ZooKeys 306: 1–21 (2013)
doi: 10.3897/zookeys.306.5455
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
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Identification of the terebrantian thrips (Insecta, Thysanoptera) associated with cultivated plants in Java, Indonesia

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Academic editor: *Lyubomir Penev* | Received 3 May 2013 | Accepted 30 May 2013 | Published 3 June 2013

Citation: Sartiami D, Mound LA (2013) Identification of the terebrantian thrips (Insecta, Thysanoptera) associated with cultivated plants in Java, Indonesia. ZooKeys 306: 1–21. doi: 10.3897/zookeys.306.5455

Abstract

An illustrated identification key is provided to 49 species of Thysanoptera, Terebrantia that have been found in association with cultivated plants in Java. This is the first published identification system to this group of insects from Indonesia, and includes 15 species not previously recorded from Indonesia, and a further three species not previously recorded from Java. A table is provided indicating the plants from which thrips were taken.

Keywords

Identification keys, Indonesia, Thripidae, cultivated plants

Introduction

Judging from a list published by zur Strassen (1994), the Thysanoptera fauna of Indonesia appears to be well known. That list documents 433 thrips species from Indonesia, 279 of which are from Java. Although a useful resource for checking the names and presence of a genus or species, the list has limitations as a basis for further work by Indonesian entomologists. The alphabetic arrangement of genera, rather than grouping by sub-order and family, makes it difficult to gauge the biological diversity of the fauna, particularly as biologies are not indicated, and no advice given on identification

methods. For the Indonesian thrips fauna no practical identification system exists, although some progress has been made recently in studies on the thrips fauna of Peninsular Malaysia (Mound and Azidah 2009; Mound and Ng 2009; Mound, Azidah and Ng 2012), and a key to the Asian species of the genus *Thrips* was provided by Palmer (1992). However, many of the Asian species treated in these keys remain known only from one or a few specimens. There is thus no knowledge of the variability of such species, and their validity remains questionable (Mound 2005). Extensive field studies are needed, to establish the structural variation within and between populations of several species, before a truly robust identification system can be produced.

Most of the species listed from Indonesia by zur Strassen (1994) were collected or acquired in the 1920's by H.H.Karny whilst entomologist at the Buitenzorg Zoological Museum (Bogor). They were described either by Karny himself, or subsequently by H. Priesner who inherited most of Karny's slide collection. These slides are now housed at the Senckenberg Museum, Frankfurt. Unfortunately, Karny considered that the mouth parts of thrips would be found to hold useful taxonomic characters. Thus he slide-mounted most specimens ventral side uppermost, and as a result it is often difficult or impossible to study the dorsal character states that are now considered essential. Moreover, a high proportion of the specimens are damaged or distorted.

The 279 species of Thysanoptera listed by zur Strassen (1994) from Java are predominantly members of the sub-order Tubulifera, family Phlaeothripidae. In contrast, most thrips that are of importance to agriculture and horticulture are members of the second sub-order, the Terebrantia, and only 90 of these are listed from Java, of which 23 are members of the genus *Thrips*. For Indonesian entomologists, the absence of suitable identification keys, also the absence of an authentic reference collection, makes the task of studying these small insects particularly difficult. The objective of the present work is to provide a means of identification of the species associated with cultivated plants in Java. The intention is to enable economic entomologists in Indonesia to identify the pest thrips associated with their crops, and thus facilitate studies on the biology of these insects. In this way it is hoped that an understanding of the rich and complex Indonesian thrips fauna may be developed progressively.

The material discussed here has been collected at the following sites: West Java at Bogor and Purwakarta (lowland sites), and at Bandung and Cianjur (highland sites); Central Java at Semarang and Demak (lowland), and Banjarnegara, Tegal (highland); East Java at Kediri, Situbondo and Malang (lowland). In the text below, *indicates the three species that are newly recorded from Java, and **indicates 15 species not previously recorded from any of the Indonesian islands. The slide-mounted specimens on which this report is based are housed in the Bogor Agricultural University. It is particularly noteworthy that the worldwide pest, Western Flower Thrips, *Frankliniella occidentalis*, has not yet been recorded from anywhere in Indonesia.

The classification adopted here is the widely accepted one that is web available (ThripsWiki 2013). That web site provides full nomenclatural details of all taxa discussed in this paper, together with references and other details. Moreover, many of the common widespread species that are considered here are fully described and illustrated

in the web-available identification systems for Australia and California (Mound et al. 2012; Hoddle et al. 2012). Another useful source of information is the key to Thripinae genera associated with plant quarantine in Japan (Masumoto 2010).

Key to species

1 Antennae with 9-segments; sensoria on segments III–IV linear, either longitudinal along the segments or transverse; wing apex rounded (Fig. 2) ..... **[Aeolothripidae] 2**

– Antennae usually with 7 or 8 segments (rarely with 6 or 9); sensoria on segments III–IV emergent, either forked or simple; wing apex more or less pointed (Fig. 6)..... [**Thripidae**] **3**

2 Antennal segments III–IV long, III is 9 times as long as width (Fig. 1); segments I–II white ..... ***Franklinothrips vespiformis***

– Antennal segments III–IV scarcely longer than wide (Fig. 2), dark brown with many long setae ..... ***Mymarothrips bicolor***

3 Hind tarsi more than 0.5 as long as hind tibia ..... ***Pseudodendrothrips* sp.**

– Hind tarsi less than 0.3 as long as hind tibia **4**

4 Fore wing anterior margin with cilia arising ventrally behind the margin (Fig. 5); metathoracic furca Y-shaped and extending to mesothorax (Fig. 8) [body white, brown area between eyes; fore wing banded] ..... ***Asprothrips navsariensis***

– Fore wing anterior margin with cilia arising at margin; metathoracic furca usually not as above **5**

5 Antennal segment IV with parallel-sided apical neck that is 50% as long as this segment (Fig. 4); head and body yellow with no dark pigment..... ***Zaniothrips ricini***

– Antennal segment IV without elongate apical neck (Fig. 3), body colour various..... **6**

6 Fore wing dark and setae on costa and first vein long with apices capitate (Fig. 38), second vein with no setae; head and pronotum strongly reticulate, reticles with internal markings ..... ***Echinothrips americanus***

– Fore wing setae not capitate, second vein rarely without setae; reticulation on head and thorax rarely with any internal markings..... **7**

7 Head, body and fore femora boldly reticulate (Figs 13, 14); mesothoracic furca without a median spinula; fore wing first vein usually fused to costa..... **8**

– Head and body not boldly reticulate, fore femora without reticulation; mesothoracic furca usually with a median spinula (Fig. 9); fore wing first vein distinct from costa **15**

8 Abdominal tergite II anterolaterally with paired areas of specialised sculpture, either prominent recurved claw-like microtrichia or closely spaced ridges (Figs 11, 12) **9**

– Abdominal tergite II without paired areas of specialised sculpture..... **12**

9 Dorsal surface of head with prominent transverse ridge (cf. Fig. 14) **10**
– Dorsal surface of head without a transverse ridge **11**
10 Fore wing costal setae longer than costal cilia (Fig. 10); tergite II anterolaterally with paired area of recurved claw-like microtrichia (Fig. 12) ..... ***Copidothrips octarticulatus***
– Fore wing costal setae shorter than costal cilia; tergite II anterolaterally with paired areas of parallel ridges (Fig. 11) ..... ***Panchaetothrips indicus***
11 Terminal setae on tergite X pointed ..... ***Astrothrips* sp.**
– Terminal setae on tergite X with apices expanded ..... ***Elixothrips brevisetis***
12 Fore wing uniformly dark, with two rows of prominent setae ..... ***Selenothrips rubrocintus***
– Fore wing pale or banded, without two rows of large setae **13**
13 Fore wing second vein with row of setae (Fig. 6); tergal antecostal ridge forming series of arches (Fig. 15) ..... ***Helionothrips ananthakhrisnani***
– Fore wing with no major setae; tergites without arch-like sculpture **14**
14 Head with equiangular reticulation, without transverse ridge (Fig. 13) ..... ***Heliothrips haemorrhoidalis***
– Head with complex irregular sculpture and transverse ridge (Fig. 14) ..... ***Rhipiphorothrips pulchellus***
15 Head strongly prolonged in front of eyes (Fig. 18)..... ***Organothrips indicus***
– Head rarely extending in front of eyes **16**
16 Lateral areas of abdominal tergites II–VII with numerous large microtrichia on broad triangular bases (Fig. 16); fore wing banded, without setae ..... ***Dendrothripoides innoxius***
– Lateral thirds of tergites without such large microtrichia; fore wing veins with setae **17**
17 Pronotum with no long setae **18**
– Pronotum with at least 1 pair of prominent setae **19**
18 Body sharply bicoloured, brown with abdominal segments III–V yellow; metanotum irregularly reticulate ..... ***Anaphothrips sudanensis***
– Body uniformly dark brown; metanotal sculpture transverse (Fig. 19) ..... ***Dichromothrips corbetii***
19 Tergites with many closely spaced rows of fine microtrichia laterally (Fig. 17) ..... ***Scirtothrips dorsalis***
– Tergites without closely spaced rows of fine microtrichia laterally (Fig. 26)..... **20**
20 Abdominal tergites without paired ctenidia laterally **21**
– Abdominal tergites V–VIII with paired ctenidia laterally (Figs 26, 27) **30**
21 Pronotum with 6 pairs of long setae (Fig. 39) ..... ***Scolothrips rhagebianus***
– Pronotum with no more than 3 pairs of long setae **22**
22 Tergite VIII posterior margin with neither craspedum nor comb (Fig. 25) ... ***Bathrips melanicornis***
– Tergite VIII posterior margin with either a comb of microtrichia or a craspedum **23**

23 Tergite VIII posterior margin with a craspedum but no comb (Fig. 7) **24**
– Tergite VIII posterior margin with a comb of microtrichia (Fig. 26), either complete or present only laterally.....**25**
24 Sternite VII with three pairs of marginal setae equidistant from each other... ..... ***Craspedothrips minor***
– Sternite VII posteromarginal setae S1 and S2 close together medially, and distant from lateral setal pair S3..... ***Rhamphothrips* sp.**
25 Pronotum anterior margin with 1 pair of elongate setae (Fig. 20); metanotum almost without sculpture medially; abdominal tergites III–VI strongly reticulate (Fig. 21) ..... ***Ayyaria chaetophora***
– Pronotum anterior margin with no long setae; metanotum sculptured medially; tergites not strongly reticulate.....**26**
26 Metanotum with equiangular reticulation (Fig. 23); ocellar setae pair III shorter than distance between two ocelli (Fig. 22); antennal segment I without pair of dorso-apical setae..... ***Lefroyothrips lefroyi***
– Metanotal reticulation not equiangular; ocellar setae pair III longer than distance between two ocelli; antennal segment I with pair of setae at dorsal apex (Fig. 3).....**27**
27 Female tergite VIII with comb of long microtrichia complete medially.....**28**
– Female tergite VIII posterior margin with a few microtrichia laterall but none medially.....**29**
28 Meso and metathroacic furca with long spinula; ocellar setae pair I arising side-by-side; fore wing pale or with transverse darker bands ..... ***Mycterothrips* sp.**
– No spinula on metathoracic furca (cf. Fig. 9); ocellar setae pair I arising one setae in front of the other; fore wing uniformly dark..... ***Ceratothripoides brunneus***
29 Abdominal sternite VII posteromarginal setae all arise on margin (Fig. 24); antennal segments IV and V yellow on basal half.....***Megalurothrips typicus***
– Median pair of marginal setae on abdominal sternite VII arise in front of margin.....**30**
30 All antennal segments brown ..... ***Megalurothrips distalis***
– Antennal segment III yellow..... ***Megalurothrips usitatus***
31 Ctenidia on tergite VIII anterolateral to spiracle (Fig. 26); head with pair of setae in front of first ocellus **32**
– Ctenidia on tergite VIII posteromesad to spiracle (Fig. 27); head without pair of setae in front of first ocellus **33**
32 Tergite VIII posterior margin with complete comb of microtrichia; ocellar seta III arise on anterior margin of ocellar triangle ..... ***Frankliniella intonsa***
– Tergite VIII posterior margin with no comb of microtrichia; ocellar seta III arise between posterior pair of ocelli ..... ***Frankliniella schultzei***
33 Abdominal sternites IV–VI with discal setae (Fig. 35) **34**
– Abdominal sternites IV–VI with setae only at posterior margin (cf Fig. 24) **44**
34 Tergites II–VIII posterior margin with toothed craspedum (Fig. 27); prosternum with 2 or more pairs of setae... ***Microcephalothrips abdominalis***

– Tergites II–VIII without a toothed marginal craspedum; prosternum with no setae **35**

35 Antennal segments III and IV with sensorium simple ..... ***Bolacothrips striatopennatus***

– Antennal segments III and IV with sensorium forked **36**

36 Pronotum with only one pair of long posteroangular setae ... ***Thrips unipinus***

– Pronotum with two pairs of prominent posteroangular setae **37**

37 Sternite VII without discal setae (Fig. 35); fore wing first vein setal row complete; pleurotergites with discal setae ..... ***Thrips parvispinus***

– Sternite VII with discal setae present; fore wing first vein setal row interrupted; pleurotergites usually with no discal setae **38**

38 Pronotal posteroangular setae short, usually shorter than median metanotal setae ..... ***Thrips melastomae***

– Pronotal posteroangular setae at least as long as median metanotal setae and usually longer **39**

39 Pleurotergites with discal seta (Fig. 30); metanotum without campaniform sensilla ..... ***Thrips alliorum***

– Pleurotergites without discal seta (Fig. 32); metanotum usually with paired campaniform sensilla **40**

40 Abdominal tergite II with 4 setae laterally **41**

– Abdominal tergite II with 3 setae laterally **43**

41 Metanotal median setae arising just behind anterior margin; body colour varying from yellow to brown, but usually with tergite X brown and dark markings medially on some tergites ..... ***Thrips coloratus***

– Metanotal median setae arising at anterior margin; body brown, head and thorax sometimes yellow **42**

42 Postocular setae pair II minute; mesonotum with no sculpture close to anterior pair of campaniform sensilla (Fig. 36); fore wing clavus with terminal seta shorter than sub-terminal seta ..... ***Thrips florum***

– Postocular setae pair II at least half as long as setae I and III; mesonotum with sculpture lines close to anterior pair of campaniform sensilla (Fig. 37); fore wing clavus with terminal seta longer than sub-terminal seta ..... ***Thrips hawaiiensis***

43 Antennae with 8 segments; fore wing first vein with 7 setae on distal half; metanotum reticulate with markings inside the reticles (Fig. 34) ..... ***Thrips simplex***

– Antennae with 7 segments; fore wing first vein with 3 setae on distal half; metanotal reticulations without internal markings ..... ***Thrips safrus***

44 Head with ocellar setae pair II longer than pair III (Fig. 28) [fore wing uniformly brown] ..... ***Stenchaetothrips biformis***

– Head with ocellar setae pair II shorter than pair III **45**

45 Abdominal tergites III–V with median pair of setae more 0.5 as long as the median length of their tergite (Fig. 29) ..... ***Thrips nigropilosus***

– Abdominal tergites III–V with median pair of setae scarcely 0.3 as long as tergite **46**

46 Fore wing first vein with setal row almost complete ..... ***Thrips malloti***
– Fore wing first vein with wide gaps distally in setal row **47**
47 Pleurotergites with closely spaced rows of fine microtrichia (Fig. 32); body variable in colour but ocellar pigment grey and never red .....***Thrips tabaci***
– Pleurotergites without such rows of microtrichia; ocellar pigment red **48**
48 Tergite VIII posterior margin with no comb medially; body dark brown..... ..... ***Thrips javanicus***
– Tergite VIII posterior margin with complete comb medially; body yellow.... ..... ***Thrips palmi***

Aeolothripidae

Most of the 190 species listed in this family are from the temperate parts of the world, but a few small genera are found only in tropical countries. All the species have nine antennal segments, the sensoria on the third and fourth antennal segments form longitudinal sensory areas not emergent sense cones, and the fore wings have a broadly rounded apex and well marked veins.

***Franklinothrips vespiformis* (Crawford DL): This predatory species was collected on the leaves of *Jatropha* at Malang in association with populations of *Zaniothrips ricini*. Originally from Central America where it is widespread, it is recorded from Thailand, Japan, New Caledonia and Australia (Mound and Reynaud 2005).

**Mymarothrips bicolor* zur Strassen: Described from Krakatau Island, Indonesia, this species has been collected at Bogor and at Semarang, and is also known from northern Australia. It is presumably predatory and, as the name implies, is similar in appearance to one of the small parasitic Hymenoptera with the fore wings narrowed at the base but broadly rounded toward the apex.

Thripidae

This family comprises about 2000 described species, and is found around the world wherever plants are growing. Most species have either seven or eight antennal segments, and the sensoria on the third and fourth segments are emergent and either forked or simple. The fore wings are generally slender, and commonly bear two rows of setae. Four subfamilies are recognised, although only three are recorded here.

Thripidae – Panchaetothripinae

This subfamily comprises about 140 species in 40 genera. These are distributed throughout tropical countries, and they feed and breed on leaves not in flowers. With the exception of *Zaniothrips ricini*, the adults are dark brown, with conspicuous reticulate sculpture.

Astrothrips sp.: This genus comprises 12 leaf-feeding species that are found in tropical areas between Africa and northern Australia. All of them have a characteristic group of strongly recurved spines anterolaterally on the second abdominal tergite. An apparently undescribed species was collected recently at Tegal.

***Copidothrips octarticulatus* (Schmutz): Only one species is recognised in this genus, and this has the second abdominal similar in structure and sculpture to species of *Astrothrips*. Presumably originally from southeast Asia, and collected at Bogor, it is also recorded from the Carribean.

Elixothrips brevisetis (Bagnall): Only one species is placed in this genus, and this has been found at Bogor. It is very similar in structure and biology to species of *Astrothrips*, and is widely distributed around the tropics.

***Helionothrips ananthakrishnani* Wilson: Described from the eastern highlands of New Guinea on banana leaves (Wilson 1975), this species is here newly recorded from Java. Both sexes have been found on banana leaves at Bogor, Cianjur and Bandung. There are nearly 30 species listed in this genus, almost all from the Asian tropics.

Heliothrips haemorroidalis Bouché: Found in Bogor, the Greenhouse Thrips of temperate countries is widespread in sub-tropical areas, breeding on a wide range of plants, but usually not on herbaceous plants.

***Panchaetothrips indicus* Bagnall: Described from India, females of this species have been studied from Bogor and Semarang. Six species from the Old World tropics are listed in this genus, and an identification key was provided by Mound and Postle (2004).

Rhipiphorothrips pulchellus Morgan: This species has the abdomen almost clear yellow in contrast to the dark brown head and thorax, and is known from India and Sri Lanka to the Philippines. It is recorded from the leaves of *Ficus* and of vines, and at Situbondo was found on *Jatropha* leaves. Four other species are listed in this genus, two from Africa and two from Asia.

Selenothrips rubrocinctus (Giard): The red-banded cacao thrips probably came originally from South America but is now widespread in tropical countries. It has been taken from the leaves of *Jatropha* at Bogor and at Kediri.

***Zaniothrips ricini* Bhatti: Although described from *Ricinus* in India, this curiously pale-bodied species has been found several times breeding on *Jatropha* leaves at Bogor.

Thripidae – Dendrothripinae

Adults in this subfamily have the internal furca of the metathorax greatly enlarged and "lyre-shaped", and extending to the mesothorax. These are leaf-feeding thrips that jump actively when disturbed. About 90 species in 10 genera are recognised, and these are found particularly in tropical and sub-tropical countries.

***Asprothrips navsariensis* Tyagi: Previously known only from Gujarat, in western India, living on banana leaves, both sexes have been studied from banana leaves at

Bogor. The genus includes only four species, all from Asia but with one species widespread in greenhouses.

Pseudodendrothrips sp.: There are 19 species placed in this genus, mainly from the Old World tropics. They are minute in size, and difficult to identify to species. One species is widespread as a minor pest on the leaves of *Morus* trees used for silk-worm cultivation. A single female representing this genus was collected from *Nephelium* at Bogor.

