyozankei, Sapporo, 11–14. ix. 1918, S. Matsumura; 1ex, Sapporo, no data, S. Matsumura. [Honshu] 1♂, Meya-dam, Nishimeya, Aomori, 15. viii. 1989, T. Nakamura; 3♂ 3♀ (NSMT), Nippara, Okutama, Tokyo, 15. v. 1983 (larvae collected: 1♂, pupate 23. v. 1983, emerged on 18. vi. 1983; 1♂, pupate 24. v. 1983, emerged on 21. vi. 1983; 1♂, pupate 26. v. 1983, emerged on 22. vi. 1983; 1♀, pupate 24. v. 1983, emerged on 20. vi. 1983; 1♀, pupate 28. v. 1983,

emerged on 27. vi. 1983; 1♀, pupate 30. v. 1983, emerged on 27. vi. 1983), M. Owada; 1♀ (NSMT), Nippara, Okutama, Tokyo, 21. ix. 1976, M. Tomokuni; 1♀ (NSMT), Mt. Tenso-zan, Okutama, Tokyo, 22. ix. 1976, Y. Kurosawa; 1♀ (NSMT), Mt. Takao, Tokyo, 25. ix. 1954, H. Hirai; 1♀ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♀ (NSMT), Yashajin-Pass, Yamanashi, 8. viii. 1956, M. Kobayashi; 1♀ (NSMT), Oyabukosen, Yamanashi, 17. viii. 1957, H. Naora; 1♂, Hinoharu, Yamanashi, 20. vii. 1979, S. Tsukaguchi; 1♀ (NSMT), Kuzuonsen, Nagano, 15. viii. 1955, M. Ogata; 1♀ (NSMT), Kakuma, Shinano, 8–10. viii. 1956, K. Fujimoto; 2♀ (NSMT), Haizawa-onsen, Kiso, 30. viii. 1967, collector unknown; 1♀, Umegashima Spa, Shizuoka, 30. ix. 1996, T. Nakamura; 1♂, same locality, 1. x. 1996, T. Nakamura; 1♀, Mt. Makio-san, Osaka, 18. ix. 1980, S. Tsukaguchi; 1♀, same locality, 4. viii. 1982, S. Tsukaguchi; 2♀, Daisen, Tottori, 18. viii. 1922, S. Matsumura. [Kyushu] 1♀, Kirishimajingu, Kagoshima, 16. vii. 1976, S. Tsukaguchi.

*Distribution.* Japan (Hokkaido, Honshu, Shikoku, Kyushu); Korea, China, Russian Far East.

*Remarks.* This species is similar to *Gatzara decorilla* (Yang, 1997) and *G. decorosa* (Yang, 1988), both from China, in general appearance, but is different from them by the coloration of vertex and the wing length (forewing length 23–31 mm in *G. jezoensis*, whereas 27–36 mm in *G. decorilla* and 38–40 mm in *G. decorosa*). Wang *et al.* (2012) also referred to the outer margin of wings for their diagnosis (slightly protuberant in *G. jezoensis*, whereas slightly concave in *G. decorilla* and *G. decorosa*). However, slight concavity is also sometimes present in *G. jezoensis*. This character state therefore seems to be insufficient for distinguishing these species.

In having a small body, *G. jezoensis* closely resembles *G. caelestis* (Krivokhatsky, 1997) from Vietnam but differs from it by the wing pattern (Fig. 2E). This species is also similar to *Dendroleon pupillaris* in having brown-patterned wings but can be easily distinguished from it by external features (see Remarks of *De. pupillaris*).

### Genus *Epacanthaclisis* Okamoto

*Epacanthaclisis* Okamoto, 1910: 285. Type species: *Acanthaclisis moiwana* Okamoto, 1905 (as “*Acanthaclisis moiwasana* [sic] (Mats.)”), by original designation.  
(For further synonymies, see Stange, 2004: 87.)

*Diagnosis.* Medium to large-sized antlions; wings moderately broad, hyaline; forewing costal area biareolate, distal crossveins branched; forewing presectoral area with approximately 5 crossveins and a few irregular cells; forewing vein Rs arising before CuA fork, sometimes almost opposite; forewing veins 2A and 3A separate, usually connected by 2 crossveins; hindwing costal area simple, distal crossveins branched; hindwing presectoral area usually with 1–2 crossveins; hindwing vein Rs arising before MP2 fork; male with pilula axillaris; femoral sense hair present in all legs; male often with hair pencils or tuft on dorsal surface of tergite IV; male ectoproct elongate oval, sometimes lobed postero-ventrally; gonarcus arched in dorsal view; mediuncus present between parameres; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses large, long; anterior gonapophyses small; gonapophyseal plates well developed; spermatheca slender.

*Remarks.* This Palaearctic genus comprises 13 species, most of which are known from China (Stange 2004; Ao *et al.* 2010). This genus is well characterized by the combination of the following unique character states: biareolate forewing costal area;

presence of femoral sense hair on hind femur; males of some species with hair pencils or tuft on dorsal surface of tergite IV.

Although Krivokhatsky (1998) described “male genitalia with mediuncus situated between paired parameres”, the figures of male genitalia given by Krivokhatsky (1998) were not labeled. Consequently, Ao *et al.* (2010) speculated that the mediuncus named by Krivokhatsky (1998) is not homologous with the mediuncus defined by Aspöck *et al.* (1980a, 1980b). Based on this interpretation, Ao *et al.* (2010) mentioned that “genitalia without mediuncus between a pair of parameres”. The presence of mediuncus situated between a pair of parameres in *E. moiwana* (Fig. 20C–F) is confirmed here. Moreover, I recognized the unlabeled mediuncus illustrated in the figures of male genitalia given by Krivokhatsky (1998). Therefore, in the figure of male genitalia given by Ao *et al.* (2010), I interpret that ‘gs (= gonarucus)’ and ‘pa (= parameres)’ in fig. 2D correspond to parameres and mediuncus, respectively.

*Epacanthaclisis moiwana* (Okamoto)  
(Figs 2GH, 20, 21)

*Acanthaclisis moiwanus* [sic] Okamoto, 1905: 115.

*Acanthaclisis moiwasanus* [sic]: Matsumura, 1908: 40.

*Epacanthaclisis moiwasana* [sic], Okamoto, 1910: 285, fig. 1; Esben-Petersen, 1935: 234.

*Distoleon tetragrammicus*: Esaki *et al.*, 1938: 127 [not *Distoleon tetragrammicus* (Fabricius, 1798)].

*Epacanthaclisis* [sic] *moiwasana* [sic]: Banks, 1941: 2.

*Epacanthaclisis moiwana*: Kuwayama, 1962: 389; 1966: 139; Ao *et al.*, 2010: 51; Yoshitomi *et al.*, 2013: 2.

*Epacanthaclisis moiwanus* [sic]: Hölzel, 1972: 10; Stange, 1976: 297; Krivokhatsky, 1998: 40; Stange, 2004: 89.

(For further literature, see Kuwayama, 1962: 389.)

*Redescription*. Male. Head. Vertex moderately raised, rounded, brown to dark brown, with two pairs of yellow markings, one at middle, the other along posterior margin, moderately covered with short dark hairs; occiput dark brown dorsally, yellow to brown ventrally. Frons yellow to pale brown, with broad dark brown marking extending from vertex to below base of antenna, emarginate ventrally at middle, moderately covered with white hairs; gena yellow, dark brown dorsally; clypeus yellow, with sparse erect long dark hairs. Antenna blackish-brown, long, with slightly defined club, densely covered with short dark hairs, short white hairs present from scape to approximately fifth proximal flagellomere; scape with yellow portion dorsally; flagellum comprising approximately 42 flagellomeres, each flagellomere with distal whitish-yellow annulation. Mouthparts yellow: labrum with brown hairs; 3rd, 4th and 5th maxillary palpomeres brown to dark brown; cardo with dark brown spot at distal end; stipes with dark brown spot at proximal end; 3rd labial palpomere dark brown to blackish-brown, yellow distally, spindle-shaped, tapering to acute apex, with palpimacula on distal 1/3; submentum with long white and dark hairs.

Thorax. Pronotum (Fig. 2H) broad, approximately as long as wide, yellow, median longitudinal dark grayish-brown stripe broadened anteriorly, sometimes including narrow yellow midline, 2 pairs of dark grayish-brown spots on each side of median longitudinal stripe sometimes fused with each other, lateral margins dark grayish-brown, moderately

covered with short hyaline hairs and long dark hairs. Cervical sclerites dark grayish-brown. Mesonotum dark grayish-brown to blackish-brown, sparsely covered with long dark hairs; mesoprescutum with yellow portion on each lateral surface; mesoscutum with two pairs of yellow spots at middle, several long hyaline hairs on posterior surface; mesoscutellum sometimes with pair of yellow spots postero-laterally. Metanotum dark grayish-brown to blackish-brown, with sparse long hyaline hairs; metascutum with pair of yellowish-brown spots at middle. Meso- and metapleuron mostly pale dark brown to dark grayish-brown, except for some whitish-yellow portions, densely covered with long white hairs.

Legs. Yellow, short. Coxae with brown to dark brown spot on outer surface, densely covered with long white hairs. Femora dark brown at distal end, densely covered with short dark hairs, long white setae and long black setae; femoral sense hair present in all legs. Tibiae densely covered with short dark hairs and long black setae, mixed with sparse white hairs; fore tibia dark brown at proximal and distal ends, with dark brown band at proximal 1/3; mid tibia dark brown at distal end, with dark brown band at proximal 1/3; hind tibia dark brown at distal end, with narrow dark brown band at proximal 1/3, which often almost indistinct, without white hairs. Tibial spurs brown proximally, reddish-brown distally, long, slender, slightly curved, in fore- and midlegs approximately as long as combined length of Ta1–Ta3 to Ta1–Ta4, in hindleg approximately as long as combined length of Ta1–Ta2 to Ta1–Ta3. Tarsi dark brown to blackish-brown, Ta1 and Ta5 yellow to brown proximally, densely covered with black hairs dorsally, short black setae ventrally, mixed with white hairs proximally; in fore- and mid tarsi Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as combined length of Ta1–Ta4; in hind tarsus Ta1 approximately as long as combined length of Ta2–Ta4, Ta5 shorter than combined length of Ta1–Ta4, without white hairs. Claws reddish-brown, long, slender, simple, slightly curved, approximately 2/3 as long as tibial spurs.

Wings (Fig. 2G). Forewing round at apex; veins and crossveins mostly dark brown, with some yellowish-white areas, Sc finely alternating dark brown to blackish-brown and yellow, R alternating blackish-brown and yellow; 2 grayish-brown oblique streaks, one at riegma area, the other at anastomosis of CuA2 and CuP+1A, several faint dark liner spots in subcostal cell, veins irregularly shaded with grayish-brown along posterior margin; costal area biareolate, distal crossveins branched; presectoral area with 3–6 crossveins and 1–8 irregular cells; Rs arising before CuA fork, sometimes almost opposite, with 8–13 branches from origin of Rs to hypostigmatic cell; CuP supporting 1–2 cells before fusing with 1A; 2A and 3A separate, connected by 2 crossveins; hypostigmatic cell long; pterostigma yellowish-white, with dark brown proximal spot; anterior Banksian line distinct, posterior Banksian line often indistinct. Hindwing approximately as long as forewing, narrower than forewing; only one grayish-brown oblique streak at riegma area; costal area simple, distal crossveins branched; presectoral area with 1–3 crossveins; Rs arising before MP2 fork, with 8–12 branches from origin of Rs to hypostigmatic cell; pterostigma without dark brown proximal spot; anterior Banksian line distinct, posterior Banksian line often indistinct; male with pilula axillaris.

Abdomen. Shorter than hindwing, densely covered with dark hairs, long white hairs mixed proximally, segments I to IV yellow to pale yellowish-brown, following segments brown to dark brown, with yellow posterior margin, tergite V distinctly inflated without hair-pencils or tuft on dorsal surface.



Terminalia (Fig. 20AB): tergite IX almost square, ventral margin smoothly rounded, postero-dorsal margin slightly lobed posteriorly in lateral view, divided dorsally; sternite IX rather rounded at apex in ventral view; ectoproct elongate oval, lobed postero-ventrally in lateral view, with dark and hyaline hairs postero-dorsally, dense long dark setae postero-ventrally. Genitalia (Fig. 20C–F): gonarcus large, broad, arched; mediuncus

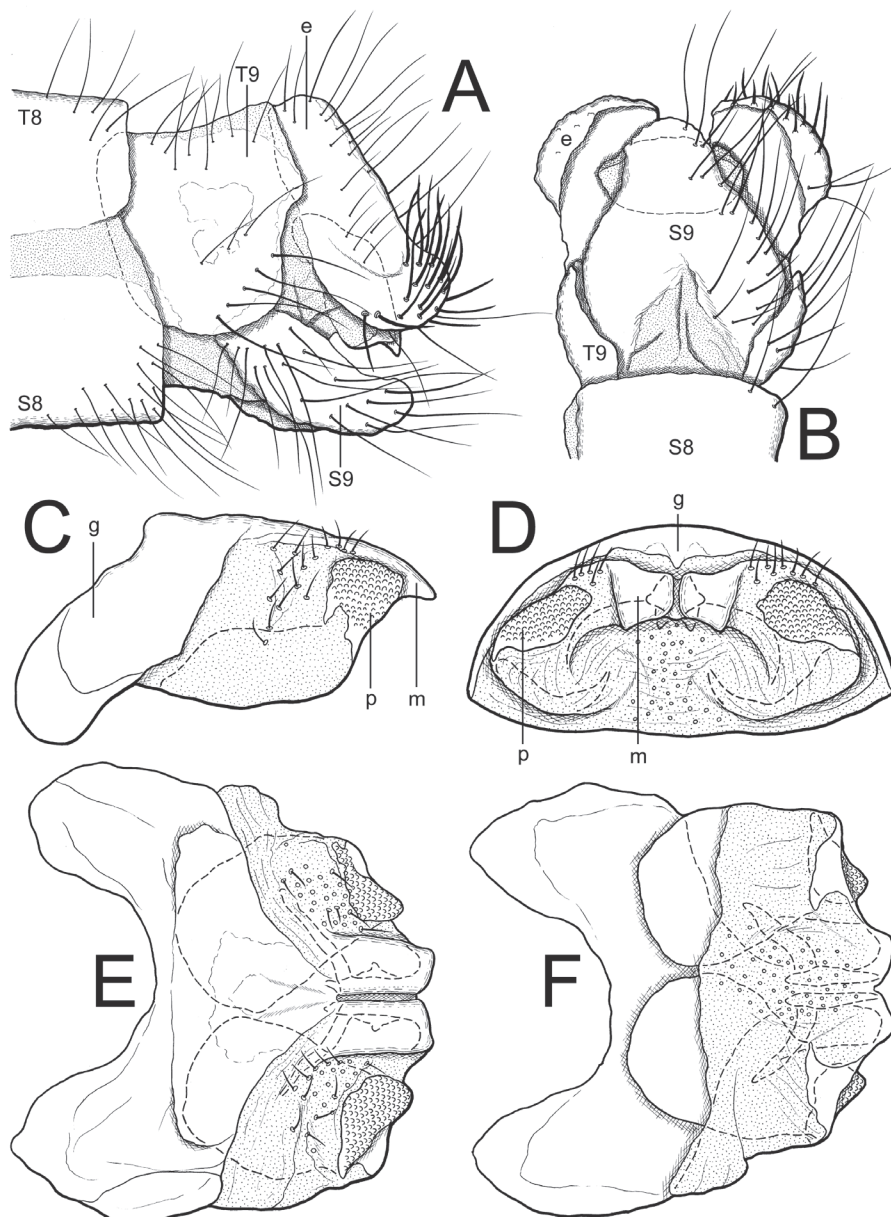


Fig. 20. Male terminalia of *Epacanthaclisis moiwana*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

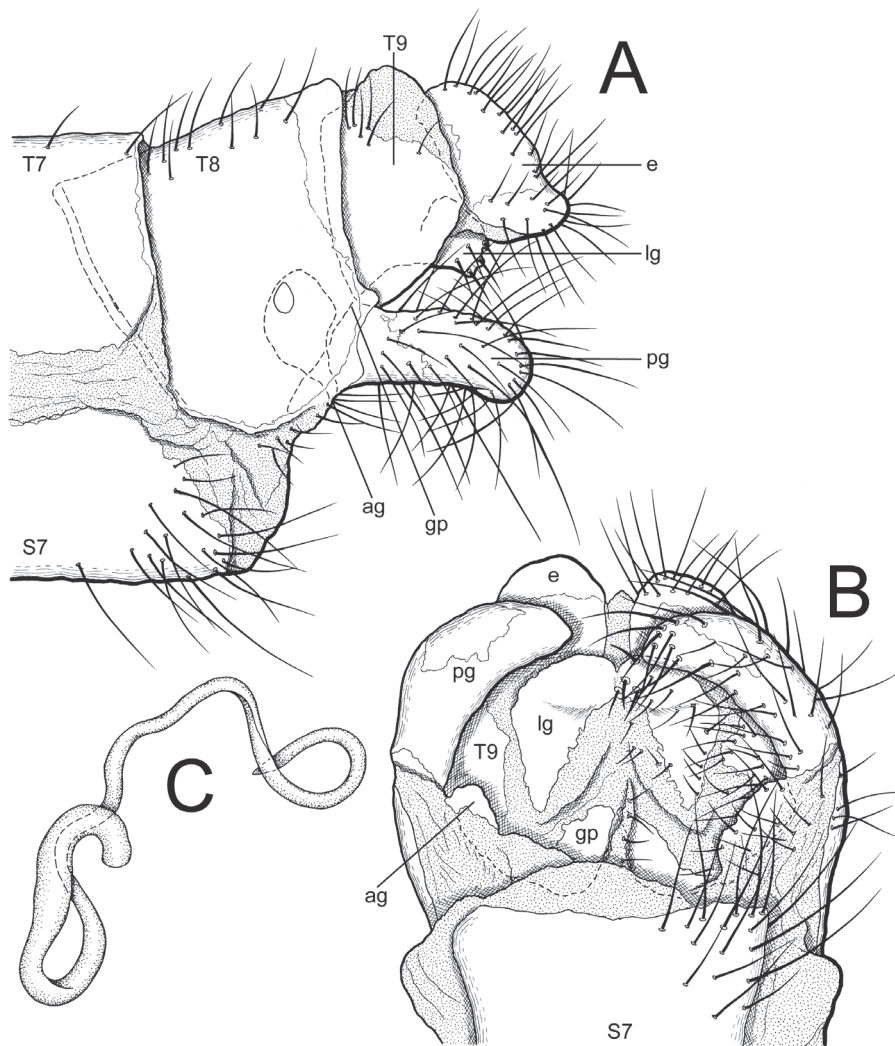


Fig. 21. Female terminalia of *Epacanthaclisis moiwana*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

present between parameres, well developed and sclerotized; parameres black posteriorly, densely arranged with minute punctations.

*Length*: B, 34–45; FW, 36–44; HW, 35–43.

**Female.** Almost as in male, but coloration darker; wings slightly broader; abdomen dark grayish-brown to blackish-brown, paler proximally, densely covered with dark hairs, mixed with long white hairs on segments I to III. Terminalia (Fig. 21AB): sternite VIII with dense long black setae posteriorly; tergite IX narrow in lateral view, divided dorsally; ectoproct oval, with slight ventral lobe in lateral view, with long black setae posteriorly, without fossorial bristles; lateral gonapophyses long in lateral view, broad, with dense long black fossorial setae posteriorly; posterior gonapophyses

long, finger-like, curved in ventral view, with dense long dark hairs proximally, long black setae distally; anterior gonapophyses small in ventral view, with dense long black setae; gonapophyseal plates large, broad; pregenital plate well sclerotized, present on membrane just below anterior margin of tergite VIII in lateral view; spermatheca (Fig. 21C) short, apically slender, with well sclerotized base.