Thripidae – Thripinae

This is one of the two largest groups of Thysanoptera, with over 1600 recognised species in almost 250 genera. These thrips are found all over the world, many are associated with flowers, but a particularly large number of species breed only on grasses. This subfamily includes the major pest thrips, including all the tospovirus vector species.

Anaphothrips sudanensis Trybom: This strikingly bicoloured species was collected at Bogor. It is widespread in sub-tropical areas on various grasses, and is sometimes considered a minor pest of cereal crops. As in all 80 species of the genus *Anaphothrips*, the pronotum does not have any long setae (Mound and Masumoto 2009).

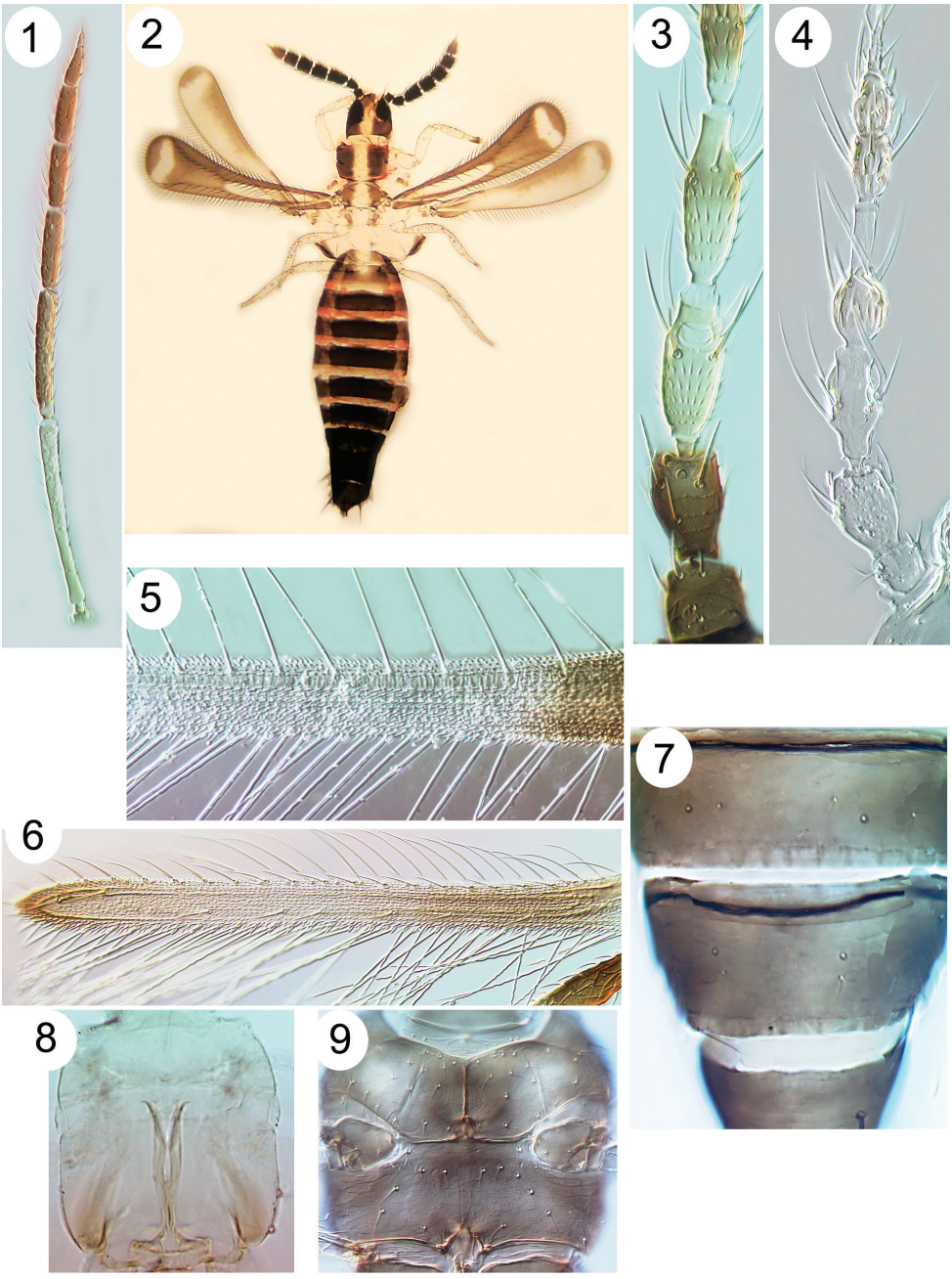
Ayyaria chaetophora Karny: The only species in this genus is widespread from India to Japan and Australia. It appears to breed on a wide variety of plants, including *Glycine*, *Tagetes* and *Ricinus*, and at Purwakata adults have been found on many different plant species.

Bathrips melanicornis (Shumsher): This species with curiously dark antennae is widespread from India across Southeast Asia to northern Australia. It has been collected at Bogor and Cianjur, and although often reported from crops, there is no reliable information concerning the plants on which it breeds. The only other species in the genus was described from India.

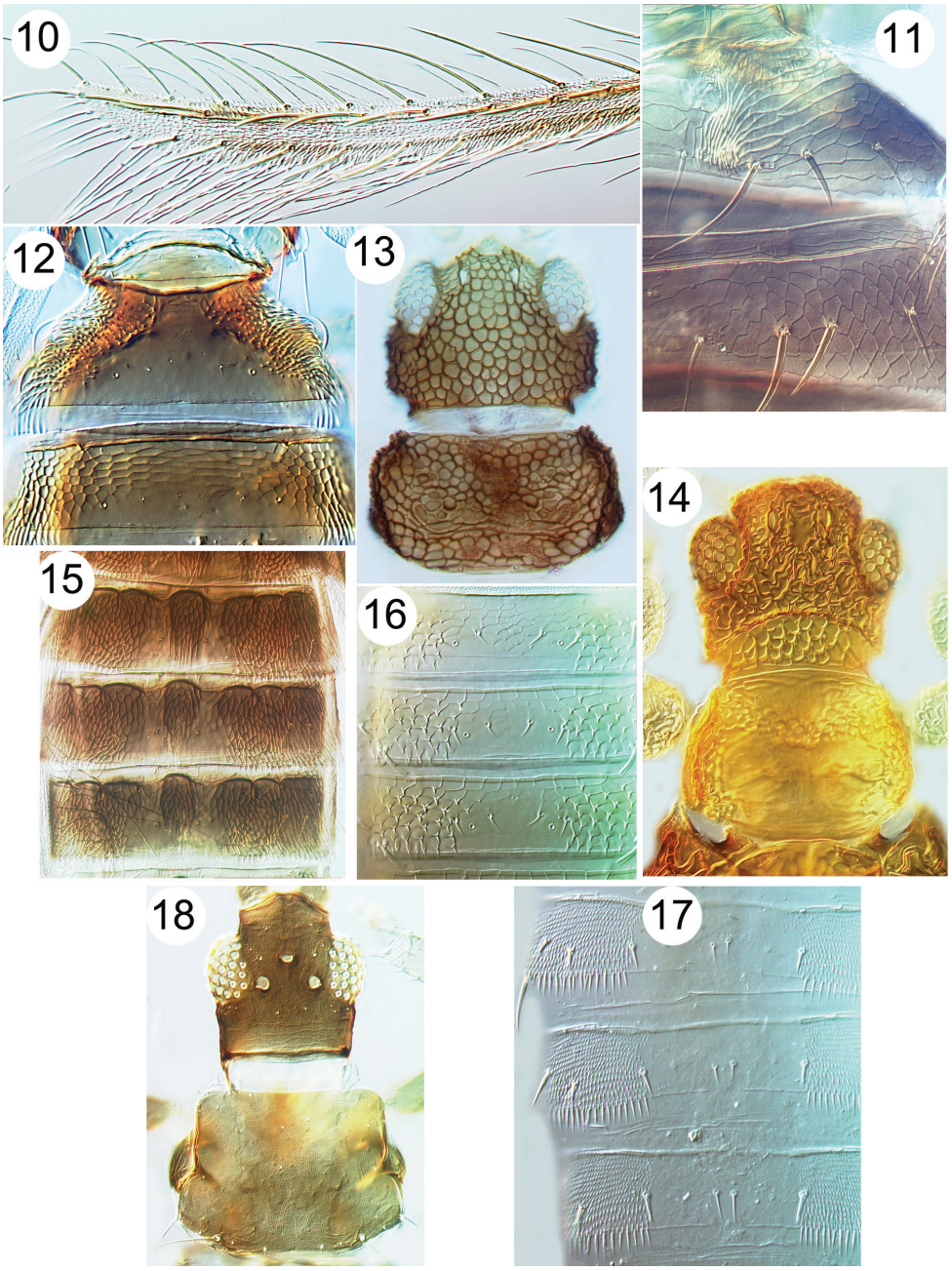
Bolacothrips striatopennatus (Schmutz): Described from Sri Lanka, but widespread across Asia to Japan, Guam and Australia, this yellow species breeds on grasses, and has been found at Cianjur. Although closely related to *Thrips* genus, the sensoria on the third and fourth antennal segments are simple not forked (Mound 2011b).

******Ceratothripoides brunneus* Bagnall: Although described from West Africa, this species is common in Peninsular Malaysia, also in Thailand where it is reported as a tospovirus vector on tomatoes (Mound and Nickle 2009). A few specimens were taken at Cianjur. Although similar in appearance to *Megalurothrips* species, the eighth abdominal tergite bears a complete comb of long microtrichia.

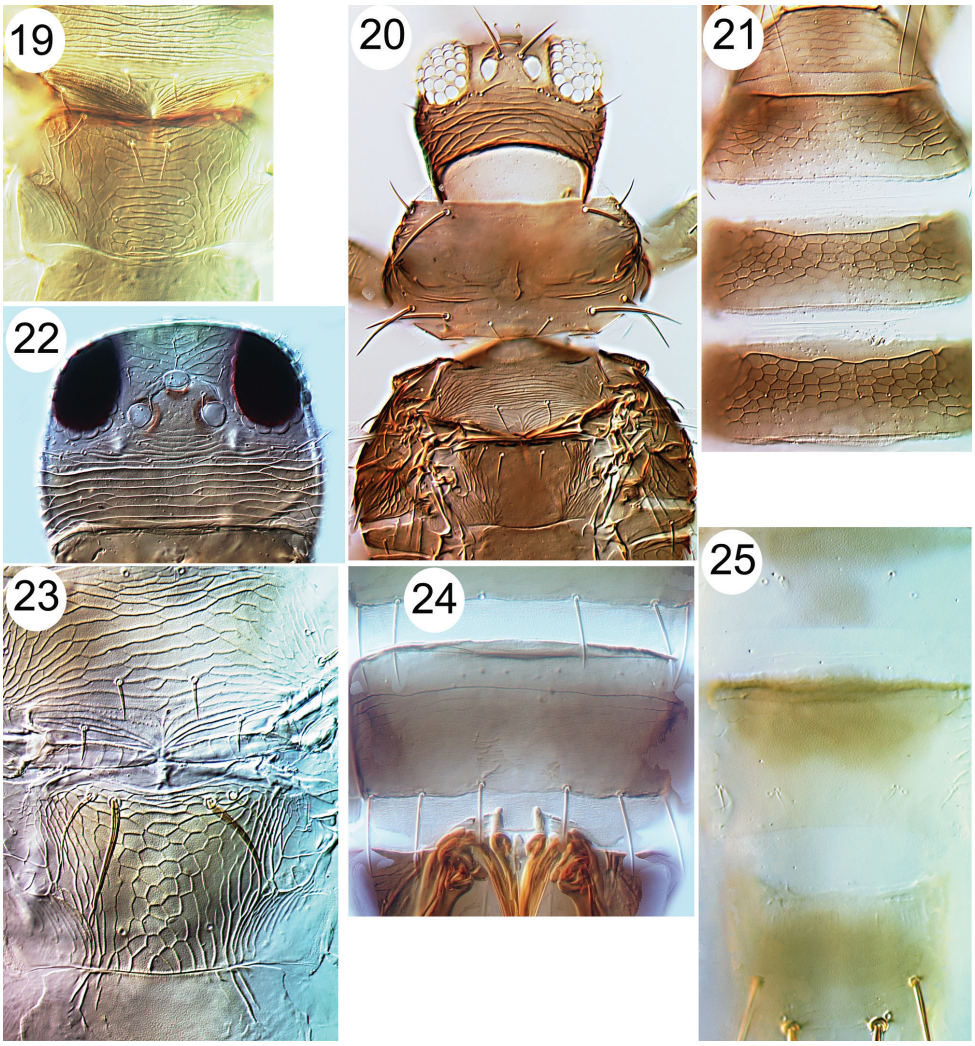
*****Craspedothrips minor* (Bagnall): This is the most widespread of the 10 species in this genus, all from the Old World tropics. It is thought to be associated with the flowers of *Cassia* species (Mound et al. 2012), and at Bogor was found on *Mimosa* flowers. The posterior margins of the abdominal tergites and sternites bear a distinctive craspedum, or lobed fringe.



Figures 1–9. Thripinae from Java. **1** *Franklinothrips vespiformis*, antenna **2** *Mymarothrips bicolour*, female **3** *Megalurothrips typicus* antennal segments I–V 4 *Zaniothrips ricini* antenna **5** *Asprothrips navsariensis*, fore wing **6** *Helionothrips ananthakrishnani* fore wing **7** *Craspedothrips minor*, tergites VII & VIII **8** *Asprothrips*, metafurca **9** *Echinothrips americanus*, with mesosternal spinula.



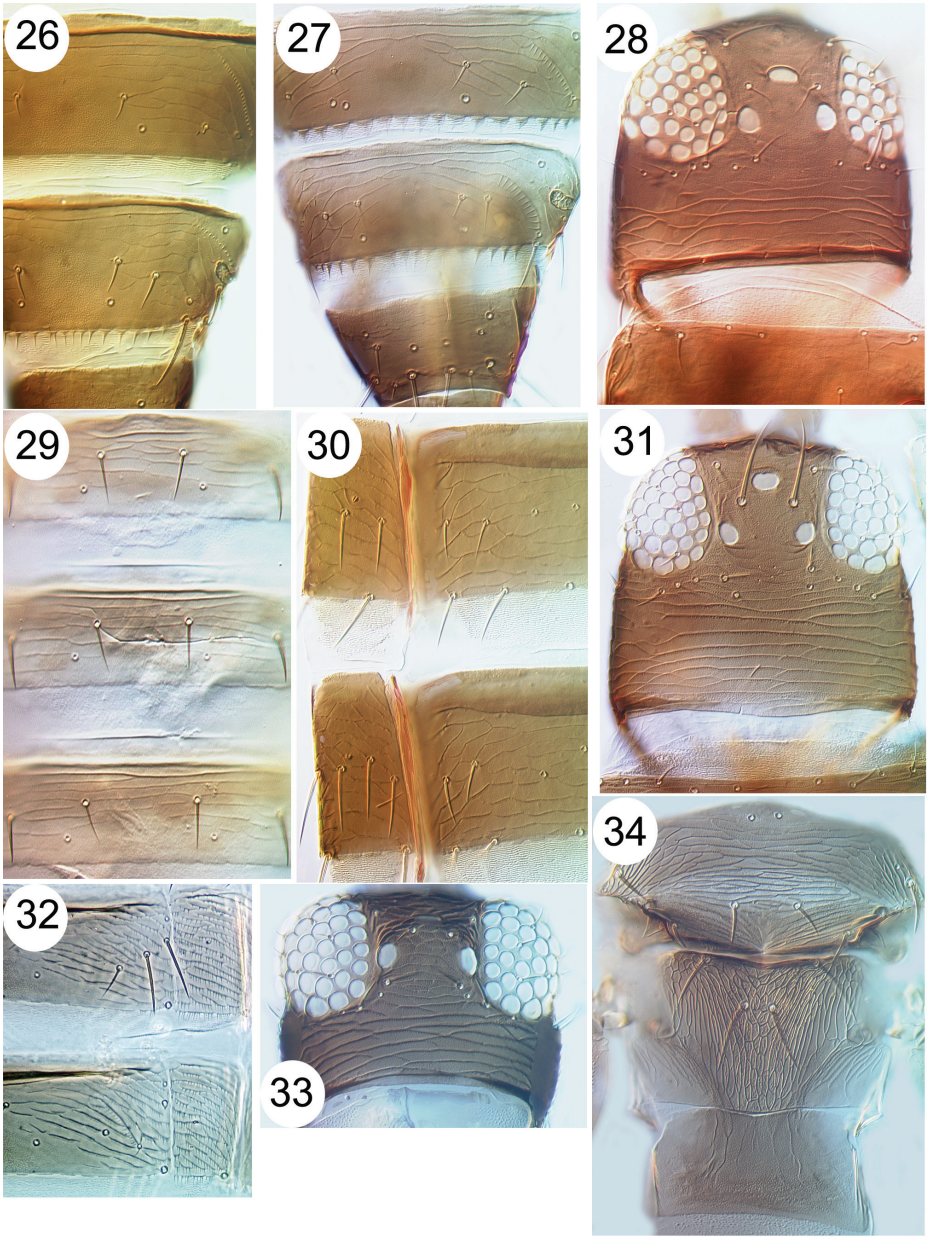
Figures 10–18. Thripinae from Java. **10** *Copidothrips octarticulatus* fore wing **11** *Panchaetothrips indicus*, tergites I & II **12** *Copidothrips octarticulatus*, tergites I & II **13** *Heliothrips haemorroidalis*, head & pronotum **14** *Rhipiphorothrips pulchellus*, head & pronotum **15** *Helionothrips ananthakrishnani*, tergites **16** *Dendrothripoides innoxius*, tergites **17** *Scirtothrips dorsalis*, tergites **18** *Organothrips indicus*, head & pronotum.



Figures 19–25. Thripinae from Java. **19** *Dichromothrips corbetti*, metanotum **20** *Ayyaria chaetophora*, head & thorax **21** *Ayyaria chaetophora*, tergites **22** *Lefroyothrips lefroyi*, head **23** *Lefroyothrips lefroyi*, metanotum **24** *Megalurothrips typicus*, sternite VII **25** *Bathrips melanicornis*, tergites VII–IX.

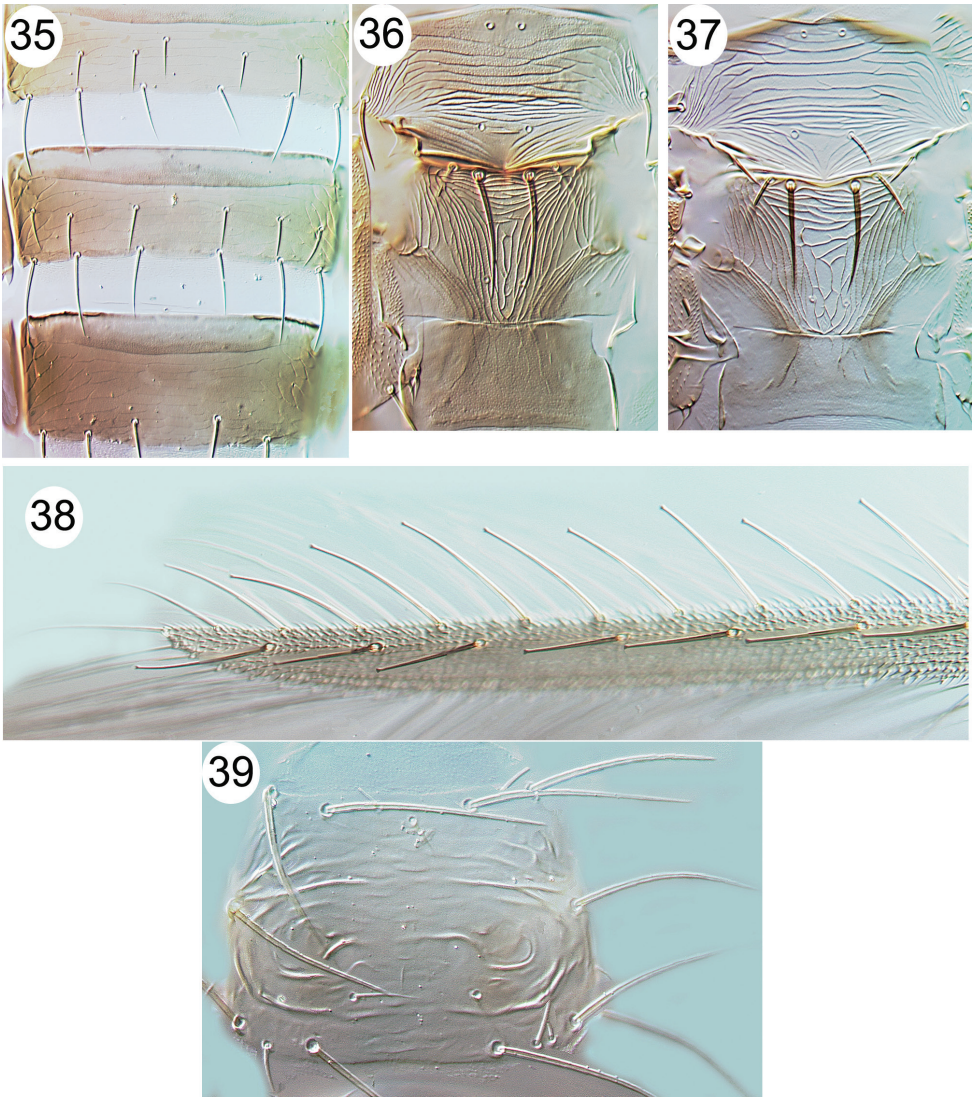
Dendrothripoides innoxius (Karny): One of only five species in this genus, this is associated with the leaves of *Ipomoea* species including sweet potato. Originally from Southeast Asia, and found at Bogor, it is also recorded from Brazil. The abdominal tergites laterally bear distinctively large, broadly based, microtrichia.

Dichromothrips corbetti (Priesner): Species in this genus breed on Orchidaceae in the Old World tropics, but *corbetti* has been widely distributed in greenhouses, and was recently found at Malang. Unlike the other 17 species in the genus, *corbetti* has no long setae on the pronotum.



Figures 26–34. Thripinae from Java. **26** *Frankliniella intonsa*, tergites VII & VIII **27** *Microcephalothrips abdominalis* tergites VII–IX **28** *Stenchaetothrips biformis*, head **29** *Thrips nigropilosus*, tergites **30** *Thrips alliorum*, pleurotergite & sternite **31** *Thrips alliorum*, head **32** *Thrips tabaci*, tergites & pleurotergites **33** *Thrips simplex*, head **34** *Thrips simplex*, metanotum.

***Echinothrips americanus* Morgan: The Poinsettia Thrips is considered a pest of *Capsicum* crops under glass in Europe. It is usually associated with the leaves of various decorative Araceae and Euphorbiaceae, but is highly polyphagous. Originally from



Figures 35–39. Thripinae from Java. **35** *Thrips parvispinus*, sternites V–VII **36** *Thrips florum*, meso & metanota **37** *Thrips hawaiiensis*, meso & metanota **38** *Echinothrips americanus*, fore wing **39** *Scolothrips rhagebianus*, pronotum.

eastern North America, it has been reported recently from Cianjur in Java, also northern Australia and China (Mound et al. 2013).

***Frankliniella intonsa* (Trybom): This species is widespread from Europe to Taiwan, and has been found at Cianjur and Bandung on rose and on strawberry plants. It is similar in structure and biology to the major pest species, *F. occidentalis*, from which it is distinguished by the short setae behind the eyes and the absence of campaniform sensilla on the metanotum.

Frankliniella schultzei (Trybom): Presumably originally from South America, this species is widespread throughout tropical countries. A tospovirus vector, it is distinguished from most species of *Frankliniella* by the lack of a marginal comb on the eighth tergite of females, and the presence of a pair of setae between the posterior pair of ocelli. It appears to be variable in colour, from yellow to brown, and a single brown male was collected at Bogor.

Lefroyothrips lefroyi (Bagnall): Only four species are listed in this genus, of which this one is associated with the flowers of tea plants in northern India. A single female has been seen from Cianjur.

Megalurothrips distalis (Karny): Species of this genus breed in the flowers of Fabaceae in the Old World tropics. Although 13 species are described, they cannot all be recognised (Palmer 1987). Females of *distalis* are distinguished from the more common *usitatus* by the dark brown colour of the third antennal segment. This species was found at Cianjur.

Megalurothrips typicus Bagnall: This species can be distinguished by the presence of all three pairs of setae arising at the posterior margin of the seventh sternite in females, instead of the median pair arising sub-marginally. Also, the antennae are more extensively yellow than in the other members of the genus. It has been found at Tegal.

Megalurothrips usitatus (Bagnall): This is the most common thrips in the flowers of cultivated legume plants across most of tropical Asia (Palmer 1987), and has been seen from Bogor and Tegal.

Microcephalothrips abdominalis (Crawford DL): Common in the flowers of many Asteraceae, this sub-tropical species is often associated with crops of *Helianthus*. Found at Bogor, Bandung and Cianjur, it is similar to species of genus *Thrips* in having ctenidia laterally on the tergites, but the posterior margin of the tergites bears a distinctive row of triangular teeth.

****Mycterothrips*** sp. This genus is widespread around the world, with the species apparently all leaf-feeding, and one a pest in Asia on *Glycine max*. One female of a bicoloured species has been seen from Banjarnegara, a highland area in central Java. This apparently undescribed species has discal setae on the sternites, a character state that is found in only five of the 29 species described in this genus.

****Organothrips indicus*** Bhatti: This species breeds underwater in the mucilage on the stems of some aquatic plants, such as *Eichornia crassipes*, and *Typha* species. It is recorded from India and also from northern Australia, and was found at Demak. A closely similar species is recorded from the Pacific islands (Mound 2000).

Rhamphothrips sp.: The females of species in this genus are particularly difficult to identify. However, specimens taken at Bogor were readily recognised as members of this genus, because the median two pairs of marginal setae on the seventh sternite arise very close together in the mid-line (Mound and Tree 2011).

Scirtothrips dorsalis Hood: Species of this genus have closely spaced transverse rows of microtrichia laterally on the abdominal tergites. This Oriental species is a widespread pest on several crops. It was collected at Bogor, and is a tospovirus vector in India,

and introduced to Israel and the Caribbean. It is unusual amongst the 100 described species of *Scirtothrips* in having microtrichia almost covering all of the sternites, instead of these being restricted to the lateral areas (Mound and Stiller 2011).

** *Scolothrips rhagebianus* Priesner: Very similar to the North American *S. sexmaculatus*, this species is recorded from Egypt to Australia, and has been seen from Malang. All *Scolothrips* species have six pairs of long setae on the pronotum, and are predators of spider mites (Mound 2011a).

Stenchaetothrips biformis (Bagnall): The rice thrips is widespread across Asia, on grasses as well as rice, and has been seen from Bogor and Cianjur. *Stenchaetothrips* species are very similar to *Thrips*, but have the lateral pair of setae between the eyes longer than the median pair (Ng and Mound 2012).

** *Thrips alliorum* (Priesner): Apparently breeding on onions, this species is recorded widely in southeast Asia, and also in Hawaii, and has been seen from Cianjur. It is dark brown, with the head projecting slightly in front of the eyes.

Thrips coloratus Schmutz: This species varies greatly in colour, from pale yellow to brown, but the most common form is brown medially on the tergites, and tergite ten is also brown. It is a flower-living species that is known widely across Southeast Asia into northern Australia, and was collected at Bogor.

Thrips florum Schmutz: This is one of the most common and widespread flower thrips across Asia to the Pacific islands, and is also introduced to the Caribbean and southern Florida. Collected at Bogor, and at Cianjur, it is very similar to *hawaiiensis* in structure and biology (Mound and Masumoto 2005).

Thrips hawaiiensis (Morgan): This is the most commonly collected flower thrips across Asia to the Pacific and eastern Australia, and was found at both Bogor and Cianjur. It is also introduced to the southern parts of the USA, as well as some Caribbean islands.

Thrips javanicus Priesner: Specimens identified as this species were taken at Bogor. The species requires further study as it is not clearly distinguished from several other Asian species that lack sternal discal setae (Mound 2005).

Thrips malloti Priesner: Widespread from India to northern Australia, this species was collected at Bogor. The fore wing is dark except at the base, and the first vein has an almost complete row of setae, in contrast to *javanicus*.

Thrips melastomae Priesner: This is another poorly defined species that is recorded from Malaysia to the Philippines and was taken at Bogor. Palmer (1992) suggests that it may be associated with species of the plant genus *Melastoma*.

* *Thrips nigropilosus* Uzel: This polyphagous pest species has been found at Cianjur infesting the leaves of carrots, but in Europe it is associated with various other crops including lettuce, and in Kenya has been reported as a pest of Pyrethrum crops. The wings vary from fully complete to shorter than the thoracic width, and the median setae on the tergites are unusually long.

Thrips palmi Karny: A major pest species and tospovirus vector, this species is sometimes abundant in southeast Asian countries causing severe leaf damage to various crops such as egg plant. It has been taken from various crop plants in Java at Bandung, Bogor and Cianjur.

Thrips parvispinus (Karny): In Indonesia, including Java, this is probably the most widespread and commonly collected thrips species (Mound and Collins 2000). The body size and colour are variable, probably in relation to the temperature during development. The body and wing lengths were greater on specimens from *Capsicum* in the highlands of West Java than in specimens from this crop in the lowlands (Sartiami et al. 2011). At large populations this species is likely to damage crops such as capsicum and potato, and it has been take at Bogor, Cianjur and Bandung.

Thrips simplex (Morison): The Gladiolus thrips is found throughout the world wherever these flowers are grown. Feeding by this thrips causes the flowers and leaves to be marked by pale streaks, and specimens have been studied from Bogor.

** *Thrips safrus* Mound & Masumoto: Collected recently at Bogor, this is the first record of this polyphagous species from outside Australia, where it is common in the northern tropical and sub-tropical parts of the continent (Mound and Masumoto 2005).

Thrips tabaci Lindeman: One of the most widespread species of thrips, the Onion Thrips does not usually occur in the wet tropics. It can produce large populations on various crops under hot dry conditions, and has been found at Cianjur.

** *Thrips unispinus* Moulton: described from New Guinea, large numbers of this species have been found in Mango flowers in northern Australia, and it is here recorded from Cianjur.

Table 1. Plants from which thrips have been collected in Java.

Family Name	Host Plant	Thrips species
Acanthaceae	*Ruellia* sp.	*Copidothrips octarticulatus* *Thrips parvispinus*
Amaryllidaceae	*Allium* spp.	*Bolacothrips striatopennatus* *Thrips alliorum*
Anacardiaceae	*Mangifera indica*	*Thrips hawaiensis*
Annonaceae	*Polyalthia longifolia*	*Helionothrips ananthakrishnani*
Apiaceae	*Coriander sativum*	*Thrips parvispinus*
	Daucus carota	*Thrips nigropilosus* *Thrips parvispinus* *Thrips tabaci* *Megalurothrips typicus* *Megalurothrips usitatus*
Apocynaceae	*Allamanda cathartica*	*Thrips nigropilosus* *Thrips malloti*
Araceae	*Colocasia* sp.	*Heliothrips haemorrhoidalis*
Arecaceae	*Elais guineensis*	*Thrips hawaiiensis* *Thrips melastomae*
Asteraceae	*Lactuca sativa*	*Thrips parvispinus*
	Ageratum sp.	*Microcephalothrips abdominalis*
Brassicaceae	*Brassica oleracea*	*Thrips nigropilosus*
	Brassica rapa	*Thrips parvispinus*
Burseraceae	*Canarium sp.*	*Helionothrips ananthakrishnani*

Family Name	Host Plant	Thrips species
Caricaceae	*Carica papaya*	*Thrips hawaiiensis* *Thrips parvispinus*
Clusiaceae	*Garcinia mangostana*	*Scirtothrips dorsalis* *Thrips hawaiiensis*
Convolvulaceae	*Ipomoea aquatica*	*Thrips parvispinus*
	Ipomoea batatas	*Mymarothrips bicolor* *Bathrips melanicornis* *Microcephalothrips abdominalis*
Cucurbitaceae	*Cucumis sativus*	*Organothrips indicus* *Thrips palmi* *Thrips parvispinus*
	Momordica charantica	*Megalurothrips usitatus*
	Luffa acutangula	*Thrips parvispinus*
Cyperacea	*Cyperus*	*Thrips nigropilosus*
Euphorbiaceae	*Aleurites mollucana*	*Helionothrips ananthakrishnani*
	Jatropha curcas	*Franklinothrips vespiformis* *Mymarothrips bicolor* *Heliothrips haemorrhoidalis* *Rhipiphorothrips pulchellus* *Selenothrips rubrocintus* *Zaniothrips ricini* *Scolothrips rhagebianus*
Fabaceae	*Mimosa pudica*	*Thrips parvispinus* *Thrips malloti* *Crapedothrips minor*
	Vigna unguiculata	*Thrips hawaiiensis* *Thrips parvispinus* *Megalurothrips usitatus*
	Phaseolus vulgaris	*Thrips parvispinus*
	Cicer arietinum	*Bathrips melanicornis* *Megalurothrips usitatus*
	Arachis hypogaea	*Megalurothrips usitatus*
Iridaceae	*Gladiolus* sp.	*Thrips simplex*
Lamiacea	*Ocimum* sp.	*Astrothrips* sp. *Bathrips melanicornis* *Frankliniella schultzei* *Thrips palmi*
Lauraceae	*Persea americana*	*Thrips hawaiiensis*
Melastomataceae	*Melastoma* sp.	*Bathrips melanicornis* *Rhamphothrips* sp.
Musaceae	*Musa* spp.	*Asprothrips navsariensis* *Helionothrips ananthakrishnani*
Myrtaceae	*Psidium guajava*	*Thrips hawaiiensis*
	Syzygium sp.	*Scirtothrips dorsalis*
Orchidaceae	*Dendrobium* sp.	*Dichromothrips corbetti* *Thrips parvispinus*
Oxalidaceae	*Averrhoa carambola*	*Asprothrips navsariensis* *Heliothrips haemorrhoidalis* *Thrips javanicus*
Pandanaceae	*Pandanus* sp.	*Heliothrips haemorrhoidalis* *Elixothrips brevisetis*

Family Name	**Host Plant**	**Thrips species**
Phyllanthaceae	*Sauropus androgynus*	*Bathrips melanicornis* *Echinothrips americanus* *Thrips palmi* *Thrips parvispinus*
Poaceae	*Imperata* sp.	*Megalurothrips usitatus*
	Zea mays	*Thrips hawaiiensis* *Thrips nigropilosus* *Thrips parvispinus*
	Oryza sativa	*Selenothrips rubrocinctus* *Microcephalothrips abdominalis*
	Triticum aestivum	*Anaphothrips sudanensis*
	Axonopus sp.	*Bathrips melanicornis*
Rosaceae	*Rosa* spp.	*Bathrips melanicornis* *Bolacothrips striatopennatus* *Ceratothripoides brunneus* *Frankliniella intonsa* *Microcephalothrips abdominalis* *Thrips coloratus* *Thrips florum* *Thrips parvispinus* *Thrips unispinus* *Megalurothips distalis* *Megalurothrip usitatus* *Lefroyothrips lefroyi*
	Fragaria vesca	*Frankliniella intonsa* *Thrips palmi*
Rutaceae	*Citrus* spp.	*Heliothrips haemorrhoidalis* *Thrips hawaiiensis* *Thrips malloti*
Sapindaceae	*Nephelium lappaceum*	*Pseudodendrothrips* sp. *Thrips coloratus* *Thrips parvispinus*
Solanaceae	*Nicotiana tabacum*	*Thrips parvispinus*
	Solanum lycopersicum	*Thrips palmi* *Thrips parvispinus*
	Solanum tuberosum	*Thrips parvispinus*
	Solanum nigrum	*Thrips parvispinus*
	Solanum melongena	*Thrips palmi* *Thrips parvispinus*
	Datura metel	*Thrips palmi*
	Capsicum annuum	*Bathrips melanicornis* *Microcephalothrips abdominalis* *Thrips hawaiiensis* *Thrips parvispinus*
Verbenaceae	*Lantana camara*	*Dendrothripoides innoxius* *Bathrips melanicornis* *Thrips florum* *Thrips malloti*
Zingiberaceae	*Curcuma longa*	*Panchaetothrips indicus*
	Curcuma zantorrhiza	*Panchaetothrips indicus*

Acknowledgements

This paper was prepared during a working visit by Dewi Sartiami to CSIRO at Canberra. This visit was made possible through a grant kindly supplied by the Crawford Fund, Australia. We are grateful to two referees, Adriano Cavalleri and Desley Tree, for help and advice in improving this paper.

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ZooKeys 306: 23–36 (2013)
doi: 10.3897/zookeys.306.5216
www.zookeys.org

RESEARCH ARTICLE

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A review of the genus *Monema* Walker in China (Lepidoptera, Limacodidae)

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Academic editor: *E. van Nieukerken* | Received 27 March 2013 | Accepted 29 May 2013 | Published 3 June 2013

urn:lsid:zoobank.org:pub:4FFDB920-7E4A-4F33-9D8E-16CC7189723F

Citation: Pan Z, Zhu C, Wu C (2013) A review of the genus *Monema* Walker in China (Lepidoptera, Limacodidae). ZooKeys 306: 23–36. doi: 10.3897/zookeys.306.5216

Abstract

Four species and one subspecies of the genus *Monema* Walker, 1855 are recognized from China, in which *M. tanaognatha* Wu & Pan **sp. n.** is described as new, *M. coralina* Dudgeon, 1895 and *M. meyi* Solovyev & Witt, 2009 are newly recorded for China. The female of *M. meyi* is reported for the first time. *Monema nigrans* de Joannis, 1901 and *M. melli* Hering, 1931 are synonymized with *M. flavescens* Walker, 1855. *Cnidocampa rubriceps* Matsumura, 1931 is regarded here as a subspecies of *Monema flavescens* Walker, 1855. The photographs of moths and their genitalia are given. A key to the species of the genus is provided.

Keywords

Lepidoptera**,** Limacodidae, *Monema,* new species, China

Introduction

The genus *Monema* was erected by Walker in 1855, based on the type species, *Monema flavescens* Walker, 1855.

Prior to the present study the genus included the following species: *M. flavescens* Walker, 1855, *M. nigrans* de Joannis, 1901, *M. coralina* Dudgeon, 1895, *M. rubri-*

ceps (Matsumura, 1931), *M. melli* Hering, 1931 and *M. meyi* Solovyev & Witt, 2009 and it is distributed in Nepal, Bhutan, China, Far East of Russia, Korea, Japan, and northern Vietnam (Hering 1913, 1933; Solovyev 2008; Solovyev and Witt, 2009; Yoshimoto 1993, 1994). The diagnosis of the genus is given below.

In China three taxa have been recorded (Cai 1981; Inoue 1992; Wu 2005, 2012; Wu and Fang 2010) up to now. In this paper, four species are reported for China, including one species described as new to science and two species newly recorded for China. *Monema nigrans* and *M. melli* are synonymized with *M. flavescens*. *Cnidocampa rubriceps* is regarded here as a subspecies of *M. flavescens*.

Materials and methods

Material examined for this study originates from the insect collections of the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing, P. R. China. All types of new species are deposited in IZCAS

Photographs of moths and their genitalia were captured using Canon-EOS-7D with the help of micro-lens. Standard methods of dissection and mounting in Euparal follow Holloway et al. (1987).

Systematics

Monema Walker, 1855

http://species-id.net/wiki/Monema

Monema Walker, 1855: 1102,1112. Type species: *Monema flavescens* Walker, 1855: 1112, by monotypy.

Cnidocampa Dyar, 1905: 952. An unnecessary replacement name for *Monema* Walker, 1855, [not preoccupied by the plant genus *Monema* Greville, 1827].

Description. Moths medium-sized, body yellowish. Male antennae filiform and thicker than in female. Labial palpi extremely long, more than three times eye diameter. Forewings with R_3 + R_4 stalked from R_5 and R_2 stalked with their stem. Hindwings with M_1 and Rs stalked. Forewings with two narrow brown fasciae running from apex to 3/4 and 1/3 of inner margin respectively; basal part of forewing bordered by proximal fascia yellow, rest brown. Hind tibiae with two pairs of spurs.