*Length:* B, 29–37; FW, 38–42; HW, 38–41.

*Specimens examined.* Lectotype ♀ (SEHU), *Epacanthaclisis moiwana* (Okamoto). Verbatim label data: “Sapporo / Matsum”; “Jyozan”; “*Acanthaclisis moiwanus* n. sp. / det H. OKAMOTO / COTYPE 1906”. Other specimens. 1ex, no other data; 1♂ (NSMT), no other data; 1♂, Azumayama, 8. viii. 1931, S. Kato. [Hokkaido] 1♀, Jozankei, Sapporo, 11–14. ix. 1918, S. Matsumura; 1♀, Mt. Teine, Sapporo, 23. viii. 2002, G. Ito. [Honshu] 1♀ (NSMT), Kushiishiyama, Ajigasawa, Nishitsugaru-gun, Aomori, 6. viii. 1986, A. Abe; 2♀, Meya-dam, Nishimeya, Aomori, 15. viii. 1989, T. Nakamura; 1♀, same locality, 16. viii. 1989, T. Nakamura; 1♀, same locality, 19. viii. 1989, T. Nakamura; 1♂, same locality, 21. viii. 1989, T. Nakamura; 1♀, same locality, 8. ix. 1989, T. Nakamura; 1♀ (NMST), Noda-mura, Iwate, 29. vii. 1955, K. Oda; 1♂, Yamadera-Yusenkyo, Yamagata, 27. vii. 2003, K. Mizota; 1♀, Mt. Bandai, 27. viii. 1927, S. Matsumura; 1♀, Shiobara, 12–13. viii. 1931, S. Matsumura; 1♂ (NSMT), Mt. Tenso-zan, Okutama, Tokyo, 11. viii. 1976, Y. Kurosawa; 1♀ (NSMT), Nippara, Okutama, Tokyo, 29. viii. 1984, M. Owada; 1♂ 1♀ (NMST), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♂ (NSMT), Tobira kosen, Nagano, 18. viii. 1955, M. Ogata; 1♂ (NSMT), Kyu-Karuizawa, 25. vii. 1956, K. Omoto; 1♂ (NSMT), Kakuma, Shinano, 8–10. viii. 1956, K. Fujimoto; 1♀, Shinshu, 1929, Y. Ota; 1♀, Hikagedaira, Gifu, 20. viii. 1982, S. Hashimoto; 2♂, Konya Spa, Shizuoka, 25. viii. 1996, T. Nakamura; 1♀ (NMST), Mt. Hiei, Kyoto, 28. viii. 1954, M. Ogata; 1♂ (NSMT), same locality, 21. vii. 1965, M. Ogata; 1♀, Mt. Makiosan, Izumi, Osaka, 11. viii. 1984, S. Tsukaguchi; 1♀ (NMST), Darumamine, 360m, Himeji, 12. vii. 1955, K. Nishimura; 1♀, Mt. Wasamata, Kamnikitayama, Nara Pref., 9. viii. 1989 (Light Trap), M. Uenishi. [Shikoku] 1♂, Nii, Kokubunji, Kagawa, 20. v. 1968, H. Toshima. [Kyushu] 1♂ (NSMT), Mt. Kurinodake, Kagoshima, 27. vii. 1974, M. Sakai.

*Distribution.* Japan (Hokkaido, Honshu, Shikoku, Kyushu); China.

*Remarks.* This species closely resembles *Epacanthaclisis banksi* Krivokhatsky, 1998 and *E. batangana* Yang, 1992, both from China, in general appearance but differs from the former by the absence of male hair pencils of tergite VI and from the latter by the presence of an inflated abdominal segment VI in males.

Krivokhatsky (1998) reported that the males of some antlion species have hair pencils or tuft on dorsal surface of tergite IV and referred to its pheromone dispersing function. Krivokhatsky (1998) found hardened filamentous material clutching hooked hair brushes on the tergite IV in one male of *E. continentalis* Esben-Petersen, 1935 and considered it as residues of the secretion. In the present study, I also found a male of Japanese *E. moiwana* having a large quantity of crystallization on the dorsal surface of tergite IV. Although males of *E. moiwana* lack hair-pencils or tuft on dorsal surface of tergite IV, it would be also probably caused by pheromone dispersing.

#### Tribe Nemoleontini

*Diagnosis.* This tribe is characterized by combinations of the following character states: forewing vein CuP originating at or very near basal crossvein; forewing vein 2A running close to 1A for short distance, then bending at sharp angle toward 3A; hindwing vein CuA not reaching MP2, sometimes connected by crossveins; hindwing with only 1

(rarely 2 or 3) presectoral crossveins; male without pilula axillaris.

*Remarks.* This widespread tribe is the largest and most diverse one of the family. However, this tribe is poorly defined and lacks precise apomorphic characters supporting its monophyly (Stange 2004).

### Genus *Distoleon* Banks

*Distoleon* Banks, 1910: 42. Type species: *Distoleon verticalis* Banks, 1910, by original designation. (For further synonymies, see Stange, 2004: 147.)

*Diagnosis.* Medium to large-sized antlions; wings narrow to moderately broad, hyaline; costal area of both wings simple; forewing presectoral area usually with approximately 5–10 crossveins; forewing vein Rs arising beyond CuA fork; forewing veins 2A and 3A fused at one place; hindwing presectoral area with 1 crossvein; hindwing vein Rs arising before MP2 fork; male without pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs usually approximately as long as combined length of Ta1–Ta4 in fore- and midlegs, approximately as long as combined length of Ta1–Ta3 in hindleg; male usually with small tubercle bearing 2–3 black setae on pleural membrane between abdominal segments VII and VIII; male ectoproct simple, without postero-ventral lobe; gonarcus sclerotized, strongly arched in dorsal view; mediuncus absent; parameres proximally fused, distally hook-shaped in lateral view and fork-shaped in ventral view; gonosaccus usually with several long gonosetae; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses short; anterior gonapophyses absent; gonapophyseal plates present; pregenital plate absent; spermatheca short.

*Remarks.* This genus is the second largest in the tribe and consists of approximately 120 species distributed throughout the Old World tropical to subtropical regions (Stange 2004). Adults of the genus are active fliers, and larvae usually live in open sand.

### *Distoleon nigricans* (Okamoto) (Figs 3AB, 22, 23)

*Formicaleo nigricans* Okamoto, 1910: 288, fig. 2.

*Formicaleon nigricans*: Okamoto, 1914: 249.

*Formicaleo tetragrammicus*: Esben-Petersen, 1919: 110 (in part).

*Distoleon tetragrammicus*: Okamoto, 1926: 19 (not *Distoleon tetragrammicus* Fabricius, 1798).

*Distoleon nigricans*: Kuwayama, 1956: 30; 1962: 385; 1966: 138; Stange, 2004: 158; Hayashi, 2013: 198; Yoshitomi *et al.*, 2013: 3.

(For further synonymies, see Kuwayama, 1962: 385.)

*Redescription.* Male. Head. Vertex slightly raised, anterior margin angled, pale brownish-yellow, anterior transverse blackish-brown band protruding posteriorly at middle, median pair of circular blackish-brown spots sometimes narrowly connected with anterior transverse band, 2–3 pairs of blackish-brown markings postero-laterally, blackish-brown marking at posterior margin sometimes narrowly connected with median pair of circular spots, with sparse short dark hairs; occiput yellow, with dark brown to blackish-brown marking at dorsal margin, which usually fused with postero-lateral

markings of vertex. Frons yellow, broad dark brown band extending from below vertex to below base of antenna, sometimes yellow portion developed between base of antenna, with sparse dark hairs; gena whitish-yellow, yellow to pale dark brown ventrally, blackish-brown dorsally; clypeus whitish-yellow to yellow, with moderate erect long dark and pale brown hairs. Antenna dark brown to blackish-brown, shiny proximally, long, with slightly defined club, densely covered with short dark hairs, and short white hairs mixed from scape to approximately proximal 6 flagellomeres; scape dark brown, yellow distally; pedicel dark brown, with distal yellow annulation; flagellum comprising 40–45 flagellomeres, each flagellomere with distal whitish-yellow annulation. Mouthparts yellow: labrum with brown hairs; cardo mostly dark brown; stipes with dark brown spot at proximal end; 3rd labial palpomere dark brown, slightly yellow at apex, spindle-shaped, tapering to acute apex, with palpimacula at distal 1/3, with short dark hairs; submentum with long white and dark hairs.

Thorax. Pronotum (Fig. 3B) broad, broader than long, dark grayish-brown, short yellow midline extending from anterior margin to middle, sometimes small yellow spot present at postero-median margin, pair of lateral yellow stripes often connected with whitish-yellow anterior corner at anterior transverse furrow, with long dark hairs and lateral long white hairs. Cervical sclerites whitish-yellow. Mesonotum dark grayish-brown, with variable yellow portion, moderately covered with dark hairs. Metanotum dark grayish-brown, sparsely covered with dark and white hairs. Meso- and metapleuron mostly dark grayish-brown, except for some yellow portions, densely covered with long white hairs; mesoanepisternum with dense long dark hairs.

Legs. Whitish-yellow to yellow, short, sturdy. Coxae largely dark brown to dark grayish-brown, densely covered with long white hairs; fore coxa dark brown to dark grayish-brown on outer surface, whitish-yellow on inner surface. Femora densely covered with long white and dark hairs, mixed with sparse long black setae; fore femur largely dark brown dorsally; mid femur with dark brown spot at distal end, strongly speckled with dark brown on anterior surface, sometimes brown proximally; hind femur dark brown distally and often dorsally, elongate hair-like setae absent in male; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with dark and white hairs, mixed with sparse long black and white setae; fore- and mid tibiae dark brown at proximal end, with 2 dark brown to blackish-brown bands, one at middle, the other near distal end; hind tibia yellow, speckled with dark brown to blackish-brown on ventral surface, elongate hair-like setae absent in male. Tibial spurs brown proximally, reddish-brown distally, long, stout, curved, in fore- and midlegs approximately as long as or slightly longer than combined length of Ta1–Ta4, in hindleg approximately as long as or slightly longer than combined length of Ta1–Ta3. Tarsi whitish-yellow, dark brown at proximal end of Ta1 and distal end of Ta1–Ta4, Ta5 brown to dark brown dorsally and distally, densely covered with dark hairs dorsally and short black setae ventrally, mixed with white hairs proximally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 longer than combined length of Ta1–Ta4. Claws reddish-brown, long, simple, curved, approximately 3/4 as long as tibial spurs.

Wings (Fig. 3A). Long, moderately broad. Forewing acute at apex; veins and crossveins dark brown and pale yellow, Sc finely alternating dark brown and yellow, R and CuA roughly alternating blackish-brown and yellow; rhexma area with small dark grayish-brown spot, larger dark grayish-brown marking at anastomosis of CuA2 and CuP+1A, crossveins irregularly shaded with dark grayish-brown; costal area simple;



presectoral area with 5–9 crossveins and 0–7 irregular cells; Rs arising beyond CuA fork, with 10–12 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 3A fused with 2A at same point; pterostigma yellowish-white, with prominent proximal blackish-brown spot; anterior and posterior Banksian lines

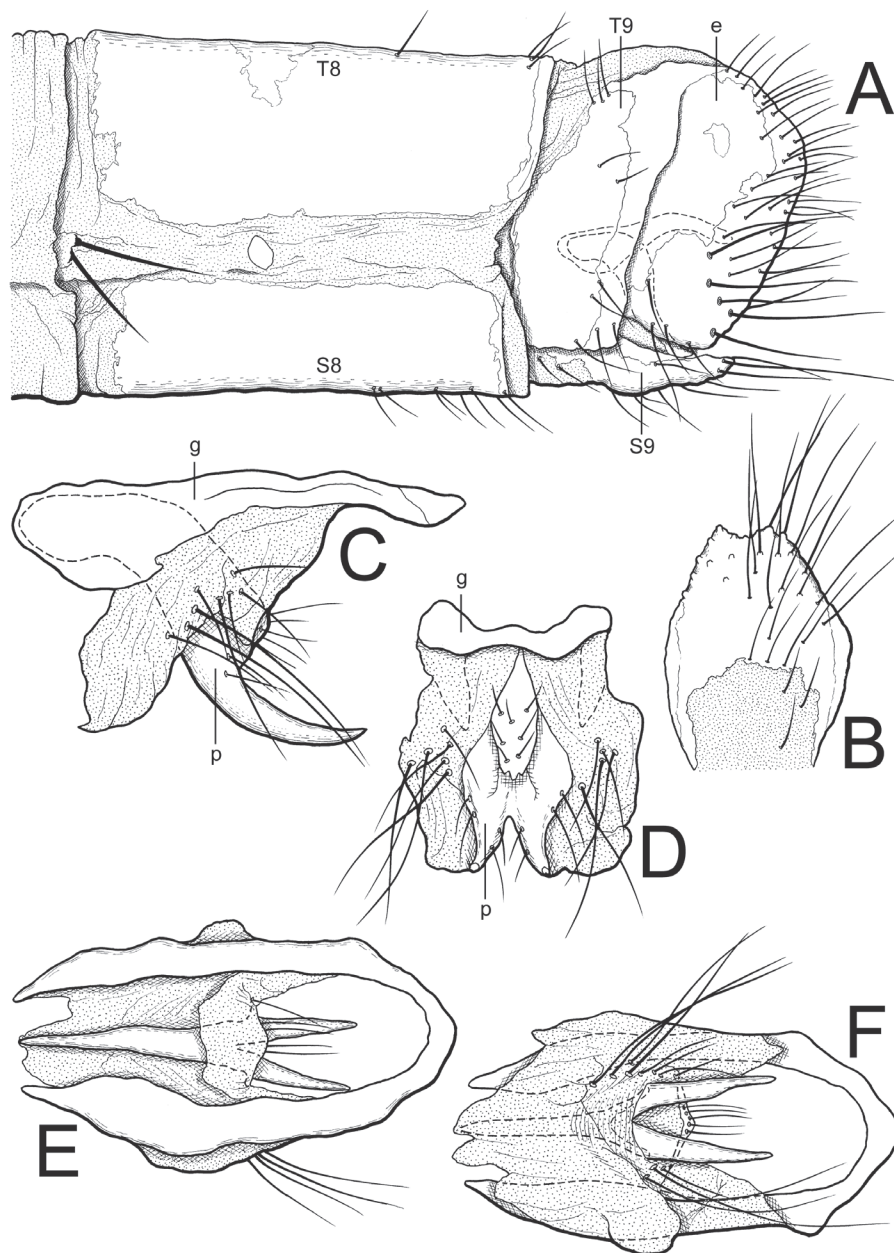


Fig. 22. Male terminalia of *Distoleon nigricans*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

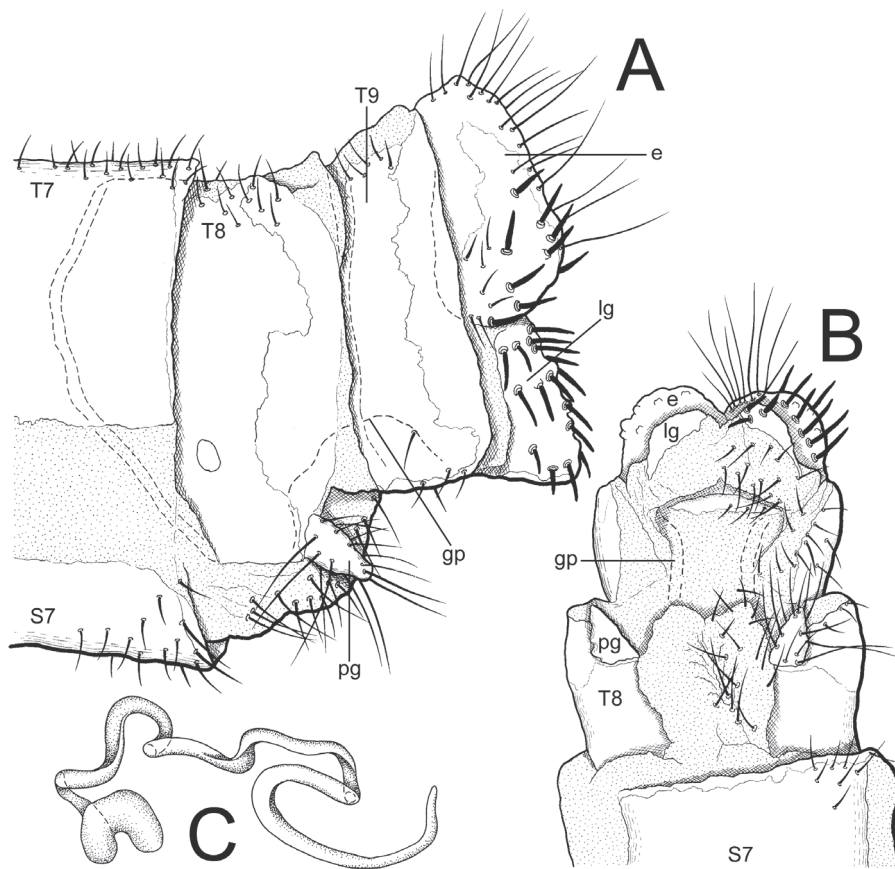


Fig. 23. Female terminalia of *Distoleon nigricans*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

distinct. Hindwing shorter and narrower than forewing; dark grayish-brown markings present only on distal 1/3, rhexia area with larger dark grayish-brown marking; presectoral area with 1 crossvein; Rs arising slightly before MP2 fork, with 9–12 branches from origin of Rs to hypostigmatic cell; hypostigmatic cell longer; pterostigma yellowish-white, with prominent proximal blackish-brown spot; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, tergites densely covered with short dark hairs, and mixed with short white hairs on tergites III to VII anteriorly, sternites densely covered with white hairs laterally and dark hairs ventrally, hairs longer anteriorly, shorter posteriorly, tergite dark grayish-brown to blackish-brown, tergites III to VII with proximal yellow marking.

Terminalia (Fig. 22AB): pleural membrane between abdominal segments VII and VIII with small tubercle bearing 2–3 black setae; sternite IX elongate in lateral view, slightly concave at distal end in ventral view; ectoproct deep in lateral view, with dense hyaline hairs posteriorly, dark black setae ventrally. Genitalia (Fig. 22C–F): gonarcus

strongly sclerotized, strongly arched in dorsal view; mediuncus absent; parameres with short setae; gonosaccus with several long black gonosetae.

*Length:* B, 35–41; FW, 38–40; HW, 35–37.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 23AB): pleural membrane between abdominal segments VII and VIII without small tubercle bearing black setae; tergite IX narrow in lateral view, divided dorsally; ectoproct short in lateral view, with short black fossorial bristles ventrally; lateral gonapophyses angled ventrally in lateral view, with short black fossorial bristles; posterior gonapophyses short, with long dark hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 23C) short.

*Length:* B, 31–41; FW, 38–44; HW, 36–42.