Male genitalia: tegumen narrow; uncus narrow and long, usually with short ventral process at apex; gnathos narrow and long, nearly as long as uncus; juxta with lateral elongate process or spines; valva elongate, with apically saccular process; saccus usually long and large, more than half of valva's width.

Female genitalia: posterior apophysis long, anterior apophysis very short and less than the half length of posterior one; sclerotized exterior flap at posterior margin of ostium bearing minute hair; ductus bursae very long, more than the half length of

the abdomen, base narrow and straight, apical part wider and spiraled; corpus bursae ovate, large; a pair of signa trigonal, bearing spines.

The larva belongs to the nettle-type, and is known only for *M. flavescens*. Its final instar larvae are 19–25mm in length. Head yellowish brown. Thorax yellowish green. Dorsum with a large purple-brown spot shaped as a dumbbell. Subdorsal scoli on T2-A9 and lateral scoli on T2, T3 and A2-8 (Fig. 22) (Long et al. 2008).

The cocoon of *M. flavescens* Walker is very hard and shaped as a sparrow-egg. It is white, with longitudinal brown stripes (Fig. 23).

The genus is related to *Hyphorma* Walker, 1865, but differs from the latter by the shorter terminal segment of the labial palpi and the stalked R_2 and R_{3-5} in the forewings. *Scopelodes* Westwood, 1841 and *Phocoderma* Butler, 1886 also have very long palpi, but the absence of a tuft of hair in 2nd or 3rd segments distinguish them from *Monema* (Hering 1931).

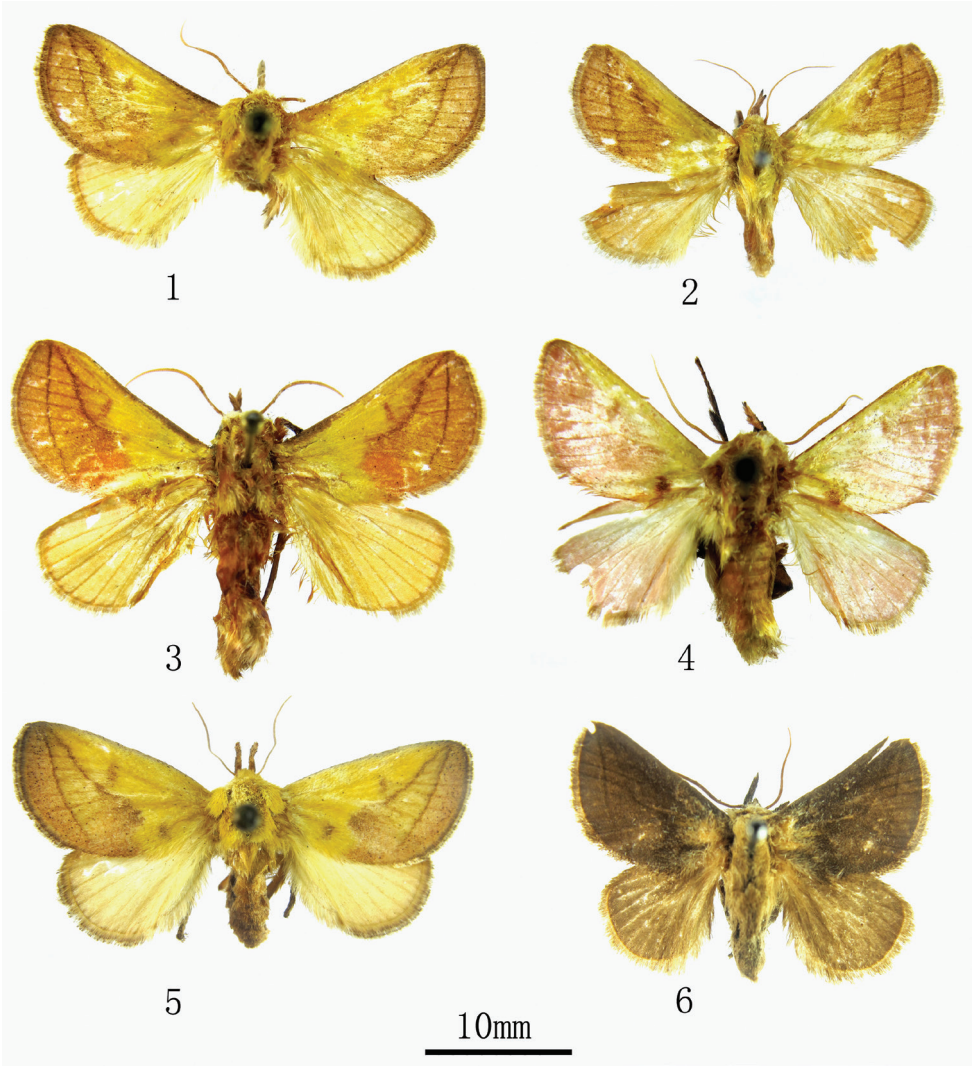
Key to the species and subspecies

1 Wings mostly pale black, brown or pale reddish 2
– Wings mostly yellow or yellowish brown 3
2 Wings mostly pale reddish ..... ***M. coralina***
– Wings mostly brown to pale black .... ***M. flavescens flavescens*** **(Black form)**
3 Frons red ..... ***M. flavescens rubriceps***
– Frons yellow 4
4 Saccus long, aedeagus straight 5
– Saccus short and wide, aedeagus S-shaped..... ***M. meyi***
5 Gnathos narrow and long; juxta long, ending in a tuft of long spines each side ..... ***M. tanaognatha*** **sp. n.**
– Gnathos short; juxta short, ending in 1-3 long spines each side ..... ***M. flavescens flavescens***

Monema flavescens **Walker, 1855**
http://species-id.net/wiki/Monema_flavescens
Figs 5, 6, 10, 12, 13, 14, 15, 16, 17, 22, 23

Monema flavescens Walker, 1855: 1112, fig. 1c. Type locality: North China.
Miresa flavescens (Walker): Seitz, 1913: 344, fig. 50c.
Cnidocampa flavescens (Walker): Cai, 1981: 99.
Cnidocampa johanibergmani Bryk, 1948: 219.
Monema melli Hering, 1931: 691, fig. 87i. Type locality: Guangdong, China. **syn. n.**
Monema flavescens var. *nigrans* de Joannis, 1901: 251.
Monema nigrans de Joannis: Solovyev and Witt 2009: 108.

Description. Wing expanse 30–32 mm in male, 35–39 mm in female. In male genitalia, the juxta is short and ends in 1-3 long spines each side. In female genitalia, the sclerotized base of ductus bursae is diagnostic.



Figures 1–6. Adults. **1** *M. tanaognatha* Wu & Pan, sp. n. , holotype (Kunming, male) **2** *M. tanaognatha* sp. n., paratype (Kunming, female) **3** *M. meyi* Solovyev & Witt (Hunan, male) **4** *M. coralina* Dudgeon (Yunnan, male) **5** *M. flavescens flavescens* Walker (Beijing, female) **6** *M. flavescens flavescens* Walker (Black form, Shanghai, male).

Distribution. Heilongjiang, Jilin, Liaoning, Inner Mongolia, Beijing, Hebei, Shandong, Henan, Shaanxi, Qinghai, Jiangsu, Shanghai, Zhejiang, Hubei, Jiangxi, Fujian, Taiwan, Guangdong, Guangxi; Russia (Far East), Korea, Japan.

Remarks. *M. melli* was described based on a single male from Guangdong, China. It differs from *M. flavescens* by the smaller size and the shorter labial palpus. According to the male genitalia of the holotype examined and provided by Mr. Solovyev, it matches well with that of *M. flavescens*. Thus we synonymize *M. melli* with *M.*

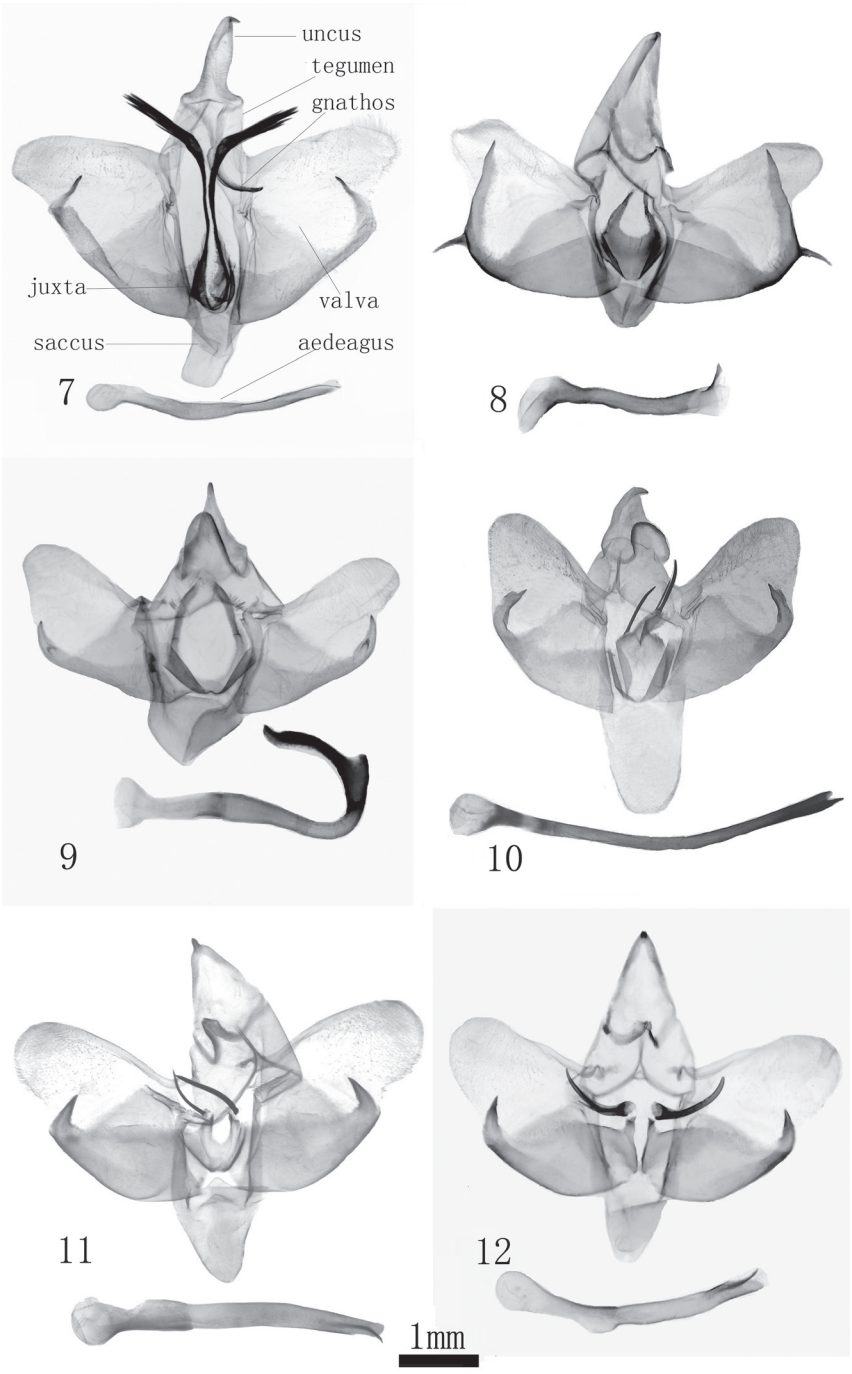
flavescens. Solovyev and Witt (2009) treated *M. flavescens* var. *nigrans* as a full species. However, the black form (var. *nigrans*) and the normal form (*flavescens*) are from the same population and the var. *nigrans* do not show any differences in the male or female genitalia with *flavescens*. Therefore we treat *M. flavescens* var. *nigrans* merely as a dark form. In Guiyang 2.75% of the population of *flavescens* belonged to the black form; the black individuals can interbreed with the non black individuals and produce fertile offspring (Long et al. 2008).

(a) *Monema flavescens flavescens* Walker, 1855
http://species-id.net/wiki/Monema_flavescens_flavescens
Figs 5, 6, 12, 13, 14, 15, 16, 17, 22, 23

Monema flavescens Walker, 1855: 1112, fig. 1c

Description. Wing expanse 25–39 mm. The aedeagus is 1.6 times as long as valva, shorter than that in ssp. *rubriceps*. Frons yellow to yellowish red.

Specimens examined. Heilongjiang, Dailing, 390m, 30 June-16 July 1962, Bai Jiuju (25♂), 4–9 July 1957 (5♂, gen. slide WU0180); Heilongjiang, Yichun, 9 July 1956 (2♂), 6 Sept. 1956 (1♂); Heilongjiang, Wuchang, Shengli Linchang, 10 July 1970 (3♂); Heilongjiang, Harbin, 17 July–17 Aug. 1936 (2♀), 81 Aug. 1940; Heilongjiang, Hulin 852 Farm, 10 July1962, Chen Tailu (1♂); Liaoning, Qingyuan, 29–30 July 1954 (1♀8♂, gen. slide WU0179); Liaoning, XInjin, 1954 (2♂); Jilin, Manjiang, 19 June–27 July 1955 (4♀10♂); Jilin, Changbai Shan, 800m, 2–13 July 1982, Zhang Baolin (2♀3♂, gen. slide WU0178); Inner Mongolia ,Ulanhot 15 July 1987 (1♂), 5 June 1957 (1♂, gen. slide WU0181); Hunan,Yongshun Shanmuhe, 600m, 3 Aug. 1988, Chen Yixin (1♂, gen. slide WU0117); Hunan, Andong, 20 May 1954 (1♂, gen. slide WU0118); Hunan, Guzhang Gaowangjie, 850m, 29 July 1988, Chen Yixin (1♂, gen. slide WU0120); Hunan, Hengshan, 22Aug. 1979 (1♂, gen. slide WU0119); Fujian, Wuyishan, Sangang, 3 Aug. 1979, Song Shimei (1♀, gen. slide WU0121); Fujian, Wuyishan, Tongmu, 26 July 1979, Song Shimei (1♂, gen. slide WU0121a); Fujian, Xiamen, 1♂, 25 June 1973, Zhang Baolin (1♂, gen. slide WU0123); Hubei, Shennongjia, 950–1640m, 18–24 July 1980, Yu Peiyu (8♂, gen. slide WU0124); Hubei, Jingzhou, July 1980 (6♂, gen. slide WU0125); Hubei, Xingshan Longmen River, 1350m, 16 June–17 July 1993, Yao Jian (9♂, gen. slide WU0126); Hubei, Zigui, Jiutouling, 100m, 12–13 June 1993, Yao Jian (3♂, gen. slide WU0127); Hubei, Xuanen, Fengshuiling 1200–1240m , 29 July 1989, Yang Longlong, Li Wei (1♂, gen. slide WU0128); Guangxi, Longsheng, 10–15 June 1980, Wang Linyao (4♂), 26 May 1963, Wang Chunguang (1♀, gen. slide WU0133, 134); Guangxi, Gualin Forestry Institute, 5 July 1981, Liang Xinqiang (1♂, gen. slide WU0145); Guangxi, Qinzhou, 15 Apr. 1980, Cai Rongquan (2♂, gen. slide WU0143); Guangxi, Jinxiu, 1100m, 10 May 1999, LI Wenzhu (1♂) (gen. slide WU0141); Zhejiang, Hangzhou, 1 Aug. 1973, Zhang Baolin (2♂); Zhejiang, Hang-



Figures 7–12. Male genitalia. **7** *M. tanaognatha* Wu & Pan, sp. n. holotype (gen. slide WU0156) **8** *M. coralina* Dudgeon (gen. slide L06051) **9** *M. meyi* Solovyev & Witt (gen. slide WU0121) **10** *M. flavescens rubriceps* (Matsumura) (16058 MWM GS Taiwan) **11** *M. melli* Hering, holotype (TYPE ZHUB GU2) **12** *M. flavescens flavescens* (Black form, gen. slide L06052)**.**

zhou, 4–21 June 1976, Chen Ruijin (1♀3♂); Zhejiang, Wenzhou, 1953, Liao Dingxi (1♂); Zhejiang, Zhoushan, 18 June 1936, O. Piel (1♂); Zhejiang, Tianmu shan, May-July 1936 (1♀3♂), 29 July 1972, Wang Ziqing (4♂) , 21 July 1973, Zhang Baolin (5♂, gen. slide WU0146); Shaanxi, Zhouzhi, 1350m, 24 June 1999, Yao Jian (3♂, gen. slide WU0174, 175) Jiangxi, Lushan, 17–19 June 1974, Zhang Baolin (2♂) (gen. slide WU0146); Jiangxi, Guling, July 1935 (1♀1♂, gen. slide WU01149); Jiangxi, 27–28 May 1957, Yu Peiyu (1♀2♂, gen. slide WU0150); Shanghai, 11–26Aug.1932, O. Piel (16♀4♂, gen. slides L06056, 57), 14 June- 20 July 1933, A. Savio (4♂); Shanghai, Botanical Park, June 1974 (1♀); Jiangsu, Yangzhou, 15 May 1926 (1♂), 20 June 1974 (1♂, gen. slide WU0182); Jiangsu, Nanjing, 1–10 June 1957, Yu Peiyu (3♀) (gen. slide WU0183); Guangdong, Guangzhou, July 1931 (5♂); Guangdong, Guangzhou, Shipai, 17 Sept. 1958, Wang Linyao (1♂); Guangdong, Nanling, 21 July 2008, Chen Fuqiang (1♂, gen. slide WU0053a) Beijing, 3–31 May 1957, Yu Peiyu (6♀15♂, gen. slide WU0184); Beijing, Xishan, 1♂, Aug.1955; Beijing, Qinghe, 1♂, 13 Mar.1957 (1♂); Beijing, Tanzhesi, 15 Aug. 1951 (1♂); Beijing, Bada ling, 24 June 1957 (1♂); Beijing, Baihua shan, 4–16 July 1973, Liu Youqiao, Zhang Baolin (5♂, gen. slide WU0185); Beijing, Sanbu, 25 July 1964, (5♂), 21 July 1972, Zhang Baolin (1♀); Hebei, Changli, 15 June-8 July 1972 (1♂6♀), 21 June 1973 (2♀, gen. slide WU0186); Henan, Songxian, Baiyun shan, 1400m, 18–20 July 2003, Qiu Reng (2♂); Henan, Huixian Baligou, 700m, 12–15 July 2002 (1♀); Henan, Neixiang Baotianman, 12 July 1998, Shen Xiaocheng (1♂). **Black form:** Shanghai Datong Route, 28 July 1980 (1♂, gen. slide L06052); Shanghai Botanical Park, June 1974, Tian Lixin (1♀) (gen. slide L06053); Shanghai, July 1935 (2♂); Jilin, Manjiang, 9–31 July 1955 (1♀2♂, gen. slides L06059, L06060).

Distribution. Mainland China; Russia (Far East), Korea, Japan.

(b) *Monema flavescens rubriceps* (Matsumura, 1931) stat. n.
http://species-id.net/wiki/Monema_flavescens_rubriceps
Fig. 10

Cnidocampa rubriceps Matsumura, 1931: 105. Type locality: Taiwan, China.
Monema rubriceps (Matsumura): Hering, 1931: 691.

Description. Wing expanse 30–32mm. It differs from *Monema flavescens flavescens* Walker by the red frons. The aedeagus about twice as long as valva, longer than that of ssp. *flavescens*.

Specimens examined. None. The image of the male genitalia of *M. rubriceps* (Matsumura) was provided by Dr. Solovyev.

Distribution. Taiwan.

Remarks. *Cnidocampa rubriceps* is treated here as a subspecies of *Monema flavescens* because the male genitalia have the same structure, except for the aedeagus that is longer in ssp. *rubriceps* than in ssp. *flavescens*.

***Monema tanaognatha* Wu & Pan, sp. n.**
urn:lsid:zoobank.org:act:AAF50A42-14EA-45E5-AAD3-0F2E027119A8
http://species-id.net/wiki/Monema_tanaognatha
Figs 1, 2, 7, 18

Description. Wing expanse 28–33mm. Labial palpus yellowish brown, tip black. Face yellow to pale red. Head and thorax yellow. Abdomen yellowish brown. Ground colour of forewing yellow, with two dark concave fasciae from apex to 1/3 and 2/3 of inner margin, distal part of forewing, bordered by proximal fascia, brown. Hindwing yellow to yellowish brown.

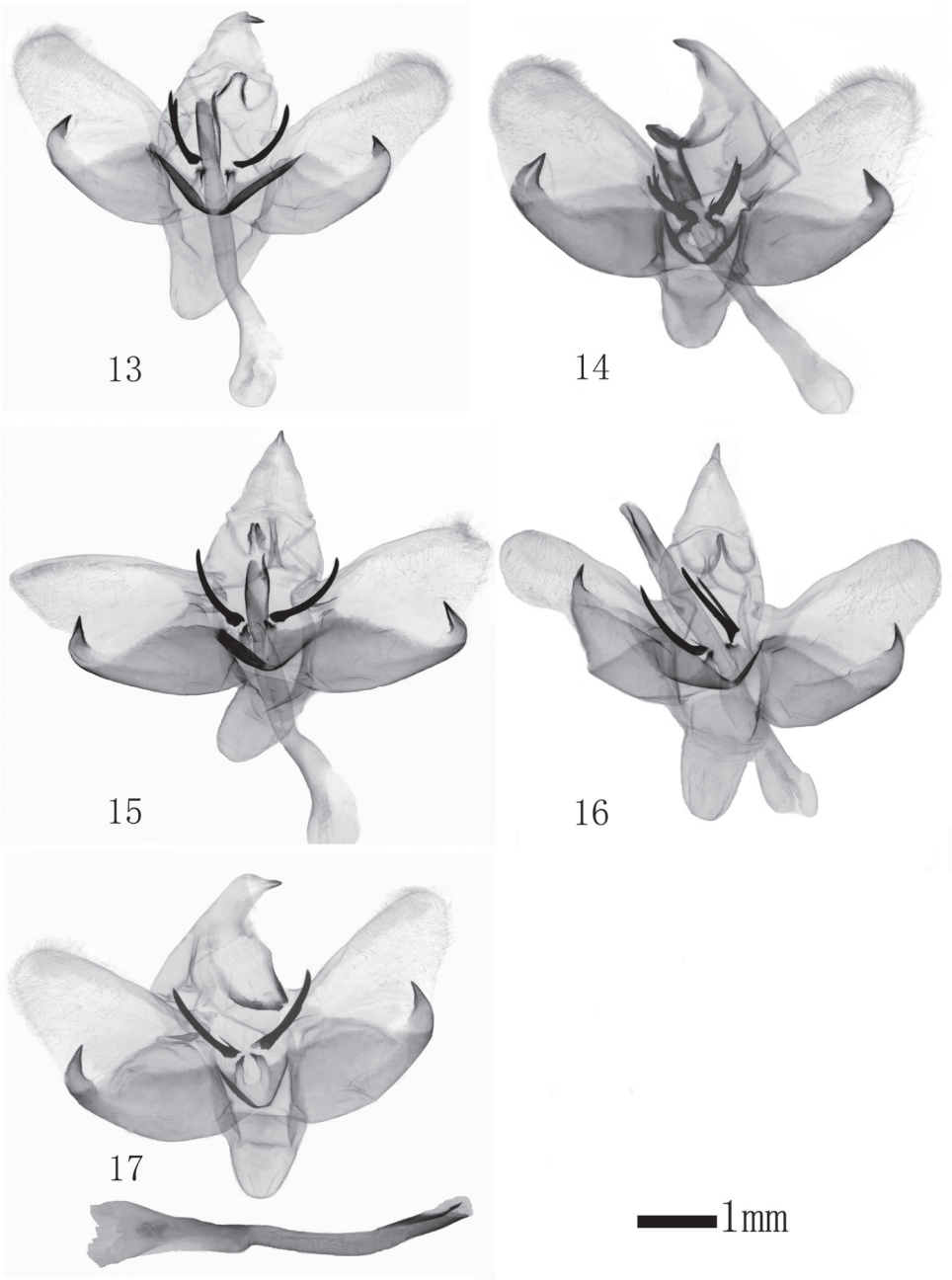
Male genitalia: tegumen narrow; uncus narrow and long, ventrally with short process on apex; gnathos narrow and very long; juxta U-shaped, each lateral bar with distal tuft of long spines; valva elongate, with a strong short apically saccular process; saccus long and relatively narrower than that of *flavescens*; aedeagus slightly longer than valva, narrow and straight.

Female genitalia: posterior apophysis long, anterior apophysis very short; sclerotized exterior flap at posterior margin of ostium smaller, bearing minute hair; ductus bursae very long, basal half narrow and straight, apical half wider and spiraled; corpus bursae ovate, large; a pair of signa trigonal, bearing spines.

Type material. Holotype: male, Kunming, Yunnan, 16 May 1980, Song Shimei (gen. slide WU0156). Paratypes: 1♀♂, same data as holotype (gen. slide WU0157); Xuanwei, Yunna , 1890m, 1♂, 25 June 1979 (gen. slide WU0152). Shaanxi, Fuping, 900–950m, 23–24 July 1998, Yuan Decheng, Yao jian, Zhang Youwei (5♂, gen. slide WU0172); Shaanxi, Liuba Miaotaizi, 1350m, 21 July 1998, Yao jian (1♂); Shaanxi, Taibai Huangbaiyuan, 1350m, 14 July 1980, Zhang Baolin (4♂, gen. slide WU0173); Shaanxi, Ningshan Huoditang,1580–1650m, 27 July 1998, Yao Jian (4♂, gen. slides WU0171, WU0176); Gansu, Wenxian Tielou, 1450m, 1999 July 24, Yao jian, Wang Hongjian, Zhu Chaodong (7♂, gen. slide WU0164); Gansu, Kangxian, Qinghe linchang, 1400–2250m, 15 July 1998, Yao Jian (3♂), 7–9 July 1999, Yao jian (9♂, gen. slide WU0162, 163); Gansu, Kangxian, Baiyun shan, 1250–1750m, 12 July 1998, Yao Jian(3♂) (gen. slide WU0165); Gansu, Diechang, 1800m, 7 July 1998, Yao Jian (4♂, gen. slide WU0166); Gansu, Zhouqu, Shantan Linchang, 2400m, 15 July 1999, Wang Hongjian (4♂, gen. slide WU0167, 168); Sichua, Emei shan, 800–1000m, 21 June-25 July 1957, Huang Keren, Zhu fuxing, Lu Youcai (7♂, gen. slides WU0110, WU0135); Sichua, Dujiang Yan, Qingcheng Shan, 700–1000m, 3–4 June 1979, Gao Ping , Shang Jinwen (2♂) (gen. slides WU0112, WU0113); Hubei, Lichuan, Xingdou Shan, 800m, 21–23 July 1989, Li Wei (2♂, gen. slide WU0130); Guangxi, Miaoer shan, Jiuniuchang, 1150m, 7 July 1985, Fang Chenglai (2♂, gen. slide WU0132).

Distribution. Shaanxi, Gansu, Hubei, Guangxi, Sichuan, Yunnan.

Remarks. The species is similar externally to *M. flavescens*, but is well distinguished by male genitalia: gnathos is narrowing and very long; juxta is long and ending in a tuft of long spines at each side. In female genitalia, base of ductus bursae of the new species is narrow and membranous, while that of *M. flavescens* is sclerotized.



Figures 13–17. Male genitalia of *Monema flavescens flavescens* Walker. **13** Shennongjia, Hubei (gen. slide WU0124) **14** Xiamen, Fujian (gen. slide WU0123) **15** Xingshan, Hubei (gen. slide WU0126) **16** Jingzhou, Hubei (gen. slide WU0125) **17** Wuyishan, Fujian (gen. slide WU0121a)**.**

Etymology. The name is derived from Greek "Tanaos" (=Long) and "gnathos" (Greek for jaw), corresponding to the long gnathos in the male genitalia.

***Monema meyi* Solovyev & Witt, 2009, new record to China**
http://species-id.net/wiki/Monema_meyi
Figs 3, 9, 19

Monema meyi Solovyev & Witt, 2009: 108–109. Type locality: Vietnam (ZMHB).

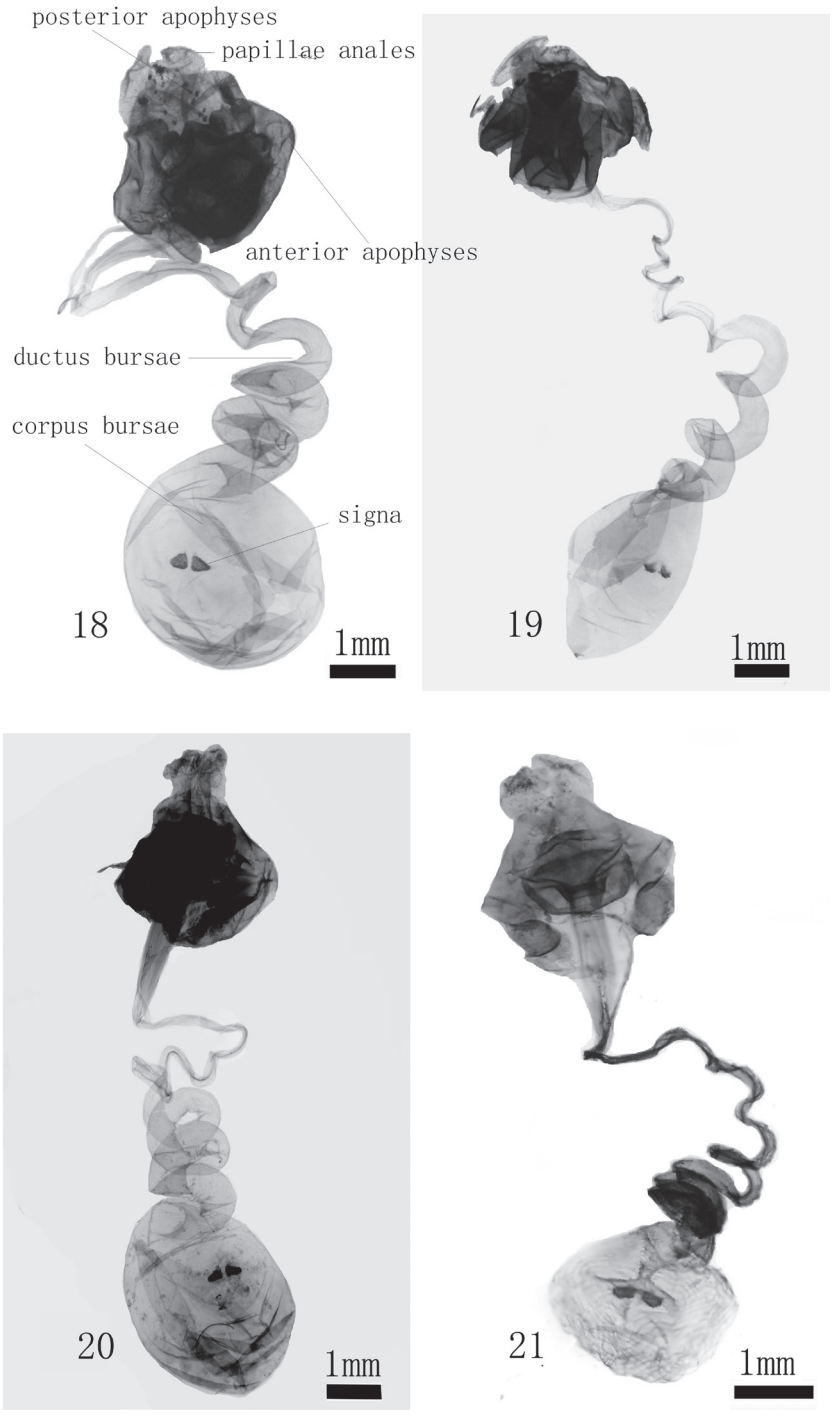
Description. Wing expanse 35-38 mm in male, 36-42 mm in female. The species is similar externally to *M. flavescens*, but well discriminated by male genitalia: saccular process divided apically, juxta with lateral row of elongate spines, very broad saccus, S-shaped aedeagus with long and strong apical spur.

Female genitalia: posterior apophysis long, anterior apophysis very short; sclerotized exterior flap at posterior margin of ostium large and elongate, bearing minute hair; ductus bursae very long, basal 1/3 narrow and straight, apical 2/3 wider and spiralled; corpus bursae ovate, large; a pair of signa trigonal, bearing spines.

Specimens examined. Hunan, Sangzhi, Baxixiang, 370m, 13 July 2009, Chen Fuqiang (1♀) (gen. slide WU0052) ; Guangdong, Chebaling (2♀8♂, gen. slides WU0053, WU0054, WU0054a); Sichuan, Emei Shan, 800-1000m, 21 June-25 July 1957, Huang Keren, Zhu Fuxing, Lu Youcai (1♀8♂, gen. slide WU0111); Sichuan, 21-24 July 1974 (1♂, gen. slide WU0137); Guizhou, Jiangkou, Fanjing Shan, 500m, 11 July 1988, Li Wei (1♀2♂, gen. slides WU0115, WU0116); Fujian, Wuyishan, 14 June 1982, Zhang Baolin (1♂, gen. slide WU0177); Jiangle, Longqi Shan, 18Aug. 1991, Song Shimei (1♂, gen. slide WU0121); Hubei, Xuanen, Fengshuiling, 1200-1240m , 25 July 1989, Yang Longlong, Li Wei (1♂, gen. slide WU0129); Hubei, Lichuan, Xingdou Shan, 800m, 21-31 July 1989, Li Wei (3♂, gen. slide WU0138); Hubei, Hefeng, Fengshuiling, 1240m, 29 July 1989, Li Wei(1♂, gen. slide WU0131); Guangxi, Jinxiu, Shengtang Shan, 900m, 17 May 1999, Li Wenzhu (1♂, gen. slide WU0140); Guangxi, Jinxiu Luoxiang, 200-400m, 15-16 May 1999, Han Hongxiang (5♂, gen. slide WU0142); Guangxi, Shangsi Hongqi Linchang, 250m, 28 May 1999, Yuan Decheng (1♂); Dayu, 16 Aug. 1985, Wang Ziqing (1♀); Jiangxi, Deyu Neiliang, 23 Aug. 1985 (1♂, gen. slide WU0150); Jiangxi, Yifengyuan, 2 June 1959 (1♂, gen. slide WU0151); Hainan, Wuzhi Shan, 25 Apr. 1984, Gu Maobin (1♀, gen. slide WU0147); Yunnan, Menghai, 1200m, 18 July 1958, Wang Shuyong (1♂, gen. slide WU0153); Yunnan, Binchuan, Aug. 1959 (2♂, gen. slide WU0154); Yunnan, Weixi, 2320m, 6 July1979 (1♂, gen. slide WU0155).

Distribution. Hubei, Hunan, Fujian, Jiangxi, Guangdong, Hainan, Guangxi, Sichuan, Guizhou, Yunnan; Vietnam.

Remarks. This species, newly recorded in China, was described based on two males from Vietnam (Solovyev and Witt 2009). This is the first report and description of the female. The sclerotized exterior flap at posterior margin of ostium is large and elongate compared to that found in *M. flavescens* and *M. tanaognatha*.



Figures 18–21. Female genitalia . **18** *M. tanaognatha* Wu & Pan sp. n. (gen. slide WU0156) **19** *M. meyi* Solovyev & Witt (gen. slide WU0147) **20** *M. flavescens flavescens* Walker (gen. slide WU0121) **21** *M. flavescens flavescens* Walker (Black form (gen. slide L06053)**.**

Figures 22–23. Larva and cocoon of *M. flavescens flavescens* Walker. **22** larva **23** cocoon.

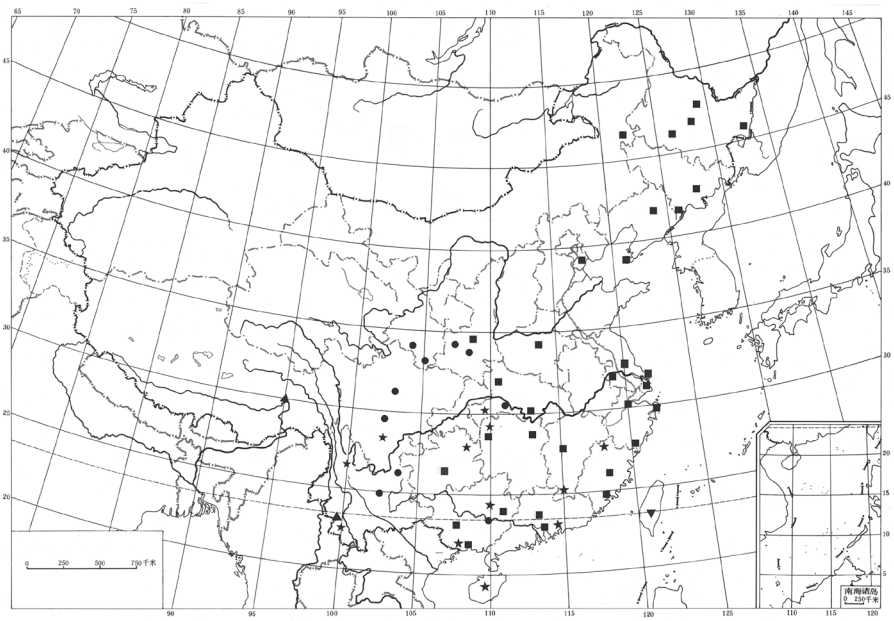


Figure 24. Distribution of *Monema* in China. ● *M. tanaognatha* Wu & Pan; ▲ *M. coralina* Dudgeon; ★ *M. meyi* Solovyev & Witt; ■ *M. flavescens flavescens* Walker; ▼ *M. flavescens rubriceps* (Matsumura).

Monema coralina Dudgeon, 1895, new record to China

http://species-id.net/wiki/Monema_coralina

Figs 4, 8

Monema coralina Dudgeon, 1895: 290. Type locality: Bhutan.

Description. Wing expanse 30-35mm. The mostly reddish wings are diagnostic. In the male genitalia, the uncus lacks the ventrally apical process.

Specimens examined. Yunnan, Xinshuangbanna, 700m, 4-15 Apr. 1993, Yang Longlong (4♂, gen. slide L06051); Xizang, Motuo, 1080m, 22 July 2006, Chen Fuqiang (1♀).

Distribution. Yunnan (Xinshuangbanna), Xizang (Motuo); Nepal, Bhutan.

Remarks. The abdomen of the female from Xizang is missing. The species is reported for the first time in China.

Acknowledgements

We are very grateful to Mr. Alexey V. Solovyev (Dept. of Zoology, Ulyanovsk State Pedagogical University, Russia) for providing photos of the adult and male genitalia of the holotype of *M. melli* Hering and the image of the male genitalia of *M. rubriceps* (Matsumura). We also extend our great thanks to two anonymous reviewers and Dr. Erik van Nieukerken for their good advice.

This work was supported by grants from the National Science Foundation, China (NSFC Grant No. 31172129, J121002), Forest Ecology Station in Linzhi, Tibet, "Western Light" Visiting Scholar Program in Tibet, and Survey of animal resources in Southeast Tibet supported by Ministry of Science and Technology.

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ZooKeys 306: 37–58 (2013)
doi: 10.3897/zookeys.306.5289
www.zookeys.org

DATA PAPER

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Iberian Odonata distribution: data of the BOS Arthropod Collection (University of Oviedo, Spain)

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Academic editor: *V. Chavan* | Received 9 April 2013 | Accepted 29 May 2013 | Published 3 June 2013

Citation: Torralba-Burrial A, Ocharan FJ (2013) Iberian Odonata distribution: data of the BOS Arthropod Collection (University of Oviedo, Spain). ZooKeys 306: 37–58. doi: 10.3897/zookeys.306.5289 Resource ID: GBIF key: http://gbrds.gbif.org/browse/agent?uuid=7e31baf8-f762-11e1-a439-00145eb45e9a

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Abstract

Odonata are represented from the Iberian Peninsula by 79 species. However, there exists a significant gap in accessible knowledge about these species, especially regarding their distribution. This data paper describes the specimen-based Odonata data of the Arthropod Collection of the Department of Biología de Organismos y Sistemas (BOS), University of Oviedo, Spain. The specimens were mainly collected from the Iberian Peninsula (98.63% of the data records), especially the northern region. The earliest specimen deposited in the collection dates back to 1950, while the 1980's and 2000's are the best-represented time periods. Between 1950 and 2009, 16,604 Odonata specimens were deposited and are documented in the dataset. Approximately 20% of the specimens belong to the families Coenagrionidae and Calopterygidae. Specimens include the holotype and paratypes of the Iberian subspecies *Calopteryx haemorrhoidalis asturica* Ocharan, 1983 and *Sympetrum vulgatum ibericum* Ocharan, 1985. The complete dataset is also provided in Darwin Core Archive format.