*Specimens examined.* Holotype ♀ (SEHU), *Distoleon nigricans* (Okamoto). Verbatim label data: “*Formicaleo / nigricans* n. sp. / Holotype det. by / H. OKAMOTO, 1910 / redet. S. KUWAYAMA / 1957”; “*Distoleon / nigricans / OKAMOTO / Det. / S. Kuwayama / 1957*”. Other specimens. [Hokkaido] 1♀, Hukushima, Osima, 6. viii. 1976, T. Kumata *et al.* [Honshu] 2♀, Meya-dam, Nishimeya, Aomori, 21. viii. 1989, T. Nakamura; 2♀ (NSMT), Tokuami, Oguni, Yamagata, 28–29. vii. 1983, Y. Kurosawa; 1♀ (NSMT), Sakata, Yamagata, 24. vii. 1954, K. Shirahata; 1♂ (NSMT), same locality, 25. viii. 1955, K. Shirahata; 1♀ (NSMT), same locality, viii. 1956, K. Shirahata; 1♀ (NSMT), Aizuwakamatsu, 30. viii. 1957, K. Kobayashi; 1ex (NSMT), Minamitachibanamura, Gunma, 28. vi. 1933, M. Mori; 1♂ (NSMT), Tainai, Kurokawa, Niigata, 28. vii. 1971, Y. Kurosawa; 1♂ 2♀ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♂ (NSMT), Yashajin-Pass, Yamanashi, 25. vii. 1955, Y. Kurosawa *et M.* Kobayashi; 1♀, Shimashimadani, Nagano, 23. v. 1975, A. Nakanishi; 1♂, Mt. Makiosan, Izumi, Osaka, 12. vii. 1982, S. Tsukaguchi. [Shikoku] 1♀, Nii, Kokubunji, Kagawa, 30. vi. 1968, H. Toshima; 1♀, Hirookagami, Haruno, Kochi, 17. v. 1992, T. Beppu. [Kyushu] 5♀ (NSMT), Mt. Hikosan, Fukuoka, 21. vii. 1969, Y. Kurosawa.

*Distribution.* Japan (Hokkaido, Honshu, Sadogashima Is., Shikoku, Kyushu); Korea, China.

*Remarks.* This species can be easily distinguished from the other Japanese *Distoleon* species by the larger body size, color pattern of pronotum (Fig. 3B), wing marking pattern (Fig. 3A), and dark brown 3rd labial palpomere.

*Distoleon contubernalis* (McLachlan)  
(Figs 3CD, 24, 25)

*Formicaleo contubernalis* McLachlan, 1875a: 175; Okamoto, 1910: 289.

*Myrmeleon contubernalis*: Matsumura, 1904: 174.

*Formicaleo abdominalis* Nakahara, 1913a: 527. Synonymized by Kuwayama, 1962: 386.

*Formicaleo esakii* Nakahara, 1913b: 298. Synonymized by Kuwayama, 1962: 386.

*Formicaleon esakii*: Okamoto, 1914: 250.

*Formicaleon contubernalis*: Okamoto, 1914: 250.

*Distoleon contubernalis*: Okamoto, 1926: 19; Baba, 1953: 17; Hayashi, 2012: 203; 2013: 198; Yoshitomi *et al.*, 2013: 3.

(For further literature, see Kuwayama, 1962: 386.)

*Redescription.* Male. Head. Vertex slightly raised, anterior margin angled, pale

brownish-yellow, anterior transverse row of 3 blackish-brown spots, median pair of circular blackish-brown spots sometimes narrowly connected with median spot of anterior transverse row, 2 pairs of blackish-brown markings postero-laterally, blackish-brown marking at posterior margin sometimes narrowly connected with median pair of circular spots, with sparse short dark hairs; occiput yellow, with dark brown to blackish-brown marking at dorsal margin, which usually fused with postero-lateral markings of vertex. Frons yellow, broad dark brown band extending from below vertex to below base of antenna, sometimes yellow portion developed between base of antenna, with sparse short dark hairs; gena whitish-yellow ventrally, yellow to blackish-brown dorsally; clypeus yellow, with sparse erect long pale yellow hairs. Antenna dark brown to blackish-brown, shiny proximally, long, with slightly defined club, densely covered with short dark hairs, and short white hairs mixed from scape to approximately fifth proximal flagellomeres; scape yellow, with dark brown markings on anterior and posterior surfaces; pedicel yellow anteriorly, dark brown posteriorly, with distal yellow annulation; flagellum comprising approximately 50 flagellomeres, each flagellomere with distal whitish-yellow annulation. Mouthparts yellow: labrum with brown hairs; 3rd labial palpomere brown, yellow at apex, spindle-shaped, tapering to acute apex, with dark brown palpicum at middle, with short dark hairs; submentum with long hyaline hairs.

Thorax. Pronotum (Fig. 3D) broad, broader than long, brown to pale grayish-brown, narrow yellow longitudinal midline extending from anterior margin to posterior margin, anterior pair of yellow spots connected with lateral yellow stripes at anterior transverse furrow, with long dark hairs and lateral long white hairs. Cervical sclerites largely whitish-yellow. Mesonotum dark grayish-brown, with variable yellow portion, sparsely covered with dark hairs; mesoprescutum with pair of yellow markings. Metanotum dark grayish-brown, usually with pair of yellow markings at middle, almost hairless. Meso- and metapleuron largely dark brown to dark grayish-brown, moderately covered with long white hairs; mesoanepisternum with several long dark hairs.

Legs. Whitish-yellow to yellow, short, sturdy. Coxae largely brown to dark brown, densely covered with long white hairs; fore coxa whitish-yellow, with dark brown portion on outer surface. Femora densely covered with short white hairs, mixed with sparse long white and black setae; fore femur largely pale dark brown dorsally, with dense short dark hairs; mid femur largely pale dark brown dorsally, with several blackish-brown spots on anterior surface; hind femur often pale dark brown dorsally, darker distally, dense elongate dark brown hair-like setae present in male; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with dark hairs, mixed with sparse long black and white setae; fore- and mid tibiae dark brown at proximal end, with 2 dark brown bands, one at middle, the other before distal end; hind tibia almost yellow, specked with dark brown on ventral surface, elongate dark brown hair-like setae present in male. Tibial spurs brown proximally, reddish-brown distally, long, stout, curved, in fore- and midlegs approximately as long as combined length of Ta1–Ta4, in hindleg approximately as long as combined length of Ta1–Ta3. Tarsi whitish-yellow, dark brown at distal end of Ta1–Ta5, Ta5 sometimes dark brown dorsally, densely covered with dark hairs dorsally and short black setae ventrally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as or slightly longer than combined length of Ta1–Ta4. Claws reddish-brown, long, simple, approximately 3/4 as long as spurs.

Wings (Fig. 3C). Forewing acute at apex; veins and crossveins dark brown and pale yellow, Sc, R and CuA alternating dark brown and yellow; rhexia area with small

grayish-brown spot, anastomosis of CuA2 and CuP+1A sometimes grayish-brown, distal crossveins and forks usually shaded with grayish-brown; presectoral area with 8–9 crossveins and 0–4 irregular cells; Rs arising beyond CuA fork, with 10–12 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused at one place; pterostigma yellowish-white, with proximal dark brown spot; anterior and posterior Banksian lines distinct. Hindwing approximately as long as forewing, and narrower than forewing; much acute at apex; membrane hardly shaded, rhexma area sometimes with small grayish-brown marking; Rs arising before MP2 fork, with 9–11 branches from origin of Rs to hypostigmatic cell; presectoral area with 1 crossvein; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, dark brown, tergites II to VIII with yellow variable markings, densely covered with short hyaline hairs.

Terminalia (Fig. 24AB): pleural membrane between abdominal segments VII and

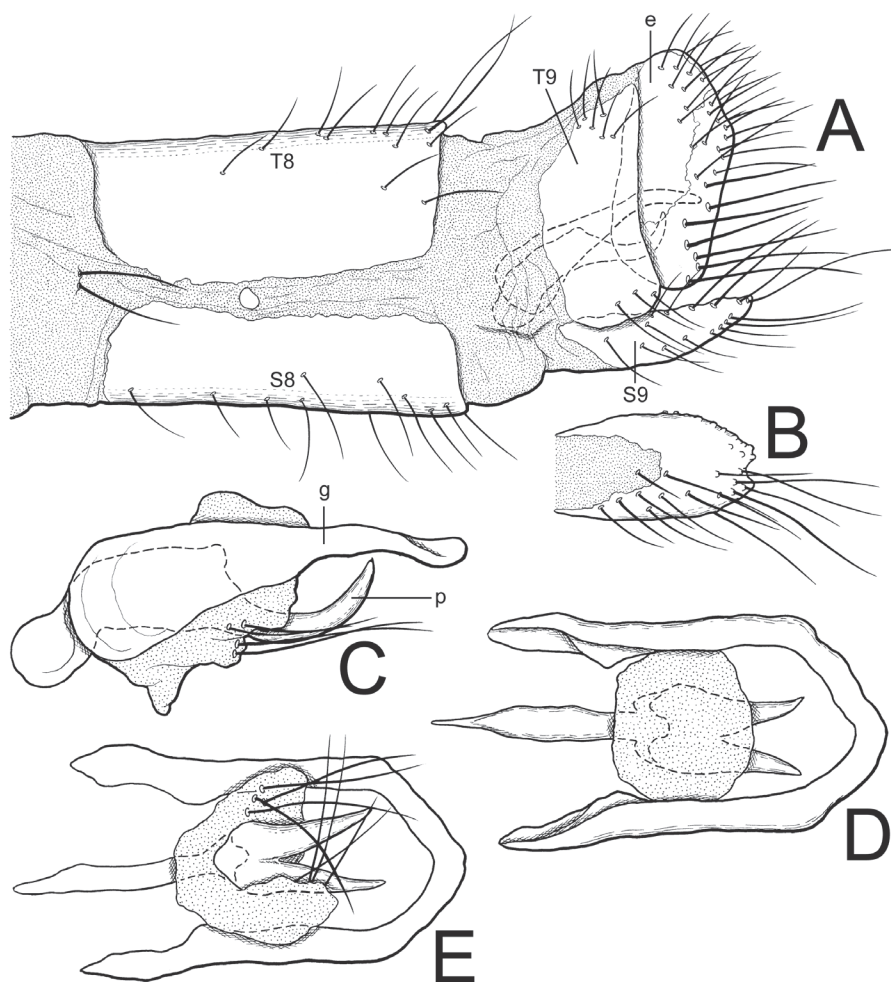


Fig. 24. Male terminalia of *Distoleon contubernalis*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.



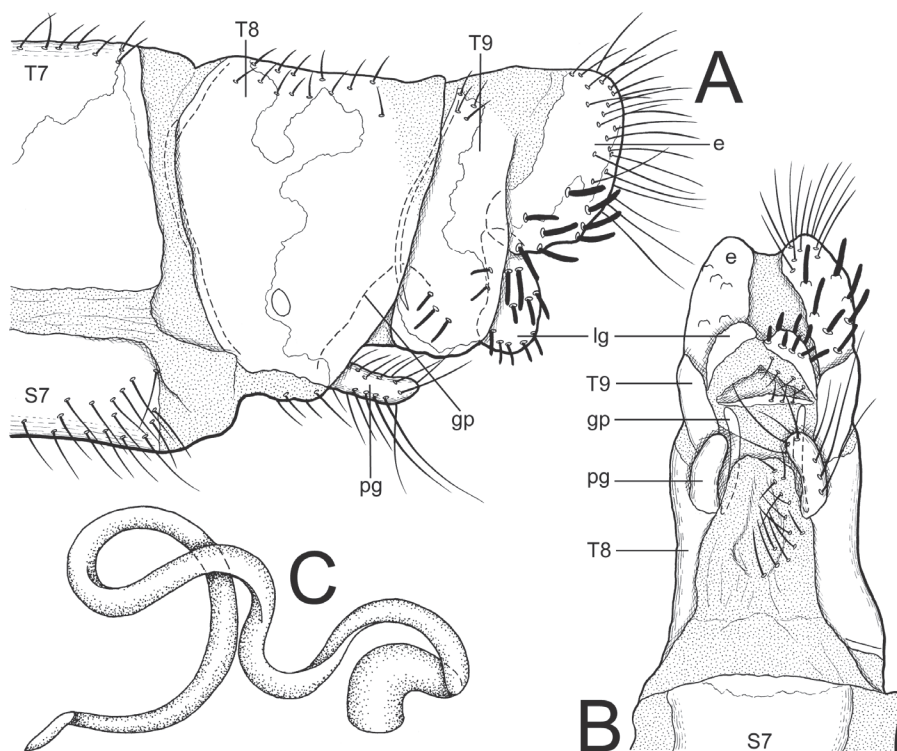


Fig. 25. Female terminalia of *Distoleon contubernalis*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

VIII with small tubercle bearing 2 or 3 black setae; sternite IX elongate in lateral view, slightly concave at distal end in ventral view; ectoproct deep in lateral view, with dense hyaline hairs posteriorly, dark black setae ventrally. Genitalia (Fig. 24C–E): gonarcus ventrally. Genitalia strongly sclerotized, strongly arched in dorsal view; mediuncus absent; parameres without setae; gonosaccus with several long black gonosetae.

*Length*: B, 35–38; FW, 35–36; HW, 34–35.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 25AB): pleural membrane between abdominal segments VII and VIII without small tubercle bearing black setae; tergite IX narrow in lateral view, divided dorsally; ectoproct short in lateral view, with short black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with short black fossorial bristles; posterior gonapophyses short, with long dark hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 25C) short.

*Length*: B, 33–36; FW, 34–41; HW, 34–40.

*Specimens examined*. Holotype ♂ (BMNH), *Distoleon contubernalis* (McLachlan). Verbatim label data: “SYN- / TYPE”; “Para- / type”; “Japan”; “McLachlan Coll. / B.M. 1938-674.”; “*Formicaleo / contubernalis*, det.”. Other specimens. 1ex, no other date; 1♂, no other date, S. Matsumura. [Honshu] 1♀ (NSMT), Shikinejima, 24. viii. 1964, I. Taki; 2♀ (NSMT), Tadami,

Niigata, 12. vii. 1960, K. Fujimoto; 1♂, Mt. Makiosan, Izumi, Osaka, 18. ix. 1980, S. Tsukaguchi; 1♀, Mt. Rokko, Kobe, Hyogo, 5. vii. 1989, S. Tsukaguchi; 1ex, Harima, no other date. [Shikoku] 1♀, Mt. Takayama, Ayagami, Kagawa, 29. vii. 1979, H. Toshima; 1♀, Man-no, Kagawa, 20. viii. 1985, H. Toshima; 1ex (NMST), Kochi, 2. vi. 1940, K. Hashimoto. [Tsushima] 2♂ (NIAES), Mt. Ohboshiyama, Mine, Tsushima Is., Nagasaki, 5–9. vii. 1983, H. Makihara. [Kyushu] 1♂ (NSMT), Mt. Hikosan, Fukuoka, 21. vii. 1969, Y. Kurosawa; 1♀, Onoaida, Yakushima, Kagoshima, 9. ix. 1979, Y. Nasu & K. Yasuda; 1♂ (NIAES), Kominato, Amamioshima, 3. vii. 1974, J. Okuma; 1♀, Amamioshima, iv. 2004 (larva collected: 1♀, emerged 21. vi. 2004), K. Fujisaki; 1♀, Tokunoshima Is., Kagoshima, 1–6. vii. 1985, M. Tanaka. [Ryukyus] 1♀ 1ex, Okinawa I., no other date, S. Sakaguchi; 1♀, Funaura, Iriomote Is., Okinawa, 23. v. 1983, T. Tanabe; 1♂ (NSMT), Komi, Iriomotezima, 24–26. x. 1973, M. Owada.

*Distribution.* Japan (Honshu, Shikinejima Is., Shikoku, Kyushu, Tsushima Is., Meshima Is., Yakushima Is., Amami-oshima Is., Tokunoshima Is., Okinawajima Is., Iriomotejima Is.); Korea.

*Remarks.* This species is closely related to *D. bistrigatus* (Rambur) and *D. boninensis* Adams, but *D. contubernalis* can be distinguished from them by the broader wings (Fig. 3C) and, in males, by the presence of elongate hair-like setae on hind femur and tibia.

*Distoleon bistrigatus* (Rambur)  
(Figs 3EF, 26, 27)

*Myrmeleon bistrigatus* Rambur, 1842: 391.

*Myrmeleon striola* Walker, 1853: 340. Synonymized by Esben-Petersen, 1915: 69.

*Myrmeleon perjurus* Walker, 1853: 340. Synonymized by Esben-Petersen, 1915: 69.

*Myrmeleon torvus* Walker, 1853: 341. Synonymized by McLachlan, 1873: 134.

*Myrmeleon violentus* Walker, 1853: 348. Synonymized by McLachlan, 1873: 134.

*Formicaleo striola*: Hagen, 1866b: 405.

*Formicaleo torvus*: Hagen, 1866b: 405.

*Formicaleo bistrigatus*: Hagen, 1866b: 404.

*Formicaleo perjurus*: Hagen, 1866b: 404.

*Formicaleo violentus*: Hagen, 1866b: 405.

*Formicaleo perjurus* var. *violentus*: McLachlan, 1883: 301.

*Formicaleo acuminatus* Matsumura, 1908: 41. nom. nud.

*Formicaleo acuminatus* Okamoto, 1910: 290, fig. 6; Nakahara, 1913b: 301; Kuwayama, 1966: 138. Synonymized by Adams, 1959: 16.

*Distoleon bistrigatus*: Banks, 1910: 43; Adams, 1959: 15; Kuwayama, 1964: 47; New, 1985b: 5; 1990: 14; 1992: 44.

*Formicaleo brahmanicus* Banks, 1913: 142. Synonymized by Adams, 1959: 16.

*Eidoleon bistrigatus*: Esben-Petersen, 1918: 15.

*Formicaleo yayeyamensis* Sakaguchi, 1927: 33; Matsumura, 1931: 1156, fig. nom. nud.

*Formicaleo yayeyamensis* Matsumura, 1931: 1156. Synonymized by Kuwayama, 1966: 138.

*Eidoleon perjurus perjurus*: Zimmerman, 1957: 158.

*Eidoleon perjurus violentus*: Zimmerman, 1957: 160.

*Distoleon brahmanicus*: Ghosh, 1984: 53.

*Redescription.* Male. Head. Vertex slightly raised, anterior margin angled, pale brownish-yellow, anterior transverse row of 3 dark brown areas, median transverse row of 4–6 blackish-brown markings, pair of dark brown spots at posterior margin sometimes

narrowly connected with median pair of median transverse row, with sparse short dark hairs; occiput yellow, with pale dark brown dorsal margin. Frons yellow, with 2 dark brown transverse band, one at above base of antenna, the other below base of antenna, with sparse short dark hairs; gena whitish-yellow ventrally, yellow to blackish-brown dorsally; clypeus yellow, with sparse erect long pale yellow hairs. Antenna dark brown, long, with slightly defined club, densely covered with short dark hairs, and short white hairs mixed from scape to approximately fifth proximal flagellomeres; scape yellow, with dark brown markings on anterior and posterior surfaces; pedicel yellow anteriorly, dark brown posteriorly, with distal yellow annulation; flagellum comprising approximately 50 flagellomeres, each flagellomere with distal whitish-yellow annulation. Mouthparts yellow: labrum with brown hairs; 3rd labial palpomere spindle-shaped, tapering to acute apex, with brown palpmacula at middle, with short dark hairs; submentum with long pale yellow hairs.

Thorax. Pronotum (Fig. 3F) broad, broader than long, pale yellow, pair of dark grayish-brown longitudinal stripes extending from anterior margin to posterior margin, lateral margins dark brown, with long dark hairs and lateral long white hairs. Cervical sclerites largely whitish-yellow. Meso- and metanotum dark grayish-brown, with broad median longitudinal pale yellow stripe extending from mesoprescutum to metascutellum, with sparse white or hyaline hairs. Meso- and metapleuron color variable, pale yellow to dark grayish-brown, moderately covered with long white or hyaline hairs; mesoanepisternum with several long dark hairs.

Legs. Whitish-yellow to yellow, short, sturdy. Coxae whitish-yellow, densely covered with long white hairs; fore coxa with dark brown portions on outer surface. Femora densely covered with short white hairs, mixed with sparse long white and black setae; fore femur largely pale dark brown dorsally, with dense short dark hairs; mid femur dark brown distally, with several blackish-brown spots on anterior surface; hind femur largely yellow, elongate hair-like setae absent in male; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with dark hairs, mixed with sparse long black and white setae; fore tibia with dark brown band at middle; mid tibiae dark brown at proximal end, with 2 dark brown bands, one at middle, the other before distal end; hind tibia yellow, speckled with dark brown on ventral surface, elongate hair-like setae absent in male. Tibial spurs brown proximally, reddish-brown distally, long, stout, curved, in fore- and midlegs approximately as long as combined length of Ta1–Ta4, in hindleg approximately as long as combined length of Ta1–Ta3. Tarsi whitish-yellow, sometimes dark brown at distal end of Ta1–Ta4, Ta5 dark brown at distal end, densely covered with dark hairs dorsally and short black setae ventrally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as combined length of Ta1–Ta4. Claws brown proximally, reddish-brown distally, long, simple, approximately 3/4 as long as spurs.

Wings (Fig. 3E). Narrow. Forewing acute at apex; veins and crossveins mostly pale yellow, partly dark brown; rhexma area with tiny grayish-brown spot, anastomosis of CuA2 and CuP+1A usually with tiny grayish-brown spot but sometimes indistinct; presectoral area with 8–10 crossveins and 0–2 irregular cells; Rs arising beyond CuA fork, with 9–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused partly; pterostigma yellowish-white, with proximal dark brown spot; anterior and posterior Banksian lines weakly developed. Hindwing longer and narrower than forewing; tapered at apex; rhexma area with liner

grayish-brown marking; Rs arising before MP2 fork, with 8–11 branches from origin of Rs to hypostigmatic cell; presectoral area with 1 crossvein; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, tergites dark brown, tergites III to VIII with yellow markings, sternites pale brown, densely covered with short hyaline hairs.

Terminalia (Fig. 26AB): pleural membrane between abdominal segments VII and VIII with small tubercle bearing 2 or 3 black setae; sternite IX elongate in lateral view;

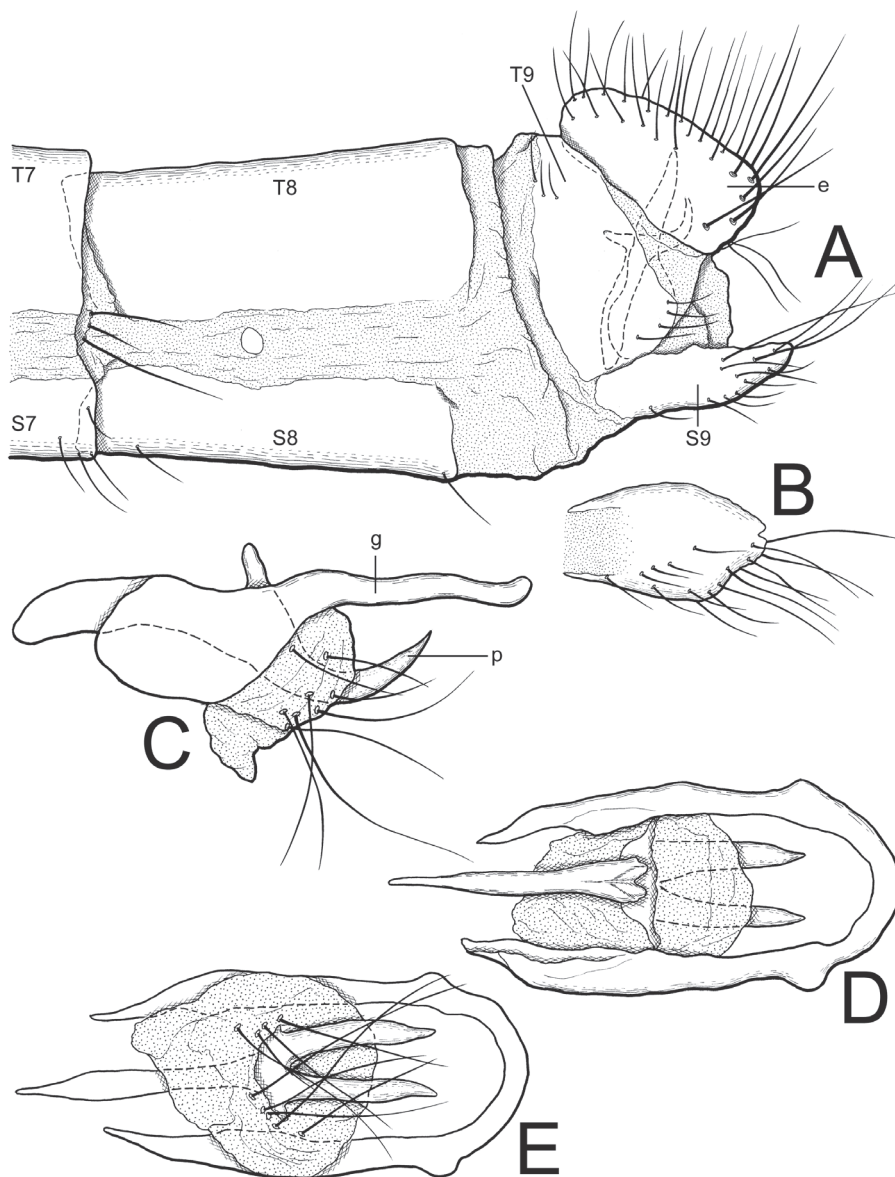


Fig. 26. Male terminalia of *Distoleon bistrigatus*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

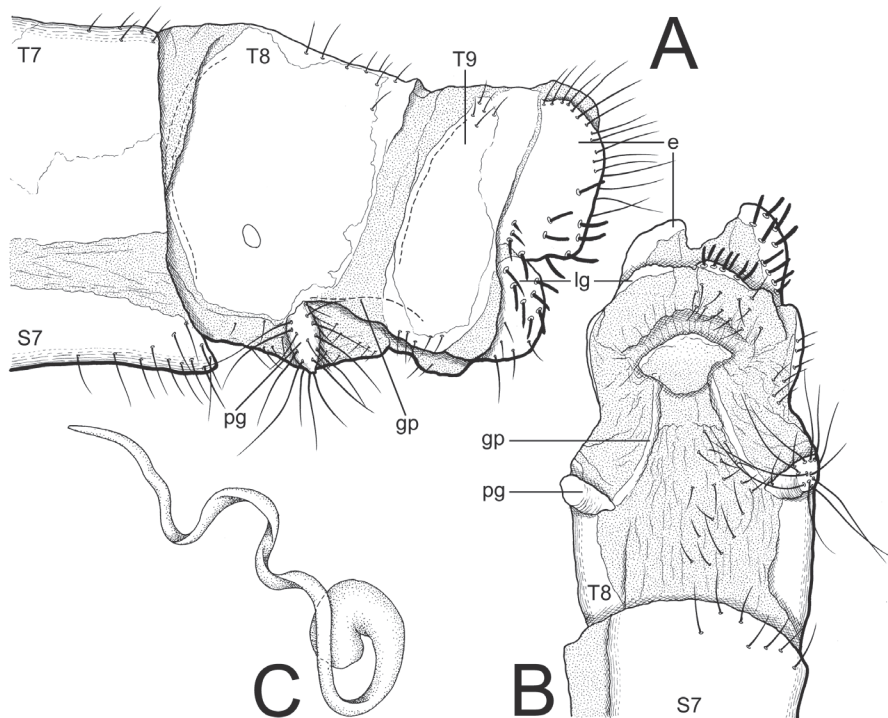


Fig. 27. Female terminalia of *Distoleon bistrigatus*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

ectoproct deep in lateral view, with dense hyaline hairs posteriorly, dark black setae ventrally. Genitalia (Fig. 26C–E): gonarcus strongly sclerotized, strongly arched in dorsal view; mediuncus absent; parameres without setae; gonosaccus with several long black gonosetae.

*Length*: B, 29–33; FW, 34; HW, 35.

Female. Coloration and general morphology, except for terminalia, almost as in male. Terminalia (Fig. 27AB): pleural membrane between abdominal segments VII and VIII without small tubercle bearing black setae; tergite IX narrow in lateral view, divided dorsally; ectoproct short in lateral view, with short black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with short black fossorial bristles; posterior gonapophyses short, with long dark hairs; anterior gonapophyses absent; gonapophyseal plates slightly arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 27C) short.

*Length*: B, 28–30; FW, 33–36; HW, 36–38.

*Specimens examined*. Lectotype ♂ (SEHU), *Formicaleo acuminatus* Okamoto. Verbatim label data: “VIII/1903 / Yayeyama / Kuroiwa”; “187”; “*Formicaleo / acuminatus / (MATS.) n. sp. / det H. OKAMOTO / COTYPE 1910*”; “*Distoleon / bistrigatus / RAMBUR / Det. / S. Kuwayama / 1957*” “Lecto-type / *Formicaleo / acuminatus / Okamoto / det. PH. ADAMS, '59*”. Holotype ♀ (SEHU), *Formicaleo yayeyamensis* Matsumura. Verbatim label data: “Japan / Matsum”; “Yaeyama / 1910” [written on the back of the above-mentioned label]; “Type / Matsumura”; “*Formicaleo /*



*yayeyamenisis* / Mats / det. Matsumura”; “*Distoleon / bistrigatus* / Rambur / Det. / S. Kuwayama / 1957”. Other specimens. [Ryukyus] 1♂ (NSMT), Nago, Okinawa, 28. x. 1963, Yamasaki; 1♂, Okinawa, no data, S. Sakaguchi; 1♀ (NIAES), Okinawa, no data, S. Sakaguchi; 1♀ (NIAES), Irabu I., 30. v. 1960, S. Higashihirachi.

*Non-Japanese specimens examined.* [New Guinea] 1♀ (NSMT), Papua, i. 1968, M. Oba. [Australia] 1♂ (NSMT), Casule, NSW, 11. ii. 1988, M. I. Nikitin.

*Distribution.* Japan (Ogasawara Isls., Okinoirabujima Is., Okinawajima Is., Miyakojima Is., Irabujima Is., Ishigakijima Is., Iriomotejima Is., Minami-daitojima Is.); China, India, Palau, New Guinea, Mariana Islands, Micronesia, New Hebrides, Tahiti, Australia.

*Remarks.* This species is very similar to *D. boninensis* but can be distinguished from it by the color pattern of thorax (Fig. 3F) and the distal grayish-brown streak in the hindwings (Fig. 3E).

*Distoleon boninensis* Adams  
(Figs 3GH, 28, 29)

*Distoleon boninensis* Adams, 1959: 17; Stange, 2004: 150.

*Description of male.* Head. Vertex moderately raised, anterior margin angled, pale brownish-yellow, anterior transverse row of 3 dark brown areas, median transverse row of 4–6 blackish-brown markings, dark brown marking at posterior margin sometimes narrowly connected with median pair of median transverse row, with sparse short dark hairs; occiput yellow, with dark brown dorsal margin. Frons yellow, with 2 dark brown transverse band, one at above base of antenna, the other below base of antenna, with sparse short dark hairs; gena whitish-yellow ventrally, yellow to blackish-brown dorsally; clypeus yellow, with sparse erect long pale yellow hairs. Antenna dark brown, long, with slightly defined club, densely covered with short dark hairs, and short white hairs mixed from scape to approximately fifth proximal flagellomeres; scape yellow, with dark brown markings on anterior and posterior surfaces; pedicel yellow anteriorly, dark brown posteriorly, with distal yellow annulation; flagellum comprising approximately 50 flagellomeres, each flagellomere with distal whitish-yellow annulation. Mouthparts yellow: labrum with brown hairs; 3rd labial palpomere spindle-shaped, tapering to acute apex, with brown palpicum at middle, with short dark hairs; submentum with long white hairs.

Thorax. Pronotum (Fig. 3H) broad, broader than long, pale grayish-brown, narrow yellow longitudinal midline extending from anterior margin to posterior margin, pair of small yellow spots at transverse furrow, pair of yellow longitudinal stripes laterally, lateral margins dark brown, with long dark hairs and lateral long white hairs. Cervical sclerites largely whitish-yellow. Mesonotum pale dark brown to dark grayish-brown, with variable yellow portion, sparsely covered with dark and white hairs; mesoprescutum with pair of yellow markings. Metanotum largely blackish-brown, sparse white and dark hairs along posterior margin of metascutellum. Meso- and metapleuron color variable, pale brownish-yellow to dark grayish-brown, moderately covered with long white or hyaline hairs; mesoanepisternum with several long dark hairs.

Legs. Whitish-yellow to yellow, short, sturdy. Coxae whitish-yellow, densely covered with long white hairs; fore coxa with dark brown portions on outer surface.

Femora densely covered with short white hairs, mixed with sparse long white and black setae; fore femur largely pale dark brown dorsally, with dense short dark hairs; mid femur largely pale dark brown dorsally, with several blackish-brown spots on anterior surface; hind femur often pale dark brown dorsally, darker distally, elongate hair-like setae absent in male; femoral sense hair present on fore- and midlegs, absent from

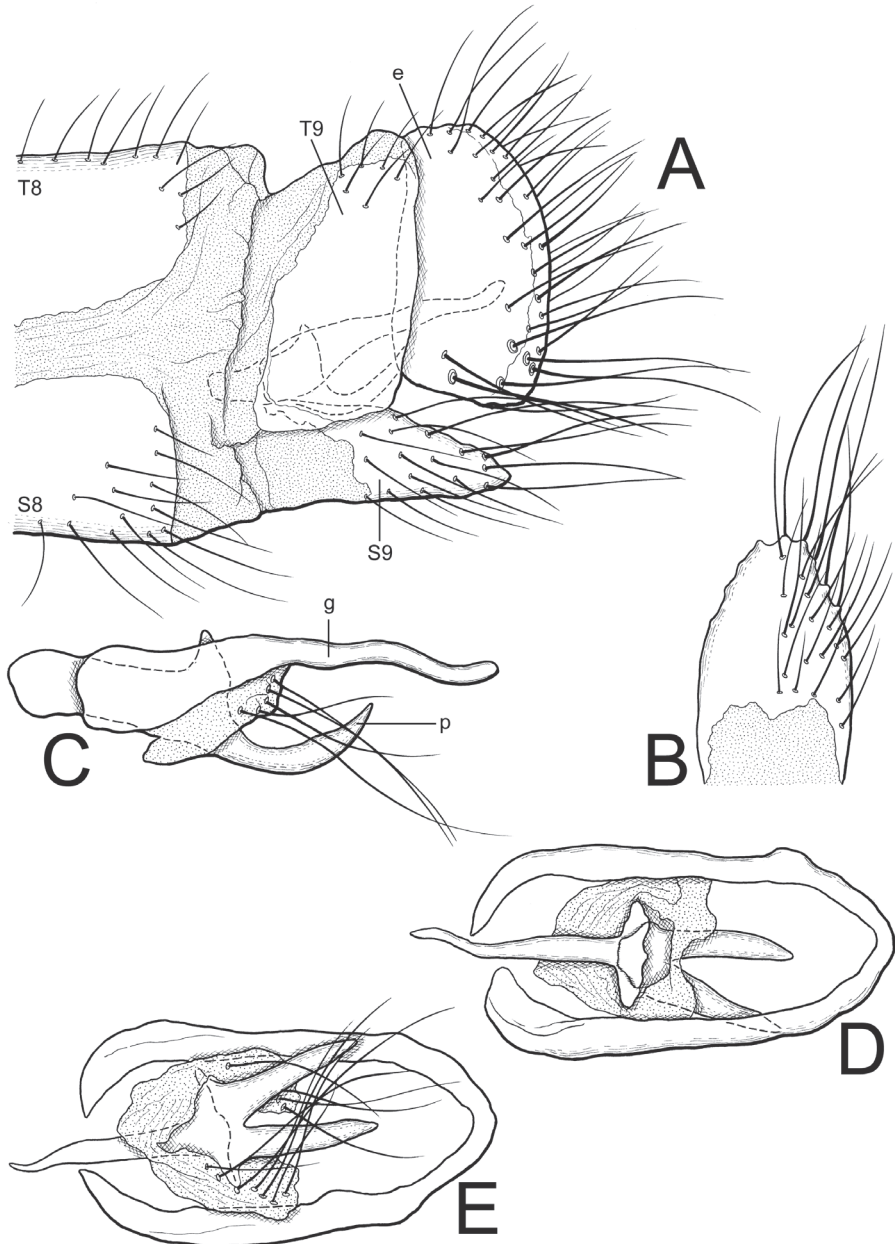


Fig. 28. Male terminalia of *Distoleon boninensis*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

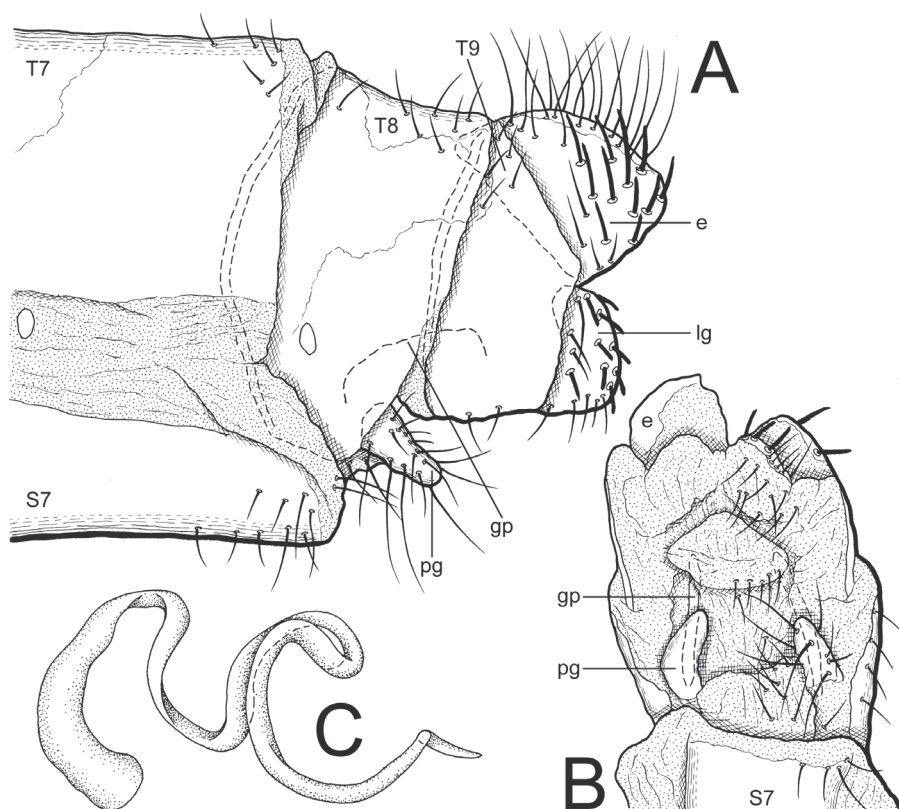


Fig. 29. Female terminalia of *Distoleon boninensis*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

hindleg. Tibiae moderately covered with dark hairs, mixed with sparse long black and white setae; fore- and mid tibiae dark brown at proximal end, with 2 dark brown bands, one at middle, the other before distal end; hind tibia largely yellow, elongate hair-like setae absent in male. Tibial spurs brown proximally, reddish-brown distally, long, stout, curved, in fore- and midlegs approximately as long as combined length of Ta1–Ta4, in hindleg approximately as long as combined length of Ta1–Ta3. Tarsi whitish-yellow, Ta5 dark brown distally, densely covered with dark hairs dorsally and short black setae ventrally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as combined length of Ta1–Ta4. Claws brown proximally, reddish-brown distally, long, simple, approximately 3/4 as long as spurs.