Keywords

Odonata, Arthropoda, Iberian Peninsula, Entomological collections, Biodiversity collections, Distribution, datasets, Spain

General description

Purpose: The purpose of this dataset is to make data associated with Odonata specimens deposited in the BOS Arthropod Collection (subcollection of Odonata: BOS-Odo) of the University of Oviedo, Spain. Iberian Odonata (and available data sets) and dragonfly data records are scanty when compared with the distribution data records from other European countries (e.g. Belgium, France, Germany, United Kingdom). Prior to publishing of this dataset, only 2700 data records associated with Iberian Odonata are accessible through GBIF data portal [accessed 2013/04/04], where as nearly 12000 data records from Iberian region for the period 1784-2009 can be tagged or extracted from various publications (includes authors unpublished data), some of which cite the specimens deposited in BOS Arthropod Collection (few listed in reference section). As depicted in Figure 1, other European data sets on dragonfly exceed by far the Iberian available records. For instance, British Odonata database comprises 500,000 records (Parr 2010), Dutch database more than 307,000 (Termaat et al. 2010), North Rhine-Westphalia 150,000 (Conce et

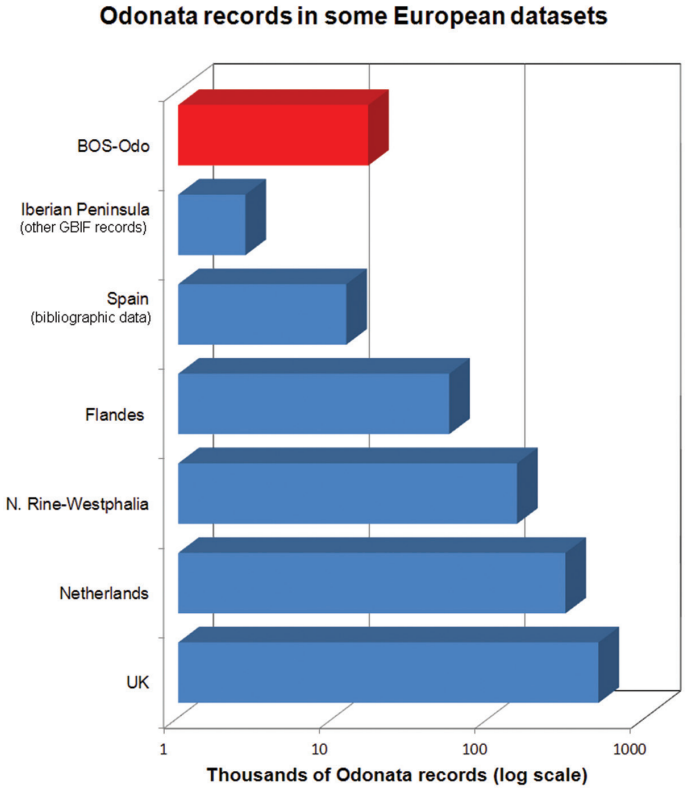

Figure 1. Odonata data records in major European data sets. Sources: BOS-Odo (this dataset); Flandes (De Knijf and Anselin 2010); Iberian Peninsula other GBIF data (GBIF dataportal http://data.gbif.org); Netherlands (Termaat et al. 2010); North Rhine-Westphalia (Conce et al. 2010); United Kingdom (Parr 2010).

al. 2010) or Flandes 55,000 (De Knijf and Anselin 2010). On this backdrop, the BOS-Odo dataset makes significant contribution of primary data about Iberian odonates for ecological, faunistic and conservation studies. Therefore main objective of this data set development were three fold; (1) provide a large dataset with primary distribution data of Iberian Odonata, (2) describe the Odonata subcollection of the BOS Arthopod Collection, (3) promote increasing inhouse and external use of the Collection and the biodiversity data associated.

Additional information: A list of publications citing Iberian odonate data contained in this dataset is provided in point 2 of reference section.

Project details

Project title: Informatización de la Colección de Artrópodos BOS de la Universidad de Oviedo / Digitisation of the BOS Arthropod Collection of University of Oviedo.

Project personnel: Antonio Torralba-Burrial

Former curator and promoter: Francisco J. Ocharan

Another administrative contact: Araceli Anadón.

BOS-Odo collectors: Collectors who have deposited more than 50 specimens include Antonio Torralba-Burrial, Francisco .J. Ocharan, David Outomuro, Rocío Ocharan, Marta I. Saloña, Antonio Benítez-Donoso, José Alberto Martínez, Saúl Rodríguez-Martínez, Matías Brotons-Padilla.

Funding: Digitisation of this biological collection is supported by Spanish National R+D+i Plan (MICINN, Spanish Government, grant ref. PTA2010-4108-I) and PCTI Asturias (Asturias Regional Government, ref. COF11-38) through a contract for ATB.

Study area descriptions/descriptor: Majority of the Odonata specimens deposited in BOS Arthropod Collection are from Iberian Peninsula, which has a geographic extent of 581,300 km^2, located between latitude 36° and 43°47'N, and between longitude 3°29'E and 9° 29'W, placed at southwest end of Europe. The geographic location and relief distribution of the Iberian Peninsula was responsible for it being glacial refuge (and speciation centre) for many groups of organisms during quaternary period, with limited contact with the rest of the continent. Later on se-veral faunal species belonging to other regions colonised the Iberian Peninsula, which makes it an interesting place for biogeographic or distribution range variations linked to climate change studies. Climatic variation in the Iberian Peninsula is diverse, with annual average air temperature ranges between 2.5 °C in high mountains in the north (Pyrenees) and 17 °C in thermo-Mediterranean zones in the south. Annual average rainfall varies between less than 200 mm in south east (e.g. some zones in Almeria province) and about 2200 mm in the north-west (north Portugal and south Galicia) (AEMET and IM 2011). This climate variation can be analysed in a bioclimatic belts scheme (Rivas-Martínez 1987) or a Köppen-Geiger climate classification system (AEMET and IM 2011). Both systems shown a more humid zone in the north and more dry

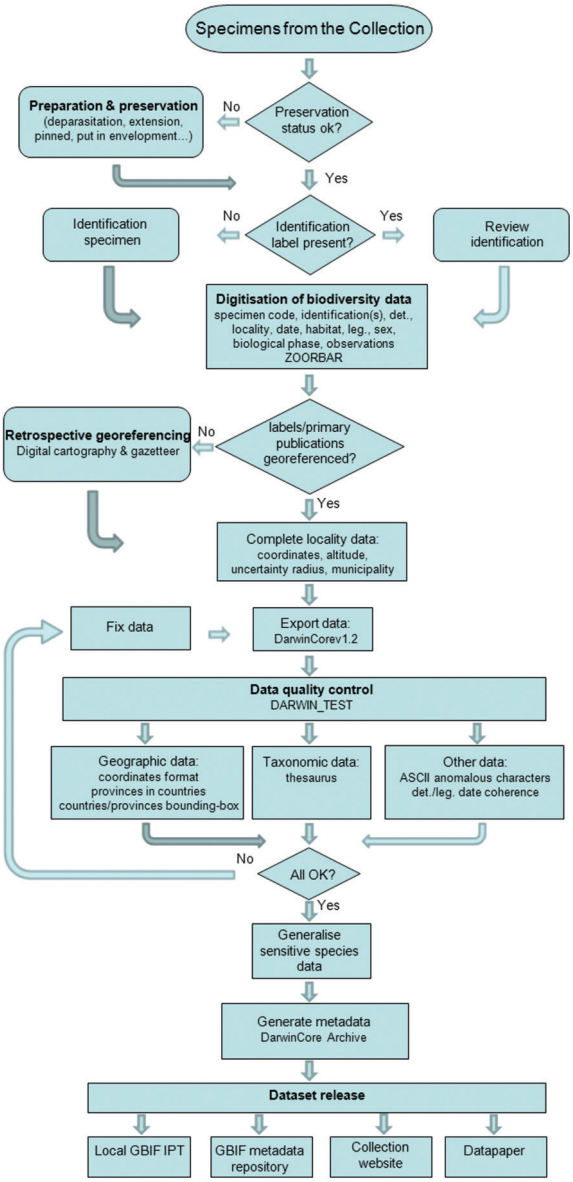

Figure 2. BOS Arthropod Collection digitisation and data publishing workflow.

in the rest of the Iberian Peninsula, although mountain ranges in this zone have their peculiar less dry/less thermic climates.

According to the European Union Habitats Directive (Directive 92/43/CEE), most of the Iberian Peninsula is included in the Mediterranean region, with a narrow band in the north belonging to the Atlantic region and a bit of the Alpine region in the

Pyrenees Mountains (biogeographic regions based on vegetation types are the same: Rivas-Martínez et al. 2004). Geographic limits between Mediterranean region and the other are along the southern slopes of the Cantabrian and Pyrenean ranges and in Galicia/northwest of Portugal. Although classification of limnological regions shows the first two bioregions joined in the Iberic-Macaronesian region and the Pyrenees retain as a separate region (Illies, 1978, adopted in the Water Framework European Directive, Directive 2000/60/CE) and odonates are aquatic organism, their Iberian distribution seems better explained in the bioclimatic belts scheme (e.g., Brotons et al. 2009, Outomuro et al. 2010).

Design description: Figure 2, depicts the digitisation workflow. Prior to digitisation, specimen is carefully examined for its preservation status and if necessary, curative treatment is provided. Subsequent to this taxonomic identification status is examined. In case of non-identified specimens, taxonomic identification is carried out involving experts. Thereafter, data associated with specimens is digitised using ZOORBAR software. In case of absence of precise geo-coordinates, retrospective geo-referencing is carried out. If the geo-coordinates are present, they are verified using digital cartography. Best practices as suggested by Chapman 2005a, Chapman and Wieczorek 2006 are followed for the geo-referencing processes. Current accurate spelling of scientific names (Askew 2004, Dijkstra and Lewington 2006) and identification of specimens were reviewed in laboratory with suitable literature (Heidemann and Seidenbusch 2002, Askew 2004, Dijkstra and Lewington 2006, Doucet 2010) as there are explained at quality controls section.

Taxonomic coverage

General taxonomic coverage description: All specimens were identified to species or subspecies level with the help of authoritative literature (Heidemann and Seidenbusch 2002, Askew 2004, Dijkstra and Lewington 2006, Doucet 2010) and expert input. All nine dragonfly families recorded from the Iberian Peninsula are present in the collection and dataset. As shown in Figure 3, Coenagrionidae and Calopterygidae are the most abundant families in the BOS Arthropod Collection: each represents approximately 21% of the total specimens deposited. The next most abundant families are the Libellulidae and Gomphidae, each representing approximately 16% of the total specimens deposited. Of the 79 species of known Odonata from the Iberian Peninsula (Torralba Burrial 2009, Mezquita Aranburu et al. 2011), 71 have specimens deposited in the BOS Arthropod Collection. Table 1 provides an account of the number of specimens of key taxa. The BOS Arthropod Collection also includes the holotype and paratypes of the Iberian subspecies *Calopteryx haemorrhoidalis asturica* Ocharan, 1983 and *Sympetrum vulgatum ibericum* Ocharan, 1985 (Table 2). Records of four protected species and nine threatened species (*sensu* the last update of the Spanish Invertebrate Red List: Verdú et al. 2011) are also included in the dataset. Details about the type specimens and those of threatened and protected species housed in the BOS Arthropod Collection are provided in Table 2.

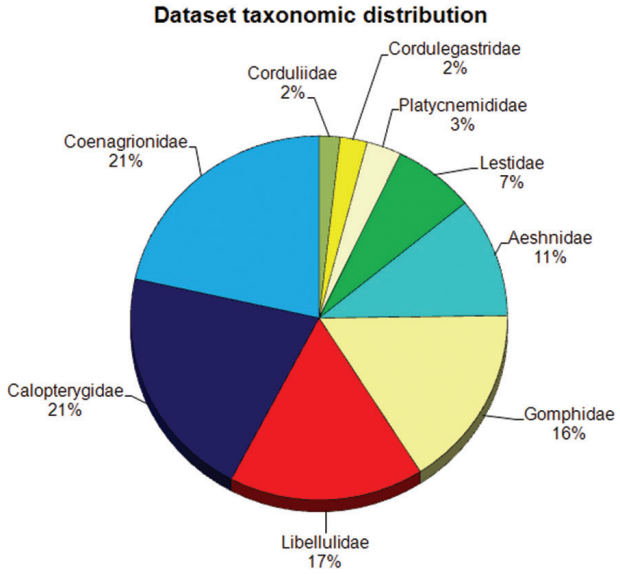

Figure 3. Taxonomic distribution of the Iberian Odonata BOS-Odo dataset.

Table 1. Taxonomic spread of specimens housed in BOS Arthropod collection.

Taxa	Nos. of genera	Nos. of species	Nos. of specimens in the collection
Family Calopterygidae	1	4	3114
Genus Calopteryx		4	3114
Family Coenagrionidae	6	14	3578
Genus Ceriagrion		1	203
Genus Coenagrion		5	872
Genus Enallagma		1	434
Genus Erythromma		2	267
Genus Ischnura		4	1453
Genus Pyrrhosoma		1	349
Family Lestidae	3	6	1160
Genus Chalcolestes		1	403
Genus Lestes		4	644
Genus Sympecma		1	113
Family Platycnemididae	1	3	499
Genus Platycnemis		3	499
Family Aeshnidae		13	1774
Genus Aeshna		7	481
Genus Anaciaeschna		1	6
Genus Anax		3	240
Genus Boyeria		1	1042
Genus Brachytron		1	5
Family Cordulegastridae	1	2	387
Genus Cordulegaster	1	2	387

Taxa	Nos. of genera	Nos. of species	Nos. of specimens in the collection
Family Corduliidae	4	5	297
Genus Cordulia		1	2
Genus Macromia		1	2
Genus Oxygastra		1	290
Genus Somatochlora		2	3
Family Gomphidae	2	7	2687
Genus Gomphus		4	97
Genus Onychogomphus		3	2590
Family Libellulidae	8	24	2778
Genus Brachythemis		1	13
Genus Crocothemis		1	321
Genus Leucorrhinia		1	2
Genus Libellula		3	179
Genus Orthetrum		7	565
Genus Selysiothemis		1	1
Genus Sympetrum		7	1654
Genus Trithemis		2	41
Genus Zygonyx		1	2
TOTAL	27	78	16604

Table 2. Type specimens and specimens of threatened and protected species housed in BOS Arthropod collection.

Scientific name	BOS-Odo ID	*	Reference
Aeshna juncea (Linnaeus, 1758)	1201-1213, 4421, 4665-4668, 6736-6737, 9499-9507, 10000-10002, 12120-12126, 13983-13985, 16235-16237	T	Verdú et al. 2011
Brachytron pratense (Müller, 1764)	1268-1271, 5668	T	Verdú and Galante 2009
Calopteryx haemorrhoidalis asturica Ocharan, 1983	3715	H	Ocharan1983
	3705-3714, 3716-3756, 3775-3804, 7381-7385,7393	P	Ocharan1983
Coenagrion caerulescens (Fonsbolombe, 1838)	1944-1972, 4096-4100, 4972-4980, 5077-5079, 5777-5079, 5787-5788, 6123-6158, 6560-6561, 7115-7140, 11608, 11830-11831, 14367-14375	T	Verdú et al. 2011
Coenagrion mercuriale (Charpentier, 1840)	1877-1943, 3894-4005, 4101-4124, 5109-5125, 5475-5476, 5738-5739, 5759, 6054-6086, 7141-7156, 8102-8106, 8374-8380, 11609-11620, 14354-14362	L	Verdú et al. 2011
Coenagrion scitulum (Rambur, 1842)	2012-2035, 4158-4162, 5068-5076, 5766-5770, 8373, 11595-11607, 11810-11819, 14364-14366,	T	Verdú et al. 2011
Cordulegaster bidentata Selys, 1843	2847	T	Verdú et al. 2011
Gomphus graslinii Rambur, 1842	4655-4656, 7258-7259, 13867-13868, 13883, 13931, 14205-14215, 16072-16074	L	Verdú and Galante 2009
Gomphus simillimus Selys, 1840	798, 4561, 5962, 6993, 8048-804, 13869-13882, 13972, 14203-14204, 14401-14402, 15924-15929, 16075-16077, 16128	T	Verdú et al. 2011

Scientific name	BOS-Odo ID	*	Reference
Gomphus vulgatissimus (Linnaeus, 1758)	797, 5327-5328, 8051-8052, 16241	T	Verdú et al. 2011
Macromia splendens (Pictet, 1843)	14197-14198	L	Verdú and Galante 2009
Onychogomphus costae Selys, 1885	5963, 6779-6780, 11788	T	Verdú et al. 2011
Orthetrum nitidinerve (Selys, 1841)	592-593, 3064	T	Verdú et al. 2011
Oxygastra curtisii (Dale, 1834)	789-792, 4333-4335, 8041, 14186-14196, 14269-14275, 14612-14689, 14923-15019, 15543-15596, 16026-16059	L	Verdú and Galante 2009
Sympetrum flaveolum (Linnaeus, 1758)	187-193, 2871-2873, 2901, 4633-4634, 4645, 16133-16135, 16209-16233	T	Verdú et al. 2011
Sympetrum striolatum (Charpentier, 1840)	16245, 16247	G	Torralba-Burrial and Ocharan 2009
Sympetrum vulgatum ibericum Ocharan, 1985	194-206, 5640	P	Ocharan 1985

*: G = gynandromorph, H = holotypus; L = legally protected species; P = paratypus; T = threatened sp. in Spain.

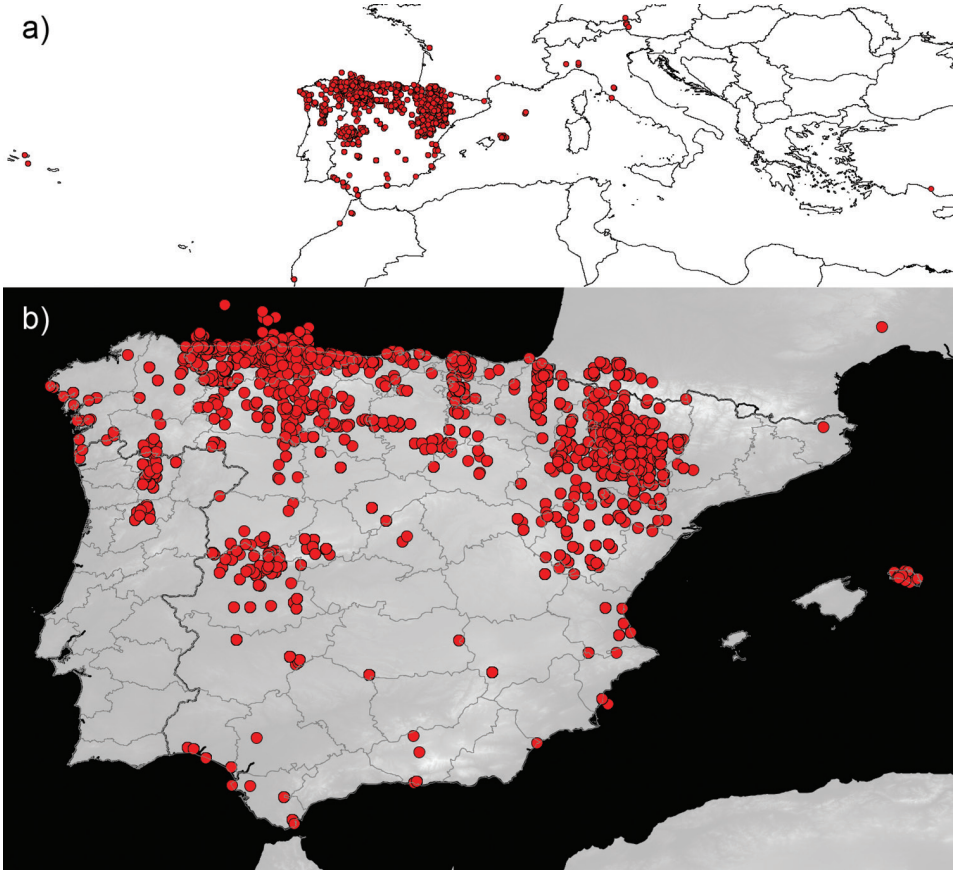

Figure 4. Geographic distribution of specimens in the BOS-Odo dataset: **a** global distribution **b** Iberian distribution.