Wings (Fig. 3G). Forewing acute at apex; veins and crossveins dark brown and pale yellow, Sc, R and CuA alternating dark brown and yellow; 2 small grayish-brown markings distinct, one at rhegma area, the other at anastomosis of CuA2 and CuP+1A; costal area simple; presectoral area with 6–8 crossveins and 0–5 irregular cells; Rs arising beyond CuA fork, with 10–14 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused partly; pterostigma yellowish-white, with proximal dark brown spot; anterior and posterior Banksian lines distinct. Hindwing narrower and slightly longer than forewing; much acute at apex;

rhegma area with distinct small grayish-brown marking; Rs arising before MP2 fork, with 10–13 branches from origin of Rs to hypostigmatic cell; presectoral area with 1 crossvein; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, dark brown, tergites III to VIII with yellow markings, densely covered with short hyaline hairs.

Terminalia (Fig. 28AB): pleural membrane between abdominal segments VII and VIII without small tubercle bearing black setae; sternite IX elongate in lateral view; ectoproct deep in lateral view, with dense hyaline hairs posteriorly, dark black setae ventrally. Genitalia (Fig. 28C–E): gonarcus strongly sclerotized, strongly arched in dorsal view; mediuncus absent; parameres without setae; gonosaccus with several long black gonosetae.

*Length:* B, 30; FW, 35; HW, 36.

*Redescription.* Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 29AB): tergite IX narrow in lateral view, divided dorsally; ectoproct short in lateral view, with short black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with short black fossorial bristles; posterior gonapophyses short, with long dark hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 29C) short.

*Length:* B, 26–34; FW, 31–39; HW, 32–40.

*Specimens examined.* Holotype ♀ (NMNH), *Distoleon boninensis* Adams. Verbatim label data: “Omura, Chichijima / Bonin Is. 5-VII-49 / Y. Kondo”; “*DISTOLEON / ACUMINATUS / (OKAM) / DET. P. ADAMS ‘57’*”; “*DISTOLEON / BONINENSIS / HOLOTYPE ‘57 / Det. P. A. Adams’*”; “*TYPE / no.64098 / u. s. n. m.*”. Other specimens. [Ogasawara] 1♀, Omura, Chichijima Is., Ogasawara, Tokyo, 28. vi. 1975, N. Watanabe; 1♀, same locality, 2. vi. 1975, N. Watanabe; 1♀, Kitamura, Hahajima Is., Ogasawara, Tokyo, 28. vi. 1975, N. Watanabe; 1♂ 2♀ 1ex (NSMT), Is. Chichi-jima, Bonin Islands, 18. vi. 1976, Y. Kurosawa; 7♀ (NSMT), same locality, 19. vi. 1976, Y. Kurosawa; 2♀ (NSMT), same locality, 20. vi. 1976, Y. Kurosawa; 1♀ (NSMT), same locality, 24. vi. 1976, Y. Kurosawa.

*Distribution.* Japan (Ogasawara Is.: Chichijima Is., Hahajima Is.)

*Remarks.* This species was originally described based on four female specimens collected from Chichijima Island, and males of this species have not been reported until now. In this study, one male specimen collected in Chihijima Island was found deposited in NSMT. This is the first record of the male of this species.

#### Genus *Neuroleon* Navás

*Neuroleon* Navás, 1909: 148. Type species: *Myrmeleon arenarius* Navás, 1914b, by subsequent designation of Navás, 1914b: 759.

(For further synonymies, see Stange, 2004: 194.)

*Diagnosis.* Small to medium-sized antlions; wings narrow, hyaline; costal area of both wings simple; forewing presectoral area usually with approximately 7 crossveins; forewing vein Rs arising beyond CuA fork; forewing veins 2A and 3A fused; hindwing presectoral area with 1 crossvein; hindwing vein Rs arising before MP2 fork; male without pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs usually absent or approximately as long as combined length of

Ta1–Ta3 in fore- and midlegs, approximately as long as combined length of Ta1–Ta2 in hindleg; male ectoproct simple, without postero-ventral lobe; gonarcus sclerotized, strongly arched in dorsal view; mediuncus absent; parameres proximally fused, distally hook-shaped in lateral view and fork-shaped in ventral view; gonosaccus usually with several long gonosetae; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses short; anterior gonapophyses absent; gonapophyseal plates present; pregenital plate absent.

*Remarks.* This is a large genus in the tribe, with approximately 120 species mainly distributed in the Afrotropical and western Palaearctic Regions (Michel & Akoudjin 2012). As pointed out by Stange (2004), this genus may consist of heterogeneous species, and taxonomic revision of the genus based on the world species is needed. Larvae have been found in open sand and under rock overhangs.

According to Michel & Akoudjin (2012), this genus can be distinguished from the genus *Distoleon* by the length of the tibial spurs (in *Neuroleon*, tibial spurs absent or approximately as long as combined length of Ta1–Ta3 in foreleg, approximately as long as combined length of Ta1–Ta2 in mid- and hindlegs, whereas, in *Distoleon*, approximately as long as combined length of Ta1–Ta4 in foreleg, approximately as long as combined length of Ta1–Ta3 in mid- and hindlegs).

*Neuroleon parvulus* (Okamoto) comb. nov.  
(Fig. 3IJ)

*Myrmeleon parvulus* Matsumura, 1908: 41. nom. nud.

*Myrmecaelurus parvulus* Okamoto, 1910: 293, fig. 7; Nakahara, 1913b: 301; 1913c: 96; Okamoto, 1914: 250.

*Distoleon parvulus*: Banks, 1937: 287; Kuwayama, 1962: 386; 1964: 46; 1966: 139; Stange, 2004: 159.

Three specimens examined in this study were all missing the apexes of the abdomen. Therefore, description of male and female terminalia is omitted.

*Redescription.* Head. Vertex moderately raised, anterior margin angled, mostly blackish-brown, sometimes pale brownish-yellow portions developed posteriorly, with short brown hairs; occiput dark brown to blackish-brown. Frons yellow, with dark brown band dorsally, moderately covered with short dark hairs; gena yellow; clypeus yellow, with several erect hyaline hairs. Antenna dark brown, short, with slightly defined club, densely covered with short dark hairs; flagellum comprising approximately 38 flagellomeres, each flagellomere with narrow distal yellow annulation, apical club with whitish-yellow portion on ventral surface. Mouthparts pale yellowish-brown: 3rd labial palpomere spindle-shaped, tapering to acute apex, with palpimacula on proximal 1/3; labrum with several brown hairs.

Thorax. Pronotum (Fig. 3J) broad, broader than long, dark grayish-brown, with narrow yellow longitudinal midline, pair of large yellow triangular markings including dark grayish-brown spot at anterior furrow, with hyaline hairs and lateral long white hairs. Cervical sclerites dark brown. Mesonotum dark grayish-brown to blackish-brown, sparsely covered with hyaline hairs; mesoprescutum with 2 pairs of yellow spots, one at antero-lateral portion, the other at middle; mesoscutum with 2 pairs of yellow spots, one at middle, the other above wing base; mesoscutellum yellow along lateral and



posterior margin, with several long white hairs along posterior margin. Metanotum dark grayish-brown to blackish-brown, with pair of yellow stripes at middle, almost hairless; metascutum with pair of yellow spots above wing base; metascutellum with yellow posterior margin. Meso- and metapleuron mostly dark brown, sparsely covered with hyaline hairs.

Legs. Yellow. Coxae largely dark brown on outer surface, moderately covered with hyaline hairs. Femora densely covered with short white and dark hairs, mixed with sparse long black and white setae; fore femur largely dark brown dorsally; mid- and hind femora dark brown dorsally at middle. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia with 3 dark brown portion dorsally, one at proximal end, others at middle and distal end, with 2–3 white long setae ventrally; mid tibia largely dark brown; hind tibia with dark brown longitudinal stripe on ventral surface. Tibial spurs reddish-brown to brown, slender, slightly curved at apex, in fore- and midlegs slightly longer than combined length of Ta1–Ta3, in hindleg approximately as long as combined length of Ta1–Ta2. Tarsus yellow, dark brown at distal end of Ta5, moderately covered with dark hairs dorsally, short black setae ventrally; Ta5 approximately as long as combined length of Ta1–Ta4; in fore- and mid tarsi Ta1 approximately as long as combined length of Ta2–Ta3, in hind tarsus Ta1 approximately as long as combined length of Ta2–Ta4. Claws reddish-brown, slender, simple, slightly curved, approximately 3/4 as long as tibial spurs.

Wings (Fig. 3I). Small, narrow. Forewing subacute at apex; veins and crossveins alternating dark brown and pale yellow; rhagma area with distinct small dark brown spot, numerous dark brown dots scattered along posterior margin; costal area simple; presectoral area with 7–8 crossveins and 0–1 irregular cells; Rs arising beyond CuA fork, with 8–9 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused at same point; pterostigma almost indistinct, with faint proximal dark brown spot; hypostigmatic cell long; anterior Banksian line absent, posterior Banksian line rather distinct. Hindwing approximately as long as forewing, slightly narrower than forewing; tiny dark brown spots fewer; Rs arising before MP2 fork, with 8 branches from origin of Rs to hypostigmatic cell; presectoral area with 1 crossvein; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen blackish-brown, densely covered with short hyaline hairs.

*Length:* B, 22; FW, 23; HW, 22–23 (body length is quotation from the original description).

*Specimens examined.* Holotype ♀ (SEHU), *Neuroleon parvulus* (Okamoto). Verbatim label data: “VII/1905 / Okinawa”; “*Myrmeleon / parvulus / n. sp.*”; “det. S. MATSUMURA” [written on the back of the above-mentioned label]; “*Myrmecaelurus / parvulus n. sp. / MATSUMURA MSC / det H. OKAMOTO / 1910*”; “HOLOTYPE” [written on the back of the above-mentioned label]; “*Distoleon / parvulus / OKAMOTO / Det. / S. Kuwayama / 1957*”. Other specimens. [Kyushu] Iex, Yanagawa, Chikugo, no other data. [Ryukyus] Iex, Okinawa, no date, S. Sakaguchi.

*Distribution.* Japan [Ogasawara Isls.(?), Kyushu, Okinawajima Is.].

*Remarks.* This species is very rare. Only the above-mentioned three specimens collected in Kyushu and Okinawa were examined. Nakahara (1913c) recorded this species from Ogasawara Islands but, as mentioned by Kuwayama (1962), specimens collected from the islands have not been confirmed and the record is questionable.

This species was transferred to *Distoleon* by Banks (1937), and subsequent researchers have followed this treatment. According to Michel & Akoudjin (2012),

*Neuroleon* can be distinguished from *Distoleon* by the length of tibial spurs (see Remarks of *Neuroleon*). The tibial spurs of this species are slightly longer than combined length of Ta1–Ta3 in fore- and midlegs and approximately as long as combined length of Ta1–Ta2 in hindleg. This character state is not agreement with the definition of *Distoleon*, but *Neuroleon*. The tibial spurs of this species are slender and slightly curved at apex, and not stout and curved as in *Distoleon*. Moreover, the body size is smaller than *Distoleon* species. Although I could not examine the terminalia of this species, these character states suggest that this species should be transferred to *Neuroleon*.

#### Genus *Paraglenurus* van der Weele

*Paraglenurus* van der Weele, 1909: 29. Type species: *Myrmeleon scopifer* Gerstaecker, 1887 (as “*P. scopifer* (Gerst.)”), by original designation.  
(For further synonymies, see Stange, 2004: 212.)

*Diagnosis.* Medium to large-sized antlions; antenna long; wings narrow to moderately broad, hyaline; costal area of both wings simple, distal crossveins branched; forewing presectoral area usually with approximately 10 crossveins; forewing vein Rs arising beyond CuA fork; forewing veins 2A and 3A fused; hindwing presectoral area usually with 1 crossvein; hindwing vein Rs arising before MP2 fork; male without pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs approximately as long as Ta1; Ta5 with dense short bristles on ventral surface; claws capable of closing against Ta5; male ectoproct simple, without postero-ventral lobe; gonarcus arched in dorsal view; mediuncus usually well developed; female ectoproct slightly lobed posteriorly; lateral gonapophyses present; posterior gonapophyses usually slender; anterior gonapophyses absent; gonapophyseal plates present; spermatheca slender.

*Remarks.* This genus consists of six described species. However, Stange *et al.* (2003) referred to the presence of undescribed species of the genus in Taiwan and South Africa.

#### *Paraglenurus japonicus* (McLachlan) (Figs 4A–G, 30, 31)

*Glenurus* (?) *japonicus* McLachlan, 1867: 248.

*Glenurus japonicus*: Hagen, 1873: 278.

*Glenurus pupillaris*: Matsumura, 1900b: 78 (not *Glenurus pupillaris* Gerstaecker, 1893).

*Glenuroides communis* Okamoto, 1910: 295, figs. 4, 4a; Kuwayama, 1966: 138; Synonymized by Okamoto, 1926: 18.

*Glenuroides japonicus*: Okamoto, 1914: 249; Kuwayama, 1962: 383.

*Eoleon japonicus*: Navás, 1921: 66.

*Paraglenurus japonicus*: Miller *et al.*, 1999: 60; Stange, 2004: 213; Krivokhatsky, 2011: 112; Yoshitomi *et al.*, 2013: 4.

*Paraglenurus littoralis* Miller & Stange in Miller *et al.*, 1999: 56; Stange *et al.*, 2003: 91; Stange, 2004: 213. Synonymized by Krivokhatsky, 2011: 112.

*Paraglenurus riparius* Miller & Stange in Miller *et al.*, 1999: 59; Stange *et al.*, 2003: 97; Stange, 2004: 214. Synonymized by Krivokhatsky, 2011: 112.

(For further literature, see Kuwayama, 1962: 383.)

*Redescription.* Male. Head. Vertex almost flat to moderately raised, pale brown, many vertical scars present anteriorly, posterior margin broadly bordered with shiny dark brown, with sparse short dark hairs; occiput whitish-yellow. Frons yellow, transverse shiny dark brown band above base of antenna, with sparse short brown hairs; gena whitish-yellow to yellow; clypeus yellow, with sparse erect long dark hairs. Antenna dark brown, long, with well defined club; scape yellow anteriorly, dark brown posteriorly; pedicel yellow anteriorly, pale brown to dark brown posteriorly; flagellum comprising approximately 45–50 flagellomeres, each flagellomere with distal whitish-yellow annulation, which sometimes indistinct distally, approximately distal 10 flagellomeres dark. Mouthparts whitish-yellow to yellow: labrum with several pale brown to brown hairs; 3rd labial palpomere, spindle-shaped, tapering to acute apex, with brown palpimacula at middle; submentum with long brown and pale yellow hairs.

Thorax. Pronotum (Fig. 4B, D, F) longer than or approximately as long as wide, color variable, pale brownish-yellow to dark grayish-brown, sometimes with pair of yellow markings posteriorly, moderately covered with short hyaline hairs and long dark hairs. Cervical sclerites dark grayish-brown. Mesonotum pale brownish-yellow to dark grayish-brown, and metanotum color variable, pale brownish-yellow to dark grayish-brown, with yellow markings, sparsely covered with dark hairs. Meso- and metapleuron largely dark brown to blackish-brown, moderately covered with long pale yellow hairs; mesoanepisternum bearing with long dark hairs.

Legs. Yellow. Coxae pale yellow, moderately covered with pale yellow hairs; fore coxa browner on outer surface. Femora moderately covered with short dark hairs, mixed with sparse long black setae ventrally; fore femur sometimes brown to pale dark brown on dorsal surface; mid- and hind femur dark brown distally, often densely speckled with dark brown on anterior surface; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark hairs, mixed with sparse long black setae; fore tibia moderately speckled with dark brown on anterior surface, with dense short brown hairs distally and ventrally; mid- and hind tibiae dark brown at distal end, densely speckled with dark brown on anterior surface. Tarsi pale yellow, Ta1 to Ta4 brown to dark brown distally, Ta5 almost dark brown, densely covered with dark hairs, dense short black bristles present on ventral surface of Ta5, Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 approximately as long as Ta1. Claws brown proximally, reddish-brown distally, long, slender, simple, almost straight, capable of closing against Ta5, approximately as long as tibial spurs.

Wings (Fig. 4A, C, E, G). Long. Forewing subacute at apex; veins and crossveins largely dark brown, whitish area present apically, Sc, R and CuA alternating dark brown and pale yellow, MP and CuP+1A almost dark brown; 2 grayish-brown spots present, small one at rhexma, the other at posterior margin near end of CuA2 and CuP+1A, which sometimes almost indistinct, membrane sometimes slightly shaded with brown along veins and crossveins; costal area simple, distal crossveins branched; presectoral area with 8–15 crossveins and 0–8 irregular cells; Rs arising beyond CuA fork, with 11–14 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused medially; hypostigmatic cell long; pterostigma white, prominent; anterior and posterior Banksian lines absent. Hindwing much acute at apex; veins and crossveins paler; 2 grayish-brown spots, small one at outside of pterostigma, the other at rhexma; presectoral area with 1 crossvein; Rs arising before MP fork, with 10–15 branches from origin of Rs to hypostigmatic cell; anterior and posterior Banksian

lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, brown to dark grayish-brown, posterior margin of tergite II to VII usually bordered with yellow, tergites III to V sometimes with median

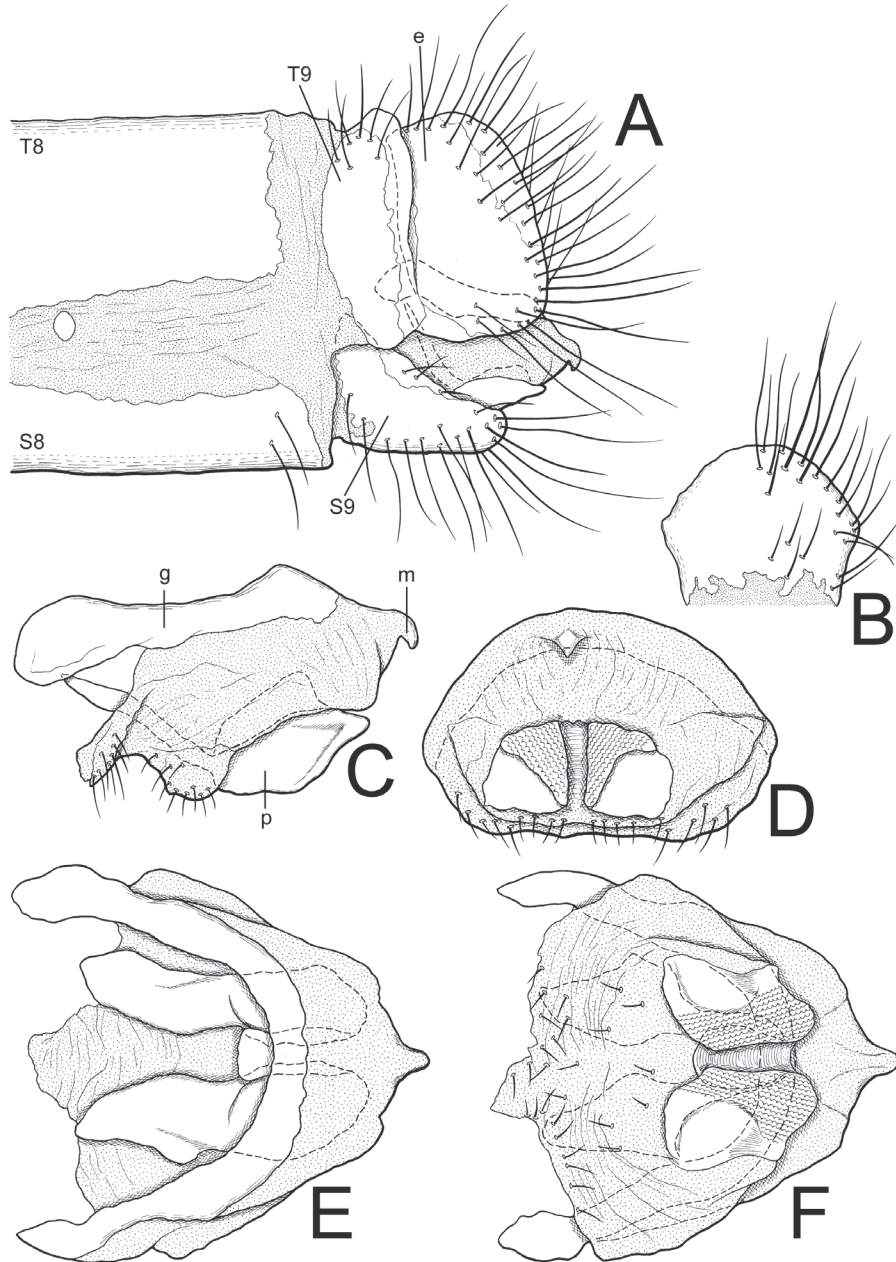


Fig. 30. Male terminalia of *Paraglenurus japonicus*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

yellow marking, densely covered with pale brown hairs.

Terminalia (Fig. 30AB): tergite IX narrow in lateral view, divided dorsally; sternite IX broad, rounded along posterior margin in ventral view, with long black setae posteriorly; ectoproct simple, almost rectangular in lateral view, with dense long dark hairs posteriorly. Genitalia (Fig. 30C–F): gonarcus shallow in lateral view, moderately arched in dorsal view; mediuncus lightly sclerotized, pale, hooked ventrally in lateral view; parameres large, well sclerotized posteriorly.

*Length*: B, 30–34; FW, 33–39; HW, 32–40.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 31AB): tergite VII with some dark setae along posterior margin medially; sternite VII with dense long dark fine hairs along posterior margin; tergite IX rather broad ventrally in lateral view, divided dorsally, with dense long dark fine hairs ventrally; ectoproct oval, ventral margin slightly lobed posteriorly in lateral view, with several black setae and dense long dark fine hairs ventrally; lateral gonapophyses elongate, with long black fossorial bristles; posterior gonapophyses long, slender, extending beyond tergite IX in lateral view, slightly curved in ventral view, with dense long dark fine hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, broad in ventral view; pregenital plate well sclerotized, triangular, present on membrane below tergite VIII in lateral view; spermatheca (Fig. 31C) short.

*Length*: B, 27–33; FW, 30–36; HW, 30–37.

*Specimens examined*. Lectotype ♂ (SEHU), *Glenuroides communis* Okamoto. Verbatim label data: “Nakano / Japan / Matsum”; “7/14 [written on the back of the above-mentioned label]”; “*Glenuroides communis* n. sp. / det H. OKAMOTO / COTYPE 1910”; “*Glenuroides japonicus* McLACHLAN/ Det. S. KUWAYAMA / 1957” “Lecto-type / *Glenuroides communis* OKAMOTO / det. KUWAYAMA ‘65”. Other specimens. 1♀ (NSMT), no other data. [Hokkaido] 1♀, Moshiri, Horokanai, 27. vii. 1999, R. Tomisawa; 1♂, Minamisyokan-so (550 m), Syokanbetsu Park, Hokkaido, 20. vii. 1984, M. Suwa; 1♂, same locality, 3. viii. 1984, T. Kumata; 1♂ (NSMT), Akabira, Hokkaido, 23. vii. 1954, K. Fujimoto; 1♀, Hokkaido Univ., Sapporo-City, 1998, G. Ito; 1♀, Gamushi, 12. vii. 1958, T. Kumata; 7♀, Siriuti, Osima, Hokkaido, 6. viii. 1976, T. Kumata *et al.* [Honshu] 1ex (NSMT), Akaishi-dam, Ajigasawa, Nishitsugaru-gun, Aomori, 11. viii. 1986, A. Abe; 1♀, Meya-dam, Nishimeya, Aomori, 15. viii. 1985, T. Nakamura; 1♂ 1♀, same locality, 8. ix. 1989, T. Nakamura; 1ex (NSMT), Tomobe, Ibaraki, 31. vii. 1932, T. Tani; 1ex (NSMT), Shoubuzawa, Kozakura, Ibaraki, 19. vii. 1936, T. Tani; 1♂ (NSMT), Karuizawa, Gunma, 21. viii. 1971, Y. Kurosawa; 1♀ (NSMT), Koonodi, 31. viii. 1920, K. K.; 1♂ 1♀, Nakano, 14. vii. year unknown, S. Matsumura; 1♂ 1ex, same locality, 15. vii. year unknown, S. Matsumura; 1ex, Tokyo, S. Matsumura; 1♂ 1ex, Takasago, 4. viii. year unknown, S. Matsumura; 1♂, Daisenji, 31. vii. year unknown, S. Matsumura; 1♀ (NSMT), Mejiro, Tokyo, 30. vii. 1949, W. Nakahara; 1♀ (NSMT), same locality, viii. 1949, W. Nakahara; 1ex (NSMT), same locality, viii. 1951, W. Nakahara; 1♂ (NSMT), Oomachi, 7. viii. 1933, Matsumoto; 1♂ (NSMT), Kinuta, Tokyo, 3. vi. 1958, Y. Kurosawa; 1♂ (NSMT), same locality, 6. vii. 1958, Y. Kurosawa; 1♂ (NSMT), same locality, 27. vii. 1966, Y. Kurosawa; 1♀ (NSMT), Shakuji, Tokyo, 22. vi. 1952, W. Nakahara; 1♀ (NSMT), Hoya, Tokyo, 14. vii. 1957, K. Fujimoto; 1♂ (NSMT), Kiyose, Tokyo, 17. vi. 1962, Y. Kurosawa; 1♀ (NSMT), Kunitachi, Tokyo, 8. viii. 1954, T. Sugimura; 4♂ 1♀ (NSMT), Mt. Takao, 1. vii. 1957, K. Fujimoto; 1♀ (NSMT), Oodarumi, Mt. Takao, Tokyo, 19. ix. 1971, Y. Kurosawa; 1♀ (NSMT), Nippara, Okutama, Tokyo, 27. ix. 1976, M. Tomokuni; 1♂ 3♀ 1ex (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♂ (NSMT), Itoigawa, Kotaki-gawa Riv., 280m, South foot of Mt. Myojosan, Niigata, 11. vii. 1983, M. Owada & T. Naito; 1♀ (NSMT), Itoigawa, Kotaki, Mt. Myojosan,



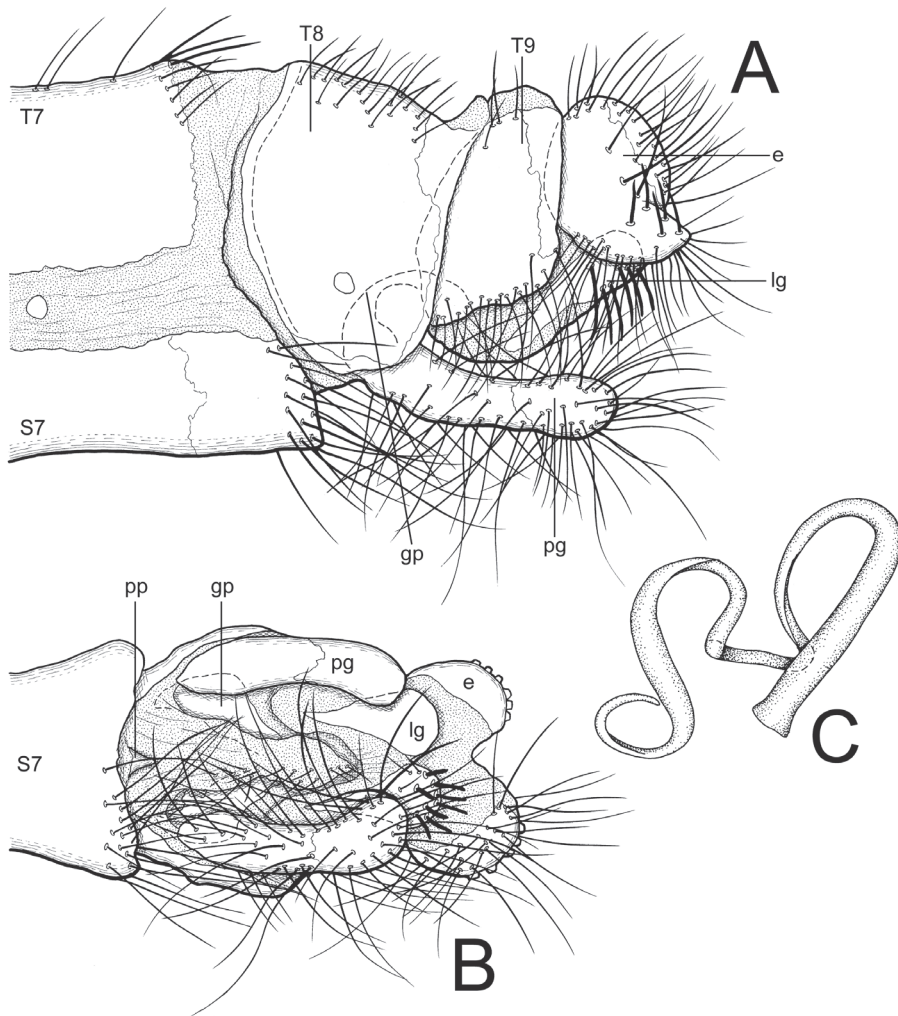


Fig. 31. Female terminalia of *Paraglenurus japonicus*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

Niigata, 16. vii. 1988, M. Owada; 1♂, Kanazawa-marunouchi, Ishikawa, 11. ix. 1994, collector unknown; 1♂ (NSMT), Haizawa-onsen, Kisoagematsu, 31. viii. 1967, collector unknown; 2♀ (NSMT), Mt. Hiei, Kyoto, 21. vii. 1955, M. Ogata; 2♀, Mt. Makiosan, Izumi, Osaka, 4. viii. 1982, S. Hashimoto. [Shikoku] 1♂, Haginoto, Kagawa, 21. vii. 1979, H. Toshima; 1♂, Okushioiri, Chunan, Kagawa, 2. ix. 1972, H. Toshima; 1♀ (NSMT), Matsuyama, Shikoku, 15. viii. 1962, collector unknown. [Kyushu] 2♂ (NSMT), Mt. Hikosan, Fukuoka, 21. vii. 1969, Y. Kurosawa; 1♀ (NSMT), Chiran, Kagoshima, 12. vii. 1963, Y. Kurosawa; 1♀ (NSMT), Nagata, Yakushima Is., 26–30. viii. 1984, M. Nishizawa. [Ryukyus] 1♀ 1ex (NSMT), Yona, Kunigami, Okinawa I., 12. vi. 1973, Y. Kurosawa; 1♀ (NSMT), Plant garden, Ishigaki, Ishigaki Is., 24. v. 1973, Y. Kurosawa; 1♂, Funaura, Iriomote Is., Okinawa Pref., 24. v. 1983, T. Tanabe.

*Distribution.* Japan (Hokkaido, Honshu, Awashima Is., Izu-oshima Is., Miyakejima

Is., Hachijojima Is., Shikoku, Kyushu, Tsushima Is., Yakushima Is., Okinawajima Is., Ishigakijima Is., Iriomotejima Is.); Korea, China, Taiwan, Russian Far East.

*Remarks.* *P. japonicus* is highly variable in body size and wing pattern. Krivokhatsky (2011) noted that the variation in wing pattern of this species overlaps with two Taiwanese species, *P. littoralis* Miller & Stange and *P. riparius* Miller & Stange. Therefore, Krivokhatsky (2011) synonymized these two Taiwanese species with *P. japonicus*.

In Japan, Hayashi (2013) and Yoshitomi *et al.* (2013) referred to the high morphological variation of this species. Moreover, Hayashi (2013) found two larval forms of *Paraglenurus* sp. from Shimane Prefecture and western Tottori Prefecture, Japan. According to Hayashi (2013), these two types can be distinguished by the hair condition of dorsal surface of head: *Paraglenurus* sp. TYPE 1 has scale-like setae, but TYPE 2 has unmodified erect setae. Hayashi (2013) revealed the correspondence of these larvae and adults, and reported that the adults of TYPE 1 are very small with faint wing pattern whereas the adults of TYPE 2 are rather large with darker wing veins. However, Hayashi (2013) could not identify them to species level, because of the high morphological variation of *P. japonicas* and the unclear taxonomic status of *P. japonicas* and *P. okinawensis*.

Through the present examinations, the morphological high variations of this species were also recognized, and such forms may be separable to several distinct species with different head structure, pronotum color pattern, wing shape and wing pattern. However, the variations are somewhat continuous, and no significant differences were determined in their genital structures. Unfortunately, in this study, I did not examine larvae and could not reveal the correspondence of the larvae and adults of them. The separation into different species is consequently postponed. Further examination of larval and adult structures and molecular-based analyses are needed to confirm the status of the different forms of this species, including the synonymies proposed by Krivokhatsky (2011).

*Paraglenurus okinawensis* (Okamoto)  
(Figs 4H, 32, 33)

*Glenuroides okinawensis* Okamoto, 1910: 296; Nakahara, 1913b: 301; Okamoto, 1914: 249; Matsumura, 1931: 1157; Banks, 1937: 287; Kuwayama, 1964: 46; 1966: 138; Tanaka, 1979: 215.

*Paraglenurus okinawensis*: Miller *et al.*, 1999: 58; Yoshitomi *et al.*, 2013: 4.

*Redescription.* Male. Head. Vertex slightly raised, pale brown, pair of small blackish-brown markings postero-laterally, many vertical scars present anteriorly, posterior margin sometimes bordered with shiny dark brown, with sparse short dark hairs; occiput pale yellow. Frons yellow, transverse shiny dark brown band above base of antenna, with sparse short brown hairs; gena whitish-yellow; clypeus pale yellow, with sparse erect long brown hairs. Antenna pale brown to brown, long, with well defined club; scape yellow anteriorly, dark brown posteriorly; pedicel pale brown; flagellum comprising approximately 45 flagellomeres, each flagellomere with distal whitish-yellow annulation, approximately distal 10 flagellomeres dark. Mouthparts yellow: labrum with several pale brown hairs; 3rd labial palpomere with small pale brown palpicula at middle; submentum with long brown hairs.

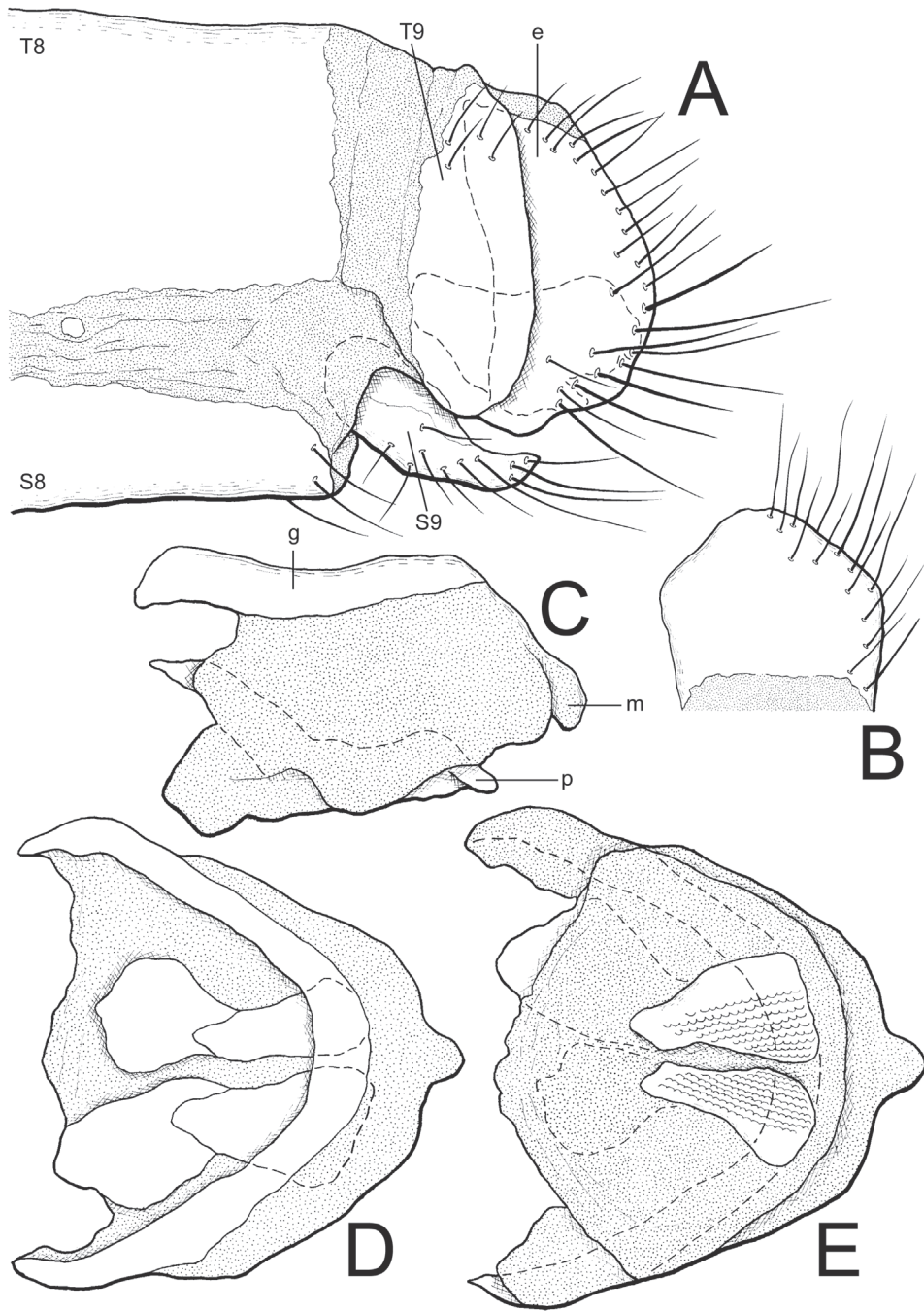


Fig. 32. Male terminalia of *Paraglenurus okinawensis*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

Thorax. Pronotum approximately as long as broad, pale brown, with pale brown hairs and long dark hairs. Cervical sclerites dark brown. Mesonotum largely pale brown, sometimes darker anteriorly and laterally, sparsely covered with pale yellow hairs; mesoprescutum with long dark hairs. Metanotum pale brown, darker laterally, with pair of longitudinal black stripes submedially, almost hairless. Meso- and metapleuron pale yellow, with longitudinal dark brown stripe at middle, moderately covered with pale yellow hairs.

Legs. Yellow. Coxae pale yellow, moderately covered with pale yellow hairs; fore coxa slightly browner on outer surface. Femora sparsely covered with short dark hairs, mixed with sparse longer black setae; fore femur sometimes brown to pale dark brown on dorsal surface; mid- and hind femur dark brown distally, often speckled with dark brown on anterior surface; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae sparsely covered with short dark hairs, mixed with sparse longer black setae; fore tibia faintly speckled with dark brown on anterior surface; mid- and hind tibiae dark brown at distal end, moderately speckled with dark brown on anterior surface. Tibial spurs brown proximally, reddish-brown distally, long, slender, slightly curved distally, approximately as long as Ta1. Tarsi pale yellow, Ta1–Ta4 brown to dark brown distally, Ta5 dark brown distally, densely covered with dark hairs, dense short black bristles present on ventral surface of Ta5; Ta1 approximately as long as or slightly longer than Ta2, Ta5 longer than Ta1. Claws brown proximally, reddish-brown distally, long, slender, simple, almost straight, capable of closing against Ta5, approximately as long as tibial spurs.