Taxonomic ranks

Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Odonata
Family: Calopterygidae, Coenagrionidae, Lestidae, Platycnemididae, Aeshnidae, Cordulegastridae, Corduliidae, Gomphidae, Libellulidae.
Common names: Dragonflies, Insects, Arthropods.

Spatial coverage

General spatial coverage: As evident from Figure 4, majority of the specimens (98.63% of total data) are from the Iberian Peninsula (mainly Spain, but also records of Portugal). The Northern part of the Peninsula is better covered: Asturias (~ 4100 specimens) and Huesca (~3400) are the provinces with more exemplars, followed by Navarra, Teruel, Zaragoza, León, Álava and Vizcaya (between 1700-500 records). Data of other 32 Spanish provinces and 2 old Portuguese continental provinces (3 districts) are available in the database (Fig. 5). Other countries appear in the collection with few specimens: Morocco and Austria, the following countries by specimens, have 40 registers each one.

Coordinates: 30°0'0"N and 47°0'0"N Latitude; 27°0'0"W and 32°0'0"E Longitude.

Temporal coverage

1950 – 2012.

Natural collections description

Parent collection identifier: Colección de Artrópodos BOS

Collection name: Colección de Artrópodos BOS de la Universidad de Oviedo: Odonata (BOS-Odo)

Collection identifier: http://data.gbif.org/datasets/resource/12776/

Specimen preservation method: Specimens are preserved as dry specimens (pinned or in transparent envelopes or in tubes) or in 70° ethanol, sorted alphabetically by family/genus/species and numerically by specimen code in drawers of metallic mobile cabinets in a cold chamber at 6 °C. In drawers with dry specimens paradichlorobenzene is used as insecticide, an additional protection for when the drawers are taken to the lab for study (see Barrientos 2004).

Curatorial unit: 16604 with an uncertainty of 0 (Specimens)

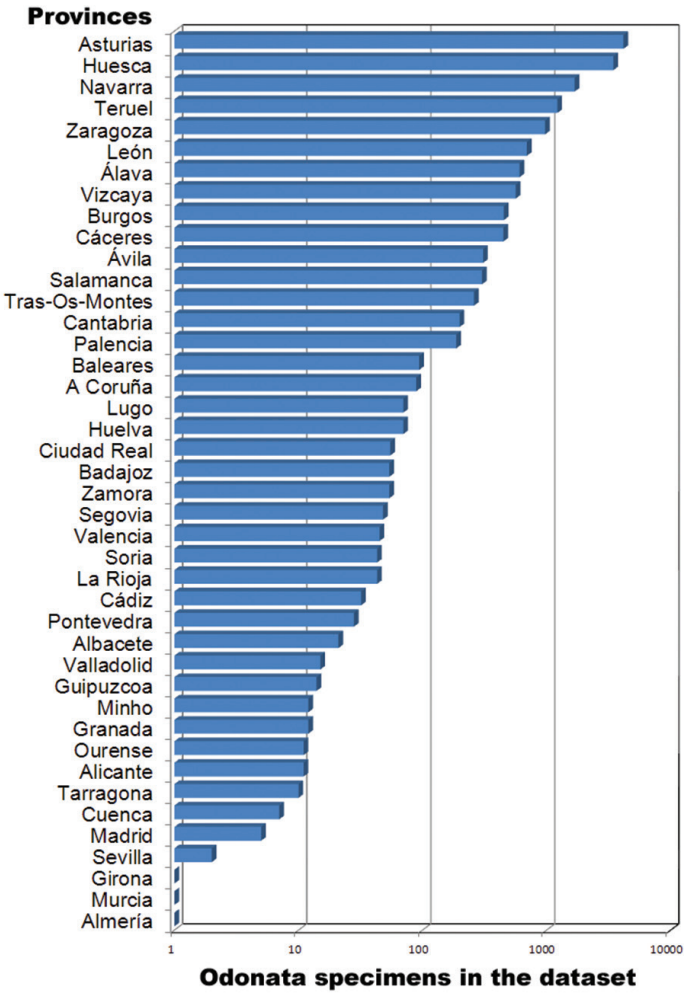

Figure 5. Specimens in each Spanish/Portuguese provinces in the BOS-Odo dataset.

Methods

Method step description: The processing workflow is shown in Figure 2. Prior to digitisation, odonate specimens in the BOS Arthropod Collection were examined and their preservation status revised: specimens were pinned, labelled and frozen to deparasitize when necessary. The status of the prepared specimens is now as follows: half (48%) of the specimens hosted in the collection are pinned adults, 22% are preserved in 70% ethanol, 18% are dried exuviae and 11% are dry specimens in transparent envelopes. All specimens are stored in metal cabinets in a cold chamber (6°C). More information about these preparation and preservation methods can be found in Entomology handbooks (e.g., Barrientos 2004). Dry specimens pinned before the year 2000 were in entomological boxes with naphthalene as an insecticide; this product was later replaced

by paradichlorobenzene. Use of these insecticides does not seem to impede the extraction and amplification of DNA from specimens (Espeland et al. 2010), but it can affect specimens' colours (Dawson 1988) and researchers' health (see Guerrero and Corsi 2012 for a recent review of these insecticide effects). The amount of insecticides used in the BOS Arthropod Collection has been reduced in recent years for these reasons.

If a dragonfly specimen had been identified before the digitisation process, then its identification was revised. When the identification label was lacking or incomplete, specimens were identified with suitable literature (see section on quality control). All biodiversity data available on the specimens' labels (i.e., specimen code, species identification and name of determiner, sex, biological phase, locality, date, habitat, collector and observations) were included in a database using ZOORBAR software (http://www.gbif.es/zoorbar/zoorbar.php), which exports data in Darwin Core (v1.2) format.

A taxonomic thesaurus was developed that includes all synonyms used in Iberian Odonata publications and spelling variants of scientific names. The thesaurus was used to convert the species identifications archived in the offline database (i.e., the species names appearing on the original specimen labels) to the correct/verified scientific name prior to being exported to the online ZOORBAR database.

Other geographic data (municipality, GPS coordinates, altitude, etc.) from specimen labels or associated publications were added to the database when available. GPS coordinates (in UTM/MGRS format) were included without resolution changes (grids of 10 × 10 km or 1 × 1 km are common in entomological studies); ZOORBAR converts the coordinates to decimal degrees and fills out the uncertainty radius at the export data step. Retrospective georeferencing of specimens (see Chapman and Wieczorek 2006) was carried out using digital cartography tools (Google Earth and IBERPIX) if coordinates were not present on the specimen labels or in primary publications. Google Earth can be used to obtain locality coordinates and altitude; it also incorporates a measurement tool that can be used to calculate the uncertainty radius of the place georeferenced. IBERPIX (http://www2.ign.es/iberpix/visoriberpix/visorign.html) is a public gazetteer combining data, maps, satellite images and orthophotographs compiled by the Spanish National Geographic Institute, with a better searchable toponyms database. An accurate, effective, reliable and quick georeferencing process can be acheived by combining the information provided by both tools. Records were sorted geographically for batch retrospective georeferencing, starting with larger batches (Chapman and Wieczorek 2006).

Biodiversity data were exported to a dataset in Darwin Core (v1.2) format. DARWIN_TEST software was used to validate and clean the geographic, taxonomic and additional data associated with the specimens. Erroneous data were corrected and data cleaning was repeated to enhance the data quality (see details in the section on quality control).

Coordinates of threatened species protected by law (e.g., *Macromia splendens*, *Oxygastra curtisii*, *Gomphus graslinii* and *Coenagrion mercuriale*, included in the European Union Habitats Directive and in the Spanish Catalogue of Threatened Species) have been generalised to 0.01° in the online database (see Chapman and Grafton 2008 for details on generalising sensitive data).

The dataset was transformed to a Darwin Core Archive format with metadata and was uploaded to the Integrated Publishing Toolkit (IPT v2.0.4) of the Spanish node of the Global Biodiversity Information Facility (GBIF) (http://www.gbif.es:8080/ipt). On the BOS Arthropod Collection website (http://www.unioviedo.es/BOS/Zoologia/artropodos), links to data pertaining to the BOS odonate specimens included in the GBIF data portal were also provided. The offline version of the dataset includes the identification history of each specimen (17846 items), the habitats in which the specimens were collected, and notes on materials derived from specimens (e.g., microscopic preparations, morphometric data, publications, etc.). This information is available on request.

Study extent description: Specimens are mainly from the north half of the Iberian Peninsula, and were collected between 1973 and 2012 (though there are some outliers from other territories or time periods). Half of the Iberian odonate records in the dataset are from the 2000s and a quarter from the 1980s, which can facilitate comparisons over time to assess changes in distribution related to global change, climate change or specific alterations of ecosystems.

Sampling description: Material deposited in the Odonata subcollection of the BOS Arthropod Collection has been collected in three ways (Fig. 6):

1) Specimens from PhD dissertations carried out at the University of Oviedo (Ocharan Larrondo 1987, Torralba-Burrial 2008, Outomuro Priede 2011) (54.75% of specimens).
2) Specimens collected during research projects, contracts, and development studies in the Department of Biology of Organisms and Systems of the University of Oviedo (32.15%).
3) Specimens from other sources: collections from students in Biology and Forestry Engineering programs at the University of Oviedo, practical courses and other sources (13.1%).

Odonates from source types 1 and 2 were collected using standardized sampling methods according to the requirements of each PhD thesis or project. Specimens from source type 3 are considered to be derived from opportunistic, unplanned and non-standardized sampling. General sampling methods include the collection of adult dragonflies with an entomological net (75.76% of records), exuviae picked directly from a substrate (18.35%), and larvae collected with an entomological net or a Surber sampler (5.82%) (see Barrientos 2004, Torralba-Burrial and Ocharan 2007b).

Specimens deposited by Ocharan (1987) were collected mainly in the provinces of Asturias (42.14%), Guipúzcoa (12.95%), Burgos and Cáceres (both ~8.8%), León (6.57%), Cantabria and Vizcaya (both 3.2%). Sampling was carried out with the intent to capture all species present in each locality. Specimens collected by Torralba-Burrial (2008) are from Aragón, and include adults (184 localities; sampling was performed until all species seen in each locality each day were captured, with a minimum two sampling sessions), larvae (standardized Surber samples from 140 fluvial reaches: Torralba-Burrial and Ocharan 2007a) and exuviae (visual search of the river banks of

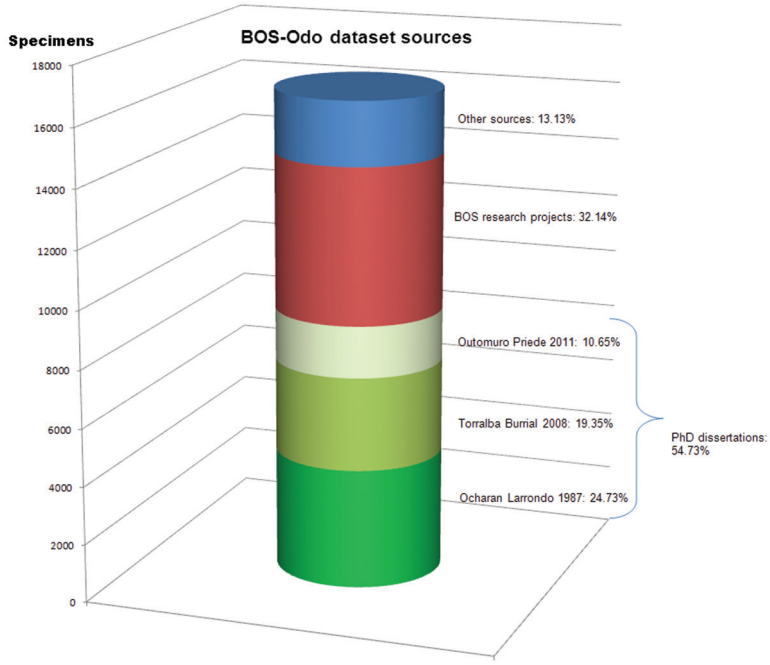

Figure 6. Sources of dragonfly specimens in this dataset.

the 140 reaches sampled, with at least two sampling sessions in each locality). Outomuro's (2011) specimens are almost all adults of *Calopteryx* spp.

It is not feasible to describe in detail the specific methodologies of each project or study of source 2), but all follow the general guidelines outlined above (examples of different methods in Martínez and Ocharan 2006, Torralba-Burrial and Ocharan 2007b, 2008). In the last few years, conservation efforts have led to a reduction in the collection of adults and an increased use of photographic records (not included in the dataset) unless the sacrifice of specimens is deemed necessary.

Quality control description: Validation and cleaning of geographic, taxonomic and additional data associated with the dragonfly specimens was incorporated at several steps of the process (Fig. 2) as an essential component of the digitisation project (see Chapman 2005a,b).

The identifications of all specimens were revised (or performed for the first time when no determination label was available with the original material) by A. Torralba-Burrial between 2010-2012 using suitable literature (adults: Askew 2004, Dijkstra and Lewington 2006; larvae and exuviae: Heidemann and Seidenbusch 2002, Askew 2004, Doucet 2010).

Scientific names on labels were checked with a taxonomic thesaurus. This thesaurus was generated by the authors and includes all synonyms used in Iberian Odonata publications, as well as spelling variants of scientific names. Current European dragonfly taxonomy trends (Dijkstra and Lewington 2006, Dijkstra and Kalkman 2012) have been considered in the assignment of valid scientific names. Geographic data

appearing on the original specimen labels were cross-checked with known published localities when available. Geographic/UTM/MGRS coordinates shown in published sources were assumed to be correct when no coordinates were included on the labels.

Unique collections' accession numbers were assigned to each specimen. Other validation procedures, including geographic coordinates format, coordinates within country/provincial boundaries, congruence between collection and identification dates and absence of ASCII anomalous characters in the dataset were checked with DARWIN_TEST (v1.3) software (http://www.gbif.es/darwin_test/Darwin_test.php). Specimens with original MGRS coordinates in a 10 × 10 km grid failed to meet the bounding-box validation in localities near coastlines and country or provincial boundaries, but these coordinates (converted to decimal degrees) were kept in the dataset with the estimated uncertainty radius.

Datasets

Dataset description

Object name: Darwin Core Archive Iberian Odonata distribution: data of the BOS Arthropod Collection of the University of Oviedo
Character encoding: UTF-8
Format name: Darwin Core Archive format
Format version: 1.0
Distribution: http://www.gbif.es:8080/ipt/archive.do?r=Bos-Odo
Publication date of data: 2013-04-08
Language: Spanish
Licenses of use: This dataset [Colección de Artrópodos BOS de la Universidad de Oviedo: Odonata (BOS-Odo)] is made available under the Open Data Commons Attribution License: http://www.opendatacommons.org/licenses/by/1.0/

External datasets

Dataset description
Object name: Colección de Artrópodos Biología de Organismos y Sistemas, Oviedo: odonatos
Character encoding: iso-8859-1
Format name: Darwin Core Archive
Format version: 1.0
Distribution: http://data.gbif.org/datasets/resource/12776
Metadata language: English
Date of metadata creation: 2013-03-20
Hierarchy level: Dataset

Acknowledgements

Pablo Muñoz (Universidad Autónoma de Madrid) and Francisco Pando (Spanish GBIF node - CSIC) reviewed the manuscript and provided helpful comments. Vishwas Chavan and anonymous reviewers enhanced it with their suggestions. The Global Biodiversity Information Facility (GBIF) financed the publication of this data paper.

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ZooKeys 306: 59–70 (2013)
doi: 10.3897/zookeys.306.4898
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DATA PAPER

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FORMIDABEL: The Belgian Ants Database

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Academic editor: *V. Chavan* | Received 25 February 2013 | Accepted 22 May 2013 | Published 3 June 2013

Citation: Brosens D, Vankerkhoven F, Ignace D, Wegnez P, Noé N, Heughebaert A, Bortels J, Dekoninck W (2013) FORMIDABEL: The Belgian Ants Database. ZooKeys 306: 59–70. doi: 10.3897/zookeys.306.4898 Resource ID: GBIF key: http://gbrds.gbif.org/browse/agent?uuid=b528799a-2d52-4023-aa02-9ce081e3ca5f

Resource citation: Polyergus Working Group and FourmisWalBru Working Group (2013 -). FORMIDABEL: The Belgian Ants Database, 27264 records. Contributed by Brosens D, Vankerkhoven F, Ignace D, Wegnez P, Noé N, Heughebaert A, Bortels J and W Dekoninck. Online at http://ipt.biodiversity.be/resource.do?r=formidabel and, www.formicidae-atlas.be, Version 1.0 (last updated on 2013-04-19), GBIF key: http://gbrds.gbif.org/browse/agent?uuid=b528799a-2d52-4023-aa02-9ce081e3ca5f. Data Paper ID: doi: 10.3897/zookeys.306.4898

Abstract

FORMIDABEL is a database of Belgian Ants containing more than 27.000 occurrence records. These records originate from collections, field sampling and literature. The database gives information on 76 native and 9 introduced ant species found in Belgium. The collection records originated mainly from the ants collection in Royal Belgian Institute of Natural Sciences (RBINS), the 'Gaspar' Ants collection in Gembloux and the zoological collection of the University of Liège (ULG). The oldest occurrences date back from May 1866, the most recent refer to August 2012. FORMIDABEL is a work in progress and the database is updated twice a year.

The latest version of the dataset is publicly and freely accessible through this url: http://ipt.biodiversity.be/resource.do?r=formidabel. The dataset is also retrievable via the GBIF data portal through this link: http://data.gbif.org/datasets/resource/14697

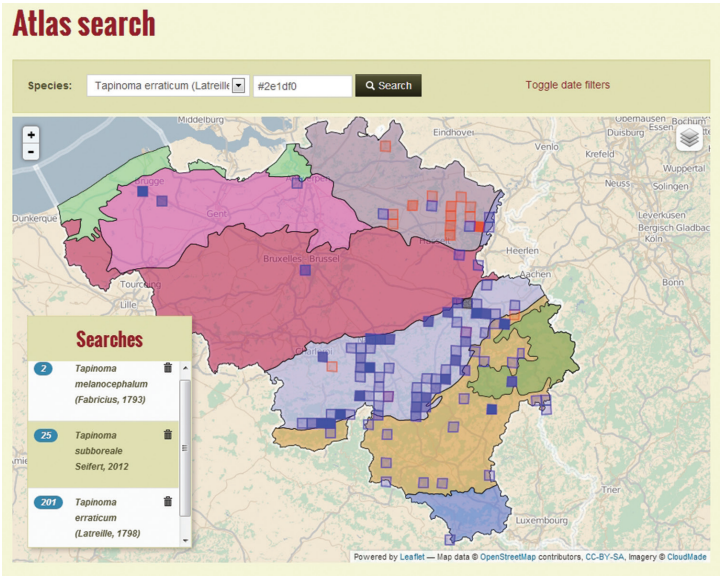

Figure 1. www.formicidae-atlas.be

A dedicated geo-portal, developed by the Belgian Biodiversity Platform is accessible at: http://www.formicidae-atlas.be

Purpose: FORMIDABEL is a joint cooperation of the Flemish ants working group "Polyergus" (http://formicidae.be) and the Wallonian ants working group "FourmisWalBru" (http://fourmiswalbru.be). The original database was created in 2002 in the context of the preliminary red data book of Flemish Ants (Dekoninck et al. 2003). Later, in 2005, data from the Southern part of Belgium; Wallonia and Brussels were added. In 2012 this dataset was again updated for the creation of the first Belgian Ants Atlas (Figure 1) (Dekoninck et al. 2012). The main purpose of this atlas was to generate maps for all outdoor-living ant species in Belgium using an overlay of the standard Belgian ecoregions. By using this overlay for most species, we can discern a clear and often restricted distribution pattern in Belgium, mainly based on vegetation and soil types.