Wings (Fig. 4H). Small. Forewing subacute at apex; veins and crossveins alternating dark brown and pale yellow, whitish near apex; rhegma area with small grayish-brown spot, grayish-brown oblique streak at anastomosis of CuA2 and CuP+1A; costal area simple, distal crossveins branched; presectoral area with 8–11 crossveins, without irregular cell; Rs arising beyond CuA fork, with 8–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused medially; hypostigmatic cell long; pterostigma white; anterior and posterior Banksian lines absent. Hindwing approximately as long as forewing; much acute at apex; veins and crossveins paler; rhegma area with larger grayish-brown marking; presectoral area with 1 crossvein; Rs arising before MP2 fork, with 9–11 branches from origin of Rs to hypostigmatic cell; hypostigmatic cell longer; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Shorter than hindwing, brown to dark brown, posterior margin of tergite II to VII usually bordered with yellow, tergites III to V sometimes with median yellow markings, densely covered with pale brown hairs.

Terminalia (Fig. 32AB): tergite IX narrow in lateral view, divided dorsally; sternite IX broad, rounded along posterior margin in ventral view, with long black setae posteriorly; ectoproct simple in lateral view, with dense long dark hairs posteriorly. Genitalia (Fig. 32C–E): gonarcus shallow in lateral view, moderately arched in dorsal view; mediuncus lightly sclerotized, pale; parameres large, well sclerotized posteriorly.

*Length:* B, 20–22; FW, 22–23; HW, 22–23.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 33A): tergite VII with some dark setae along posterior margin medially; sternite VII with dense long dark fine hairs along posterior margin; tergite IX rather broad ventrally in lateral view, divided dorsally, with dense long dark fine hairs ventrally;

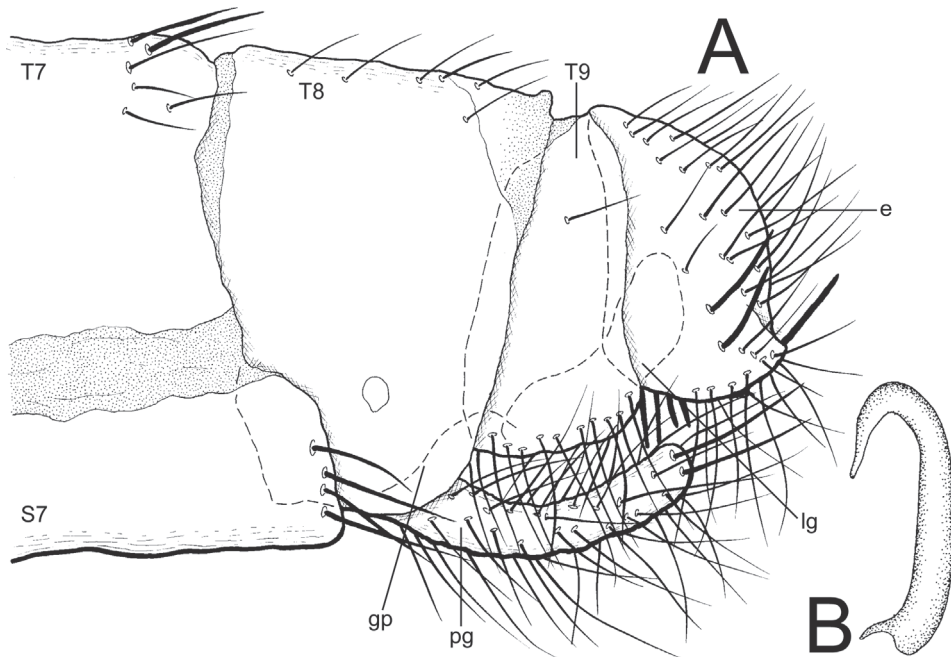


Fig. 33. Female terminalia of *Paraglenurus okinawensis*. A. Terminalia, lateral view. B. Spermatheca.

ectoproct slightly lobed ventrally in lateral view, with several black setae and dense long dark fine hairs ventrally; lateral gonapophyses elongate, with long black fossorial bristles; posterior gonapophyses long, slender, extending beyond tergite IX in lateral view, with dense long dark fine hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view; spermatheca (Fig. 33B) short.

*Length:* B, 20–24; FW, 23–25; HW, 23–25.

*Specimens examined.* Holotype ♀ (SEHU), *Paraglenurus okinawensis* (Okamoto). Verbatim label data: “Japan / Matsumura”; “Kuroiwa [written on the back of the above-mentioned label]”; “*Glenuroides / okinawensis / n. sp. / det H. OKAMOTO / 1910*”; “Holotype [written on the back of the above-mentioned label]”. Other specimens. [Shikoku] 1♀ (NIAES), Sea-shore of Kagawa, viii. 1973, T. Tanaka. [Kyushu] 1♀ (NSMT), Takarajima Is., Tokara, Kagoshima, 2. viii. 1981, H. Suzuki; 1♀, Mikyo, Amagi-cho, Tokunoshima Is., Kagoshima, 1–6. vii. 1985, M. Tanabe. [Ryukyus] 1♂ (NIAES), Okinawa, no data, S. Sakaguchi; 2♂ 1♀, Okinawa, no data, S. Sakaguchi.

*Distribution.* Japan (Honshu, Shikoku, Kyushu, Takarajima Is., Tokunoshima Is., Okinawajima Is.); Korea(?).

*Remarks.* This species closely resembles *P. japonicus* in general appearance but can be clearly distinguished from it by the significantly smaller size (forewing length 22–25 mm in *P. okinawensis*, but 30–39 mm in *P. japonicus*).

Miller *et al.* (1999) described *Paraglenurus lotzi* Miller & Stange from Taiwan. According to Miller *et al.* (1999), this species is closely related to *P. okinawensis* but differs in wing markings and structure of the tarsomeres. However, these characters are very variable and are also manifest in Japanese *P. okinawensis*. Moreover, no significant



differences were determined in their genital structures. Therefore independent species status between *P. lotzi* and *P. okinawensis* is questionable.

Krivokhatsky (2011) referred to the small specimens of *P. japonicus* collected in the southern parts of South Korea (forewing length 23–25 mm). Although Krivokhatsky (2011) mentioned that this phenomenon is apparently due to accelerated development of individuals, the body size difference between these *P. japonicus* specimens completely corresponds the above-mentioned difference between *P. japonicus* and *P. okinawensis*. Therefore, it is possible that the small specimens of *P. japonicus* collected in South Korea correspond *P. okinawensis*.

#### Genus *Pseudoformicaleo* van der Weele

*Pseudoformicaleo* van der Weele, 1909: 25. Type species: *Myrmeleon gracilis* Klug in Ehrenberg, 1834, by subsequent designation by Kuwayama, 1962: 384. (incorrect type species of *Pseudoformicaleo jacobsoni* by New, 1985a: 43)

(For further synonymies, see Stange, 2004: 121.)

*Diagnosis.* Small-sized antlions; antenna with well-defined club; pronotum longer than broad; wings narrow, hyaline, without marking; costal area of both wings simple; forewing presectoral area usually with approximately several crossveins; forewing vein Rs arising beyond CuA fork; forewing veins CuA2 and CuP+1A running parallel for long distance; forewing veins 2A and 3A fused medially; hindwing presectoral area with 1 crossvein; hindwing vein Rs arising well before MP2 fork; male without pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs approximately as long as Ta1; male ectoproct simple, without postero-ventral lobe; gonarcus strongly arched, U-shaped in dorsal view; mediuncus absent; parameres proximally fused, distally hook-shaped in lateral view and fork-shaped in ventral view; gonosaccus usually with several long gonosetae; female ectoproct simple; posterior gonapophyses short; anterior gonapophyses absent; gonapophyseal plates present; spermatheca short.

*Remarks.* This small genus consists of 9 species distributed in Africa, Madagascar, Asia and Australia (Stange 2004). The habits of adults and larvae are unknown.

#### *Pseudoformicaleo nubecula* (Gerstaecker) (Figs 5AB, 34, 35)

*Creagris nubecula* Gerstaecker, 1885: 101.

*Pseudoformicaleo jacobsoni* van der Weele, 1909: 25; Adams, 1959: 15; Kuwayama, 1962: 384. Synonymized by Esben-Petersen, 1915: 67.

*Pseudoformicaleo jacobsoni wetterensis* van der Weele, 1909: 27. Synonymized by Stange, 2004: 122.

*Protoplectron costatus* Banks, 1910: 41. Synonymized by Esben-Petersen, 1915: 67.

*Creagris matsuoakae* Okamoto, 1910: 282, fig. 3; Kuwayama, 1966: 138. Synonymized by Adams, 1959: 15.

*Tahulus caligatus* Navás, 1912a: 113. Synonymized by Esben-Petersen, 1915: 67.

*Creagris horikawae* Nakahara, 1913a: 527. Synonymized by Kuwayama, 1962: 384.

*Tahulus asthenicus* Navás, 1914e: 140. Synonymized by Esben-Petersen, 1920: 191.

*Tahulus ignobilis* Navás, 1914a: 115. Synonymized by Stange *et al.*, 2003: 102.

*Pseudoplectron costatus*: Navás, 1914d: 467.

*Pseudoformicaleo nubecula*: Esben-Petersen, 1915: 67; 1920: 191; New, 1985a: 43; 1990: 5; Stange *et al.*, 2003: 102; Stange, 2004: 122; Krivokhatsky *et al.*, 2012: 573; Yoshitomi *et al.*, 2013: 3.

*Gama matsuoekae*: Banks, 1937: 287.

*Exilunguleon nanus* Yang, 1999: 154. Synonymized by Krivokhatsky *et al.*, 2012: 573.

(For further literature, see Kuwayama, 1962: 384.)

*Redescription*. Male. Head. Vertex moderately raised, rounded, pale yellowish-brown, with anterior row of 3 blackish-brown spots and posterior row of 5 blackish-brown spots, with sparse short dark hairs; occiput gray, usually with 1–2 brown to blackish-brown vertical stripes. Frons yellow, with dark brown marking surrounding base of antenna, with sparse short dark hairs, some white hairs present between antennae; gena dark brown, with very short several white or dark hairs along dorsal ocular rim; clypeus yellow, with sparse erect long dark hairs. Antenna dark brown, short, with well defined club, densely covered with short dark hairs, short white hairs mixed from scape to approximately forth proximal flagellomere; scape yellow anteriorly, dark brown posteriorly; pedicel with distal yellow annulation; flagellum comprising approximately 38 flagellomeres, each flagellomeres with distal yellow annulation. Mouthparts brown to pale dark brown; labrum whitish-yellow, with several brown hairs; 3rd labial palpomere spindle-shaped, tapering to acute apex, with palpimacula on proximal 1/3; submentum with long dark hairs.

Thorax. Pronotum (Fig. 5B) long, longer than broad, dark brown to dark grayish-brown, with long dark and white hairs. Cervical sclerites dark grayish-brown. Mesonotum dark grayish-brown, sparsely covered with long dark hairs; mesoprescutum with pair of small blackish-brown spots posteriorly; mesoscutum with slightly curved blackish-brown streak on each antero-lateral surface, approximately 10 long white setae present anteriorly; mesoscutellum paler, yellowish along posterior margin, with blackish-brown spot antero-medially. Metanotum dark grayish-brown, with blackish-brown transverse band at middle, almost hairless. Mesopleuron and metapleuron dark brown to dark grayish-brown, moderately covered with long white hairs.

Legs. Yellow, short, sturdy. Coxae largely dark brown to dark grayish-brown, densely covered with long white setae. Femora densely covered with white and dark hairs, mixed with long white setae; fore femur dark brown distally; mid femur dark brown at distal end and on posterior surface, anterior surface speckled dark brown, with prominent blackish-brown spot on anterior surface near distal end; hind femur mostly dark brown; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae moderately covered with short dark and white hairs, mixed with sparse long black and white setae; fore tibia dark brown at proximal and distal end, with dark brown dorsal ring at middle, with dense short brown setae distally; mid- and hind tibiae dark brown at distal end, with dark brown ring on proximal 1/3. Tibial spurs reddish-brown, long, slender, slightly curved, approximately as long as Ta1. Tarsi dark brown, except for proximal yellow portion of Ta1–Ta5, moderately covered with dark hairs dorsally, rarely mixed with white hairs, sparse short black bristles present ventrally; Ta1 much longer than combined length of Ta2–Ta4, Ta5 approximately as long as Ta1. Claws reddish-brown distally, pale brown proximally, slender, slightly curved apically, ridged, approximately 1/2 as long as tibial spurs.

Wings (Fig. 5A). Short, narrow. Forewing acute at apex, often falcate near apex; veins alternating dark brown and pale yellow, crossveins dark brown and pale yellow; costal area with single row of cells; presectoral area with 6–8 crossveins, and 0–3 irregular cells; Rs arising beyond CuA fork, with 8–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A mostly

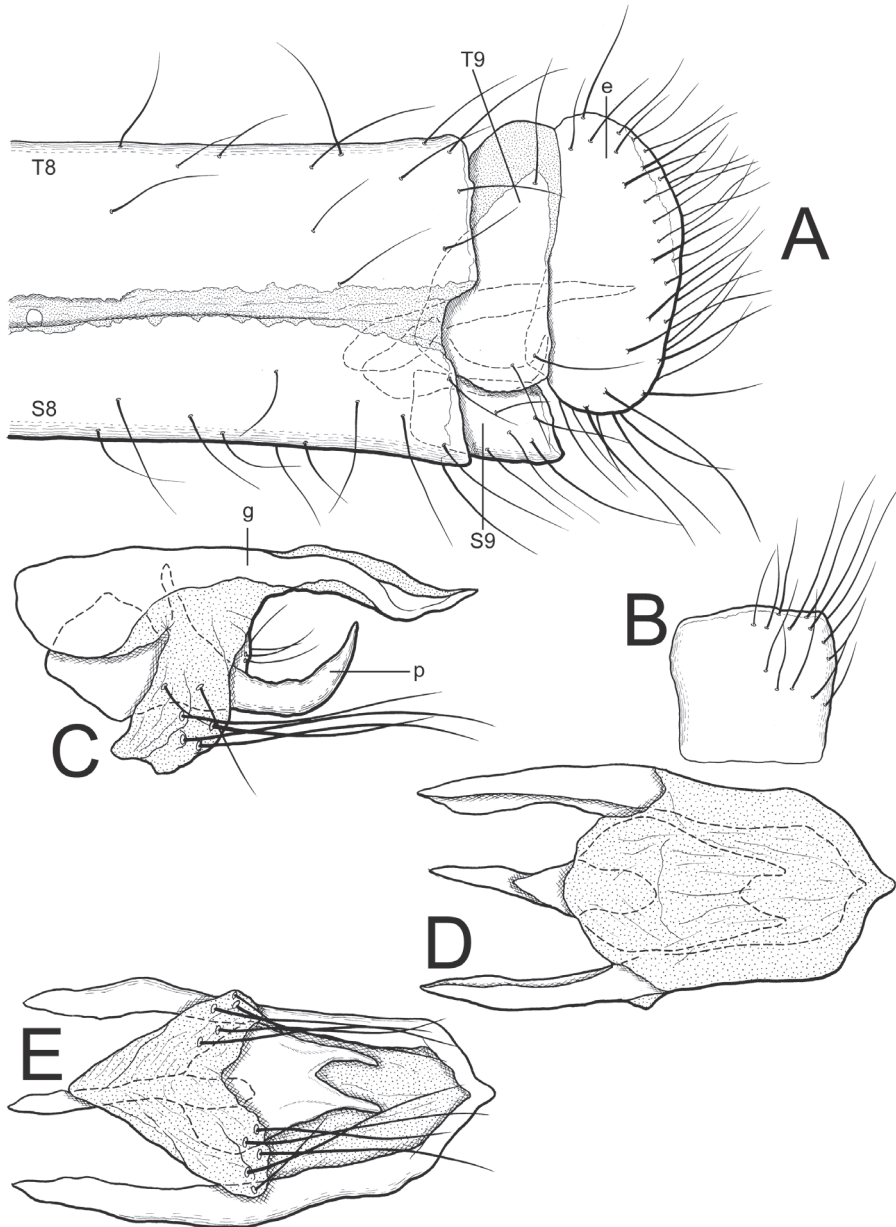


Fig. 34. Male terminalia of *Pseudoformicaleo nubecula*. A. Terminalia, lateral view. B. Sternite IX, ventral view. C. Genitalia, lateral view. D. Ditto, dorsal view. E. Ditto, ventral view.

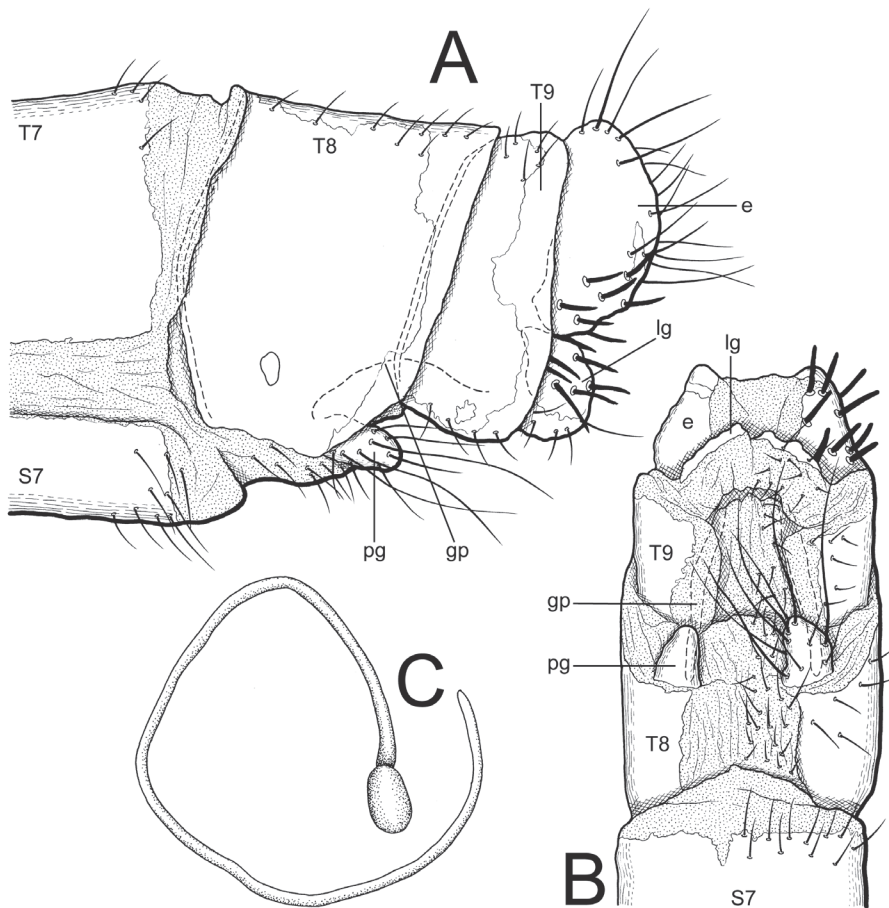


Fig. 35. Female terminalia of *Pseudoformicaleo nubecula*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

separate, medially fused, not parallel; pterostigma white to yellowish-white, with proximal dark brown spot; anterior and posterior Banksian lines absent. Hindwing shorter and narrower than forewing; presectoral area with 1 crossvein; Rs arising well before MP2 fork, with 9–11 branches from origin of Rs to hypostigmatic cell; pterostigma without proximal dark brown spot; anterior and posterior Banksian lines absent; male without pilula axillaris.

Abdomen. Blackish-brown, approximately as long as hindwing, tergite and sternite long, densely covered with short white or hyaline hairs, becoming longer anteriorly, mixed with short dark hairs posteriorly.

Terminalia (Fig. 34AB): tergite IX slightly broadened ventrally in lateral view, divided dorsally; sternite IX broad, almost square in ventral view, with long black setae posteriorly; ectoproct deep, elongated oval in lateral view, with long dark hairs posteriorly. Genitalia (Fig. 34C–E): gonarcus strongly sclerotized, strongly arched in dorsal view; mediuncus absent; parameres without seate; gonosaccus with approximately 6 long black gonosetae.

*Length:* B, 29–30; FW, 23–24; HW, 21–22.

Female. Coloration and general morphology, except terminalia, almost as in male. Terminalia (Fig. 35AB): tergite IX narrow, deep in lateral view, divided dorsally; ectoproct oval in lateral view, with short black fossorial bristles ventrally; lateral gonapophyses rounded in lateral view, with short black fossorial bristles; posterior gonapophyses short in lateral view, with long dark hairs; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 35C) slender.

*Length:* B, 26–28; FW, 25–27; HW, 22–25.

*Specimens examined.* 1♀, locality unknown, 10. vii. 1916, S. Matsumura. [Honshu] 1♀, Baibara, 19. viii. 1925, Kikuchi; 1♂, Shinodayama, Izumi, Osaka, 4. vii. 1984, S. Tsukaguchi; 1♀, same locality, 2. viii. 1984, S. Tsukaguchi; 1♀, same locality, 9. viii. 1985, S. Tsukaguchi. [Shikoku] 1♀, Mt. Tsunoyama, Sakaide, Kagawa, 6. ix. 1980, H. Toshima (Light trap); 1♀ (NIAES), Mt. Goshikidai (200m), Kagawa, 4. vii. 1973, T. Tanaka. [Ryukyus] 1♂ (NIAES), Ishigakijima, Okinawa, 21. v. 1934, K. Baba.

*Distribution.* Japan (Honshu, Shikoku, Kyushu, Ishigakijima Is.); China, Taiwan, Malaysia, Java, Sri Lanka, Palau, Western Caroline Island, Australia.

*Remarks.* This widely distributed species was originally described from Australia. Kuwayama (1962) pointed out that the Japanese specimens did not agree with the original description of Australian *P. nubecula*, especially on the wing markings. In the present study, several Japanese specimens were examined and compared with the redescription of *P. nubecula* based on the Australian specimens by New (1985a). Although I could not confirm the differences of wing markings as reported by Kuwayama (1962), the following differences were recognized: Japanese specimens have falcate wings (Fig. 5A) whereas not falcate in Australian; Japanese females lack pregenital plate (Fig. 35AB) whereas Australian females have it; Japanese female posterior gonapophyses is shorter than Australian (Fig. 35AB). However, in other external features, Japanese specimens are in close agreement with the redescription by New (1985a).

#### Tribe Acanthaclisini

*Remarks.* According to Stange (2004), this tribe is characterized by the following character state: hindwing vein CuA uniting with posterior fork of MP2 shortly after MP2 fork.

This tribe comprises 16 genera and is well defined in both adults and larvae (Stange & Miller 1985). The detailed generic review based on larvae was provided by Stange & Miller (1985). Adults of most species are large, robust and pilose, and males usually have abdominal hair pencils. The larvae of the genus do not construct pitfall traps.

#### Genus *Synclisis* Navás

*Synclisis* Navás, 1919: 218. Type species: *Acanthaclisis baetica* Rambur, 1842, by original designation.

*Diagnosis.* Large-sized antlions; thorax and legs densely hairy; wings moderately broad, long, large, hyaline; forewing costal area biareolate; forewing presectoral area usually with approximately 5–10 crossveins; forewing vein Rs arising beyond CuA



fork; forewing veins 2A and 3A fused medially; hindwing costal area simple; hindwing presectoral area usually with approximately 5 crossveins; hindwing vein Rs arising beyond MP2 fork; hindwing vein CuA uniting with posterior fork of MP2 shortly after MP2 fork; male with pilula axillaris; femoral sense hair present on fore- and midlegs, absent from hindleg; tibial spurs stout, strongly curved, usually approximately as long as combined length of Ta1–Ta3; male ectoproct with postero-ventral lobe; gonarcus broad in dorsal view; mediuncus with dorsal hook; parameres fused with gonarcus anteriorly, strongly hooked and tapered posteriorly; gonosaccus usually with long gonosetae; female ectoproct simple; lateral gonapophyses present; posterior gonapophyses long; anterior gonapophyses absent; gonapophyseal plates present; spermatheca long.

*Remarks.* This genus contains only 4 species, but the generic placement of *Synclisis cryptica* Fraser, 1955 from Madagascar is unclear (Stange 2004). The larvae are very fast runners and burrowers, preferring open sand dune areas.

*Synclisis japonica* (McLachlan, 1875)  
(Figs 5CD, 36, 37)

*Acanthaclisis japonica* Hagen, 1866a: 289. nom. nud.

*Acanthaclisis baetica* var. *japonica* Hagen, 1866b: 378. nom. nud.

*Acanthaclisis japonica* McLachlan, 1875a: 174; Okamoto, 1910: 284; Baba, 1953: 15.

*Heoclisis japonica*: Navás, 1923: 13; Kuwayama, 1962: 390; Bao & Wang, 2004: 512; Hayashi, 2012: 203; 2013: 194; Yoshitomi *et al.*, 2013: 6.

*Synclisis japonica*: Stange, 2004: 359; Krivokhatsky, 2011: 297.

(For further literature, see Kuwayama, 1962: 390.)

*Redescription.* Male. Head. Vertex moderately raised, rounded, dull grayish-black, anterior transverse shiny dark brown band sometimes divided into 3 areas, pair of shiny dark brown spots at middle, pair of dark brown portions postero-laterally, postero-median dark brown spot sometimes separated by colonal suture, with dense short dark hairs, mixed with sparse short white hairs posteriorly; occiput brown to dark brown. Frons yellow, with dark brown spot between base of antenna, densely covered with long white hairs; gena yellow; clypeus yellow, with dense erect long pale brown and white hairs. Antenna dark brown to blackish-brown, long, with slightly defined club, densely covered with short dark hairs, long white hairs mixed on scape and pedicel; scape mostly dark brown, yellow anteriorly; pedicel dark brown; flagellum comprising approximately 50 flagellomeres, each flagellomere with narrow distal whitish-yellow annulation. Mouthparts yellow: labrum with some brown hairs; labial palpus slender, much longer than maxillary palpus; 3rd labial palpomere brown, with elongate slit-like brown palpimacula near apex.

Thorax. Densely hairy. Pronotum (Fig. 5D) broad, approximately as long as broad, dark grayish-brown to blackish-brown, with pairs of longitudinal yellow stripes, sometimes narrow longitudinal yellow midline distinct, densely covered with long dark and white hairs. Cervical sclerites dark grayish-brown. Mesonotum dark grayish-brown to blackish-brown, with pair of longitudinal yellow stripes extending from anterior margin to posterior margin, densely covered with long dark hairs, mixed with very long white hairs along posterior margin; mesoscutellum with narrow longitudinal yellow midline. Metanotum dark blackish-brown, with pair of yellow spots at middle, densely

covered with very long white hairs posteriorly. Meso- and metapleuron mostly dark grayish-brown, densely covered with long white hairs.

Legs. Yellow, short, sturdy, densely hairy. Coxae densely covered with long white hairs. Femora yellow proximally, brown to dark brown distally, densely covered with

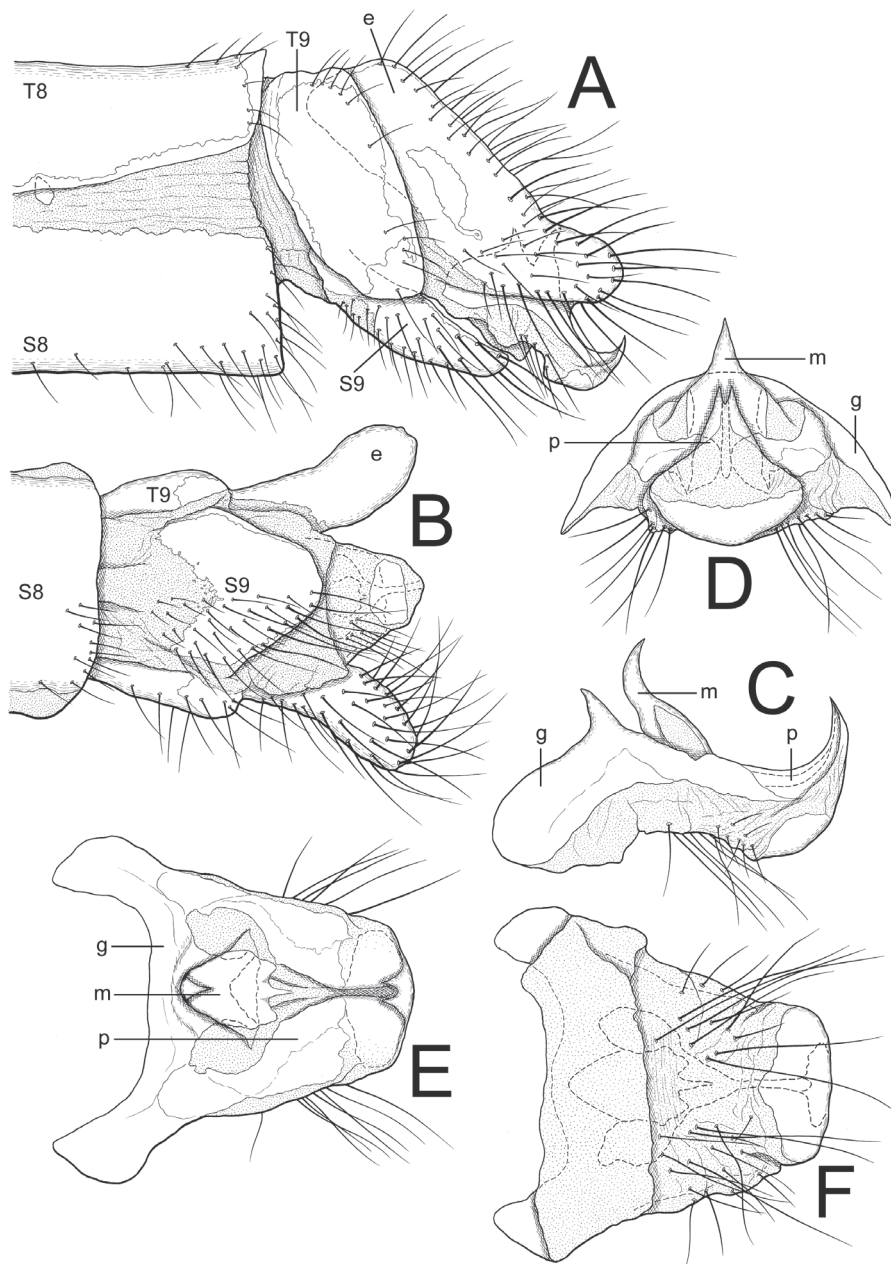


Fig. 36. Male terminalia of *Synclisis japonica*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Genitalia, lateral view. D. Ditto, caudal view. E. Ditto, dorsal view. F. Ditto, ventral view.

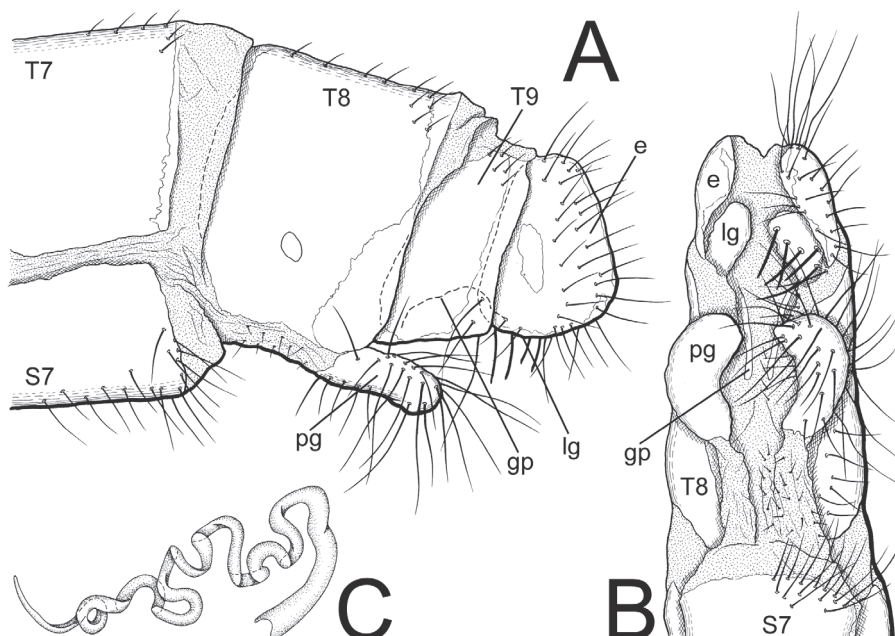


Fig. 37. Female terminalia of *Synclisis japonica*. A. Terminalia, lateral view. B. Ditto, ventral view. C. Spermatheca.

long white setae, mixed with long black setae and short black bristles ventrally; femoral sense hair present on fore- and midlegs, absent from hindleg. Tibiae densely covered with long white and black setae; fore- and mid tibiae dark brown at proximal and distal ends, with 2 dark brown spots at middle; hind tibia dark brown at distal end, with sparser setae. Tibial spurs reddish-brown, short, stout, strongly curved, approximately as long as combined length of Ta1–Ta3. Tarsi dark brown to blackish brown, except for yellow proximal portion of Ta1, densely covered with dark hairs dorsally, short black setae ventrally; Ta1 approximately as long as combined length of Ta2–Ta3, Ta5 much longer than combined length of Ta1–Ta4; claws reddish-brown, short, stout, broad at base, simple, curved.

Wings (Fig. 5C). Long, broad. Forewing rather rounded at apex; veins and crossveins alternating dark brown to blackish-brown and yellowish-white to yellow; crossveins irregularly shaded with dark brown, some small dark brown spots in subcostal cell; costal area biareolate; presectoral area with 5–10 crossveins and 0–6 irregular cells; Rs arising well beyond CuA fork, with 9–11 branches from origin of Rs to hypostigmatic cell; CuP supporting 1 cell before fusing with 1A; 2A and 3A fused; hypostigmatic cell short; pterostigma yellowish-white, with proximal dark brown spot; anterior and posterior Banksian lines well developed. Hindwing shorter and narrower than forewing; membrane almost not shaded; presectoral area with 5–7 crossveins; Rs arising well beyond MP2 fork, with 10–13 branches from origin of Rs to hypostigmatic cell; CuA uniting with posterior fork of MP2 shortly after MP2 fork; anterior and posterior Banksian lines developed; male with pilula axillaris.

Abdomen. Blackish-brown, stout, shorter than hindwing, densely covered with short dark hairs, tergite V and proximal half of tergite VI densely covered with appressed shiny silver pubescence and without hair pencil, sternite III to VIII with distal yellow marking, pleural membrane between abdominal segments VIII and IX very long.

Terminalia (Fig. 36AB): tergite IX narrow in lateral view, divided dorsally; sternite IX elongate in lateral view, broad, rounded distally in ventral view, with long black setae distally; ectoproct with elongated postero-ventral lobe, with hyaline hairs posteriorly, dense long black setae ventrally. Genitalia (Fig. 36C–F): gonarcus with dorsal tapered process directed anterodorsally in lateral view; mediuncus with slightly curved dorsal process in lateral view; parameres broad in dorsal view, strongly hooked posteriorly; gonosaccus with several long black gonosetae.

*Length*: B, 43–49; FW, 54–58; HW, 48–52.

Female. Coloration and general morphology, except terminalia, almost as in male, but pilula axillaris absent; shiny silver pubescence of tergite V and proximal half of tergite VI absent. Terminalia (Fig. 37AB): tergite IX narrow in lateral view, divided dorsally; ectoproct simple, rounded ventrally in lateral view; lateral gonapophyses small, with long black fossorial bristles; posterior gonapophyses long in lateral view, stout, curved in ventral view, with long dark setae; anterior gonapophyses absent; gonapophyseal plates arched in lateral view, slender in ventral view; pregenital plate absent; spermatheca (Fig. 37C) long, strongly convoluted.

*Length*: B, 44–52; FW, 52–60; HW, 46–54.

*Specimens examined*. 1♂, no other data; 1♀, 22. viii. 1949, no other data. [Hokkaido] 1♀, Sapporo, 14. viii. 1918, S. Matsumura; 1♂, same locality, 11. viii. 1920, S. Matsumura; 1♀, Maruyama, Sapporo, 16. viii. 1926, Uchida; 1♂, Sapporo, Hokkaido, 28. vii. 1969, H. Takizawa. [Honshu] 1♂ 1♀, Meya-dam, Nishimeya, Aomori, 15. viii. 1989, T. Nakamura; 1♀ (NMST), Sakata, Yamagata, 19. ix. 1955, K. Shirahata; 1♀ (NMST), same locality, viii. 1956, K. Shirahata; 1♂ (NSMT), Aizuwakamatsu, 28. viii. 1957, K. Muto; 1ex, Chuzenji, 23. vii. 1914, E. Gallois; 1ex, Ikaho, viii. 1927, S. Matsumura; 1♀, Kinugawa, 23–25. viii. 1933, S. Matsumura; 1♂ (NSMT), Konodai, 18. vii. 1946, K. M.; 1♀ (NSMT), Shibaura, Tokyo, 14. viii. 1943, K. M.; 1♀ (NSMT), Haneda, Tokyo, 13. viii. 1961, collector unknown; 1♀ (NSMT), Kamata, Tokyo, 9. ix. 1935, Ono; 1♂ (NSMT), Mt. Takao, Tokyo, 27. viii. 1956, K. Fujimoto; 1♀ (NSMT), Kawasaki, Kanagawa, 8. viii. 1963, collector unknown; 1♂ (NSMT), Yashajin-Pass, Yamanashi, 27. vii. 1955, Y. Kurosawa et M. Kobayashi; 1♂ 1♀ (NSMT), Tadami, Niigata, 12. vii. 1960, K. Fujimoto; 1♂ (NSMT), Mt. Myojo-san, 700m, Itoigawa, Niigata, 3. viii. 1988, Y. Kishida; 1♂ (NSMT), Karuizawa, Shinano, 16. vii, year unknown, T. Nimura; 1♀ (NMST), Usui-toge, 6. viii. 1953, M. Ogata; 1♂ 1♀ (NMST), Mt. Daisen, Tottori, 25. vii. 1955, K. Nishimura.

*Distribution*. Japan (Hokkaido, Honshu, Shikoku, Kyushu, Tanegashima Is.); Korea, China, Russian Far East.

*Remarks*. *Synclisis japonica* is the largest species of Japanese antlions and can be easily distinguished from the other Japanese species by its large body size. This species is similar to *S. kawaii* (Nakahara, 1913b) from Taiwan in general appearance but is different from it in the color pattern of thorax (Fig. 5D), the shape of male genitalia (Fig. 36C–F) and the wing length (forewing length 52–60 mm in *S. japonica*, but 48–55 mm in *S. kawaii*).

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As mentioned in the Remarks under the genus *Baliga*, Stange (2004) transferred most *Hagenomyia* species to *Baliga*. Therefore, *Hagenomyia* consists of only one African species at present. However, Bao *et al.* (2007) did not accept this taxonomic treatment, and described the following two Chinese species under the genus *Hagenomyia*. Moreover, Bao *et al.* (2007) transferred one Chinese *Myrmeleon* species to *Hagenomyia*. For these species, no official nomenclatural act has been proposed to date. These Chinese species are considered to have close affinity with Japanese species so that, taking this opportunity, we propose new generic combinations for these species as follows.

*Baliga angustala* (Bao *et al.*, 2007) n. comb.

*Hagenomyia angustala* Bao *et al.*, 2007: 46.

*Baliga coalita* (Yang, 1999) n. comb.

*Myrmeleon coalitus* Yang, 1999: 146.

*Hagenomyia coalita*: Bao *et al.*, 2007: 45.

*Baliga guangxiensis* (Bao *et al.*, 2007) n. comb.

*Hagenomyia guangxiensis* Bao *et al.*, 2007: 46.