Keywords

Formicidae, Belgium, Flanders, Wallonia, Brussels Capital Region, ecological data, grid mapping, UTM, historical data, literature, collections, observations, trapping, ants

Taxonomic coverage

General taxonomic coverage description

The taxonomic coverage (Figure 2) of this database spans the full range of ants pertaining to Belgium (indigenous ant species and exotic introduced species). The determination level is species level and, if appropriate, hybrid level. For some species, information on micro-and macrogynes is available. Key milestones of FORMIDABEL from conception till date are described in the "Dataset" section of this manuscript.

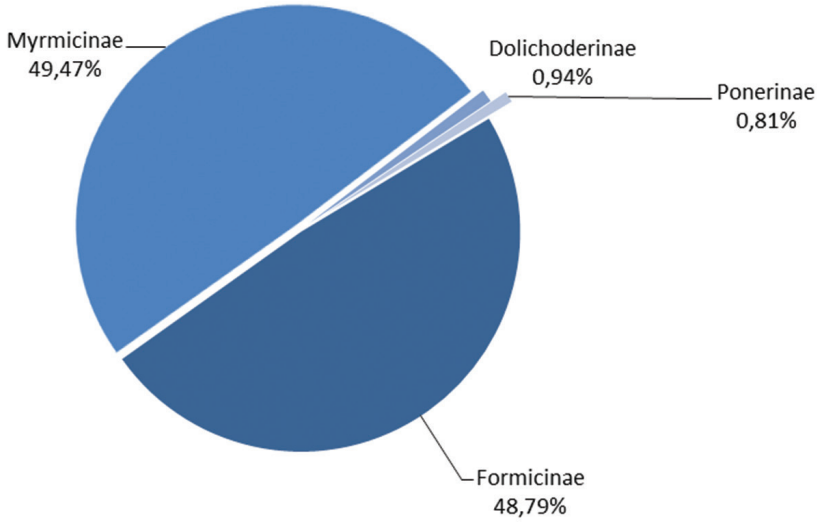

Figure 2. Taxonomic range of the FORMIDABEL database subfamilies

The taxonomic authorities followed are: Radchenko and Elmes (2010) for the genus *Myrmica* and Seifert (2007) for the other genera. The dataset contains occurrences of 76 native and 9 introduced species.

As depicted in Figure 2, the most abundant subfamily in the database is the Formicinae (49,4%) followed by the Myrmicinae (48,7%), the Dolichoderinae (0,9%) and the Ponerinae (0,8%). The top five most recorded species are *Lasius niger* (2846 records), *Myrmica rubra* (2601 records), *Myrmica scabrinodis* (1626 records), *Formica fusca* (1467 records) and *Myrmica sabuleti* (1202 records).

Taxonomic ranks

Phylum: Arthropoda
Subphylum: Hexapoda
Class: Insecta
Order: Hymenoptera
Suborder: Apocrita
Superfamily: Vespoidea
Family: Formicidae
Subfamily: Dolichoderinae, Formicinae, Myrmicinae, Ponerinae
Genera: *Anergates*, *Aphaenogaster*, *Camponotus*, *Dolichoderus*, *Formica*, *Formicoxenus*, *Harpagoxenus*, *Hypoponera*, *Lasius*, *Leptothorax*, *Linepithema*, *Manica*, *Monomorium*, *Myrmecina*, *Myrmica*, *Plagiolepis*, *Polyergus*, *Ponera*, *Solenopsis*, *Stenamma*, *Strongylognathus*, *Tapinoma*, *Technomyrmex*, *Temnothorax* and *Tetramorium*.
Common names: Ants

Spatial coverage

General spatial coverage

Belgium is a small country in Western Europe. To the west, its 70 km coastline fronts the North Sea; to the north lies the Netherlands; to the east, Germany, and to the south, France and Luxembourg. Biologeographically, the fauna of eastern Belgium belongs to the Central European Province of the Eurasian (Palaearctic) region. By contrast, the rest of the country primarily consists of an Atlantic fauna plus a few Central European relict species.

Politically and geographically, the country is divided into three parts: Flanders, Wallonia and the Brussels Capital Region (Figure 3). In Flanders (13,522 km² and population about 6 million people), to the north, soils are mainly sandy to loamy. Here, the most important habitats for ants are heathlands and dry grasslands. The Brussels Capital Region is a small region (162 km²) entirely situated in the sandy loam area. In Wallonia (17,006 km² and about 3,5 million people), to the south, soils and habitats are more diverse, ranging from forests to rocky and calcareous grasslands on loam and chalky soils. Eastern Wallonia, near the German border, includes the Hautes Fagnes, a large area of bogs and peat with some typical ant species.

Geographical method

The Universal Transverse Mercator Projection (UTM), an adaptation of the standard Mercator projection, uses a two dimensional Cartesian co-ordinate system to identify locations on the surface of the Earth (Wikipedia).

The UTM 5 Km (Universal Transverse Mercator Projection) raster projection divides Belgium in approximately 1200 25 km² squares (Figure 3). A representative number of UTM squares has been sampled (1125 UTM 5×5 km squares of which 659 squares with more than 10 records: see Figures 3 and 4) to complete the dataset. All the records in FORMIDABEL are georeferenced through the centroid coordinates of the corresponding UTM 5 km square. Therefore, the uncertainty on these coordinates is 3.500 meters, the distance between the centre and the corner of the UTM square.

Ecocodes

More than half of the records are provided with a description of the microhabitat of the record locality. This allows us to give details on ecological preferences of all Belgian ant species. In FORMIDABEL we created a list of potential microhabitats for ants in Belgium. For each of these microhabitats we use a code called the “ecocode”. This code thus gives information on the habitat were the occurrence was made. Nine types of habitat and landscape were defined to collect accurate information on the habi-

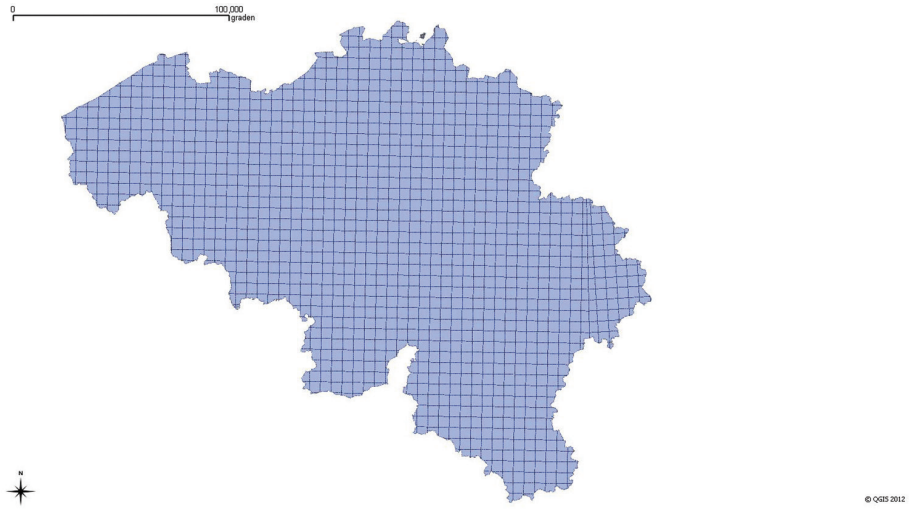

Figure 3. The UTM 5 Km grid of Belgium

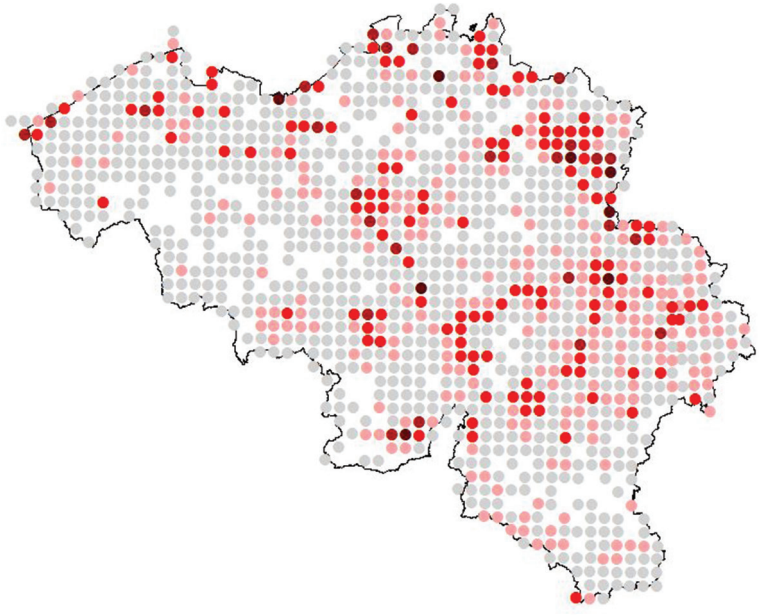

Figure 4. Projection of the number of records per UTM 5x5 km square (grey dots= 1-20 records, pink dots= 21-50 records, red dots= 51-150 records, dark red dots=151-300 records and black dots=301-644 records).

tat preference of all ant species (Dekoninck et al. 2005). These nine types are based on the EIS-code and the Flemish nature types (Vandenbussche, 2002; Zwaenepoel et al. 2002). When no habitat description was available for a record (for example, with some older records) the habitat was coded as 'Not known or not observed'. The nine

main habitats we defined were: i) anthropogenic habitats, ii) dry grasslands, iii) moist grasslands, iv) forests, v) chalk grasslands, stony slopes and other rocky xerothermic habitats, vi) shrubs, vii) heathlands, viii) fens and highland bogs and ix) coastal and inland dunes.

Coordinates

49°27'0"N and 51°32'24"N Latitude; 2°28'12"E and 6°27'36"E Longitude

Temporal coverage

The oldest record in the database goes back to May 5, 1866 and the most recent records are from August 2012. The largest part of the records were obtained after 1991 (Figure 5).

Methods

Method step description:

A large portion of the occurrence data have been collected by volunteers, other records originated from several projects and research programs. The data and specimens were sent to the Belgian ant curators, and after validation, the information was incorporated in the database. The collection records "dry specimen" originate from the Gembloux "Ant" collection and the Charles Gaspar collection, the collection of the "Cercle des entomologists Liégeois", the RBINS collection and the private collection "Roland Vannieuwenhuyse". After revision and validation, this information was also included in the database. The literature-based records were retrieved from van Boven 1970; van

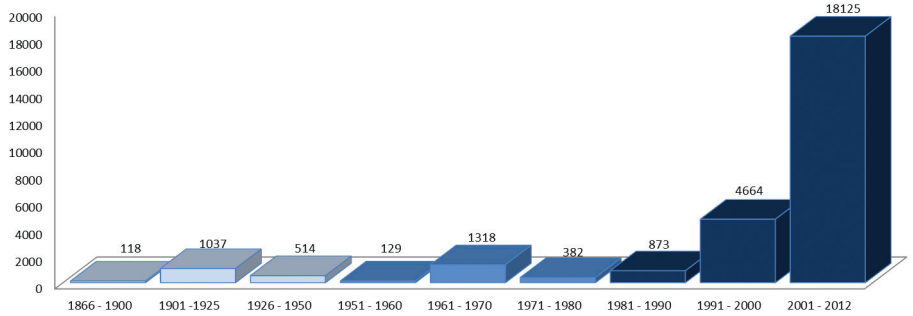

Figure 5. Temporal distribution of the records

Boven and Mabelis 1986; Dekoninck et al. 2006 and references therein. How the database evolved is described in the Database history section.

Sampling description: Most occurrence records originate from hand/nest sampling (42,3% of all records and mainly from Wallonia) and pitfall sampling (36,7% mainly from Flanders). The followed procedure differs from region to region. This is due to historical reasons. Some very interesting occurrence records were obtained by sifting, coloured water traps and Malaise traps (all less than 3 % of the total sampling). An extensive description of the sampling methods is provided by Schauff (2001).

Quality control description: All the records were validated by the dataset curators before being added to the FORMIDABEL database. The dataset curators also checked the determinations of the collection specimens. If needed, the determination was adapted and made consistent with modern taxonomy; Radchenko and Elmes (2010) for the genus *Myrmica* and Seifert (2007) for the other genera. Before the final publication of the database all the records were tested on geographical consistency by the Belgian Biodiversity Platform and corrected if necessary.

Dataset

Dataset history

At the beginning of 2001 all available records of ants in Flanders (northern part of Belgium) were brought together for the first time and several inventories were started. More than 20.000 records (for the most part gathered after 1990) were assembled in the FORMIDABEL (FORMIcidaeDAtaBELgium) database resulting in the 'Verspreidingsatlas en voorlopige Rode lijst van de mieren van Vlaanderen; Dekoninck et al. 2003. [Distribution atlas and preliminary Red list of ant species in Flanders, Belgium]. This report contains all available distribution data for Flanders. In the southern part of Belgium (Wallonia) intensive inventorying started in 2005. Until then knowledge on the distribution of ants in Wallonia was limited. Only a few areas (Haute Fagnes, Famenne and the Viroin valley) had already been inventoried. Thanks to the good cooperation between the Polyergus and the FourmisWalBru working groups; many Belgian ant records were brought together in the FORMIDABEL database. Since then, FORMIDABEL is updated with data originating from FourmisWalBru twice a year. The FORMIDABEL dataset was then used for the creation of the "Belgian Ant Atlas", (Dekoninck et al. 2012). In 2010 a cooperation agreement between the authors of the atlas and the Belgian Biodiversity Platform (www.biodiversity.be) was made. Together with the publication of the book, the data was published in Darwin Core Archives to GBIF (url: http://data.gbif.org/datasets/resource/14697/) and a dedicated data portal was created: www.formicidae-atlas.be.

The original FORMIDABEL database was created in Microsoft Access. Later, this database was completely imported in a relational SQL database. During this process

Figure 6. Formidabel flowchart

additional data cleaning was performed; see section Quality control description. The dataflow is illustrated in Figure 6.

Dataset description

The FORMIDABEL Darwin Core Archive is a custom made SQL view on the original version of the FORMIDABEL access database which is in the custody of the Belgian Ant working groups Polyergus and fourmisWalBru. Mind that every record in FORMIDABEL represent at least one occurrence, but primarily contains information on the presence of a species. The view only shows data that are accepted for publication. Fields given are:

id, decimalLatitude, family, basisOfRecord, stateProvince, identifiedBy, eventDate, modified, country, individualCount, scientificName, kingdom, order, geodeticDatum, genus, collectionCode, decimalLongitude, samplingProtocol, catalogNumber, phylum, recordNumber, countryCode, coordinatePrecision, language, coordinateUncertaintyInMeters, locality, specificEpithet, recordedBy, institutionCode, nomenclaturalCode, class.

The dataset contains primary biodiversity data, mostly occurrence data (Figure 7). Some records hold an indirect link to collection specimens. This link is only available in the original database.

Dataset preview

Object name: Darwin Core Archive Formidabel; Belgian Ants Database
Character encoding: UTF-8Format name: Darwin Core Archive format
Format version: 1.0
Distribution: http://ipt.biodiversity.be/resource.do?r=formidabel
Publication date of data: 2013-08-02
Language: English
Licenses of use: This work is licensed under a Creative Commons Attribution-Non-Commercial-ShareAlike 3.0 Unported License. http://creativecommons.org/licenses/by-nc-sa/3.0/
Metadata language: English
Date of metadata creation: 2013-02-18
Hierarchy level: Dataset
Norms for data use and publication:
Based on http://www.canadensys.net/norms

Give credit where credit is due
As is common practice in scientific research, cite the data you are using.

Be responsible
Use the data responsibly. The data are published to allow anyone to better study and understand the world around us, so please do not use the data in any way that is unlawful, harmful or misleading. Understand that the data are subject to change, errors and sampling bias. Protect the reputation of the data publisher and clearly indicate any changes you may have made to the data.

Share knowledge
Let us know if you have used the data. It helps our participants to showcase their efforts and it helps you reach a wider audience. Inform the data publisher(s) if you have comments about the data, notice errors, or want more information.

Respect the data license
Understand and respect the data license or waiver under which the data are published. It is indicated in the rights field of every record and in the dataset metadata.

Collection data: Ant Collection Gembloux (urn:lsid:biocol.org:col:33368), Collection Charles Gaspar, Collection "Cercle des entomologists Liégeois", RBINS Belgian Formicidae Collection (urn:lsid:biocol.org:col:35271), Private collection "Van Nieuwenhuyse". All collections are dry prepared insect collections. The dataset does not contain unique identifiers for specimens. To track a collection specimen, the corresponding author should be contacted.

id	basisOfRecord	eventDate	scientificName	order	locality	class	decimalLatitude	decimalLongitude
KBVE-SRB	PreservedSpecim	36353	Anergates atratulus (Scher	Hymenopte	Zonhoven	Insecta	51	5.387
KBVE-SRB	HumanObservatic	36776	Anergates atratulus (Scher	Hymenopte	Meeuwen-Gr	Insecta	51.085	5.606
KBVE-SRB	HumanObservatic	36710	Anergates atratulus (Scher	Hymenopte	Neerpelt	Insecta	51.269	5.401
KBVE-SRB	HumanObservatic	36663	Anergates atratulus (Scher	Hymenopte	Zonhoven	Insecta	50.998	5.458
KBVE-SRB	HumanObservatic	36693	Anergates atratulus (Scher	Hymenopte	Zonhoven	Insecta	50.998	5.458
KBVE-SRB	HumanObservatic	36757	Anergates atratulus (Scher	Hymenopte	Neerpelt	Insecta	51.269	5.401
KBVE-SRB	HumanObservatic	36757	Anergates atratulus (Scher	Hymenopte	Neerpelt	Insecta	51.269	5.401
KBVE-SRB	HumanObservatic	21385	Anergates atratulus (Scher	Hymenopte	As	Insecta	50.995	5.601
KBVE-SRB	HumanObservatic	2721	Anergates atratulus (Scher	Hymenopte	Rotselaar	Insecta	50.966	4.745
KBVE-SRB	PreservedSpecim	36318	Anergates atratulus (Scher	Hymenopte	Genk	Insecta	50.998	5.458
KBVE-SRB	PreservedSpecim	38972	Anergates atratulus (Scher	Hymenopte	Adinkerke	Insecta	51.068	2.536
KBVE-SRB	HumanObservatic	40029	Anergates atratulus (Scher	Hymenopte	Diest	Insecta	51.006	5.031
KBVE-SRB	HumanObservatic	40029	Anergates atratulus (Scher	Hymenopte	Diest	Insecta	51.006	5.031
KBVE-SRB	PreservedSpecim	39201	Anergates atratulus (Scher	Hymenopte	Peer	Insecta	51.088	5.463
KBVE-SRB	PreservedSpecim	39215	Anergates atratulus (Scher	Hymenopte	Peer	Insecta	51.043	5.461
KBVE-SRB	HumanObservatic	38507	Anergates atratulus (Scher	Hymenopte	Kalmthout	Insecta	51.42	4.402
KBVE-SRB	HumanObservatic	38507	Anergates atratulus (Scher	Hymenopte	Kalmthout	Insecta	51.375	4.401
KBVE-SRB	HumanObservatic	38639	Anergates atratulus (Scher	Hymenopte	Kalmthout	Insecta	51.42	4.402
KBVE-SRB	PreservedSpecim	40427	Anergates atratulus (Scher	Hymenopte	Lombardsijde	Insecta	51.159	2.75
KBVE-SRB	PreservedSpecim	38589	Anergates atratulus (Scher	Hymenopte	Visç,	Insecta	50.769	5.659
KBVE-SRB	PreservedSpecim	39694	Anergates atratulus (Scher	Hymenopte	Oostmalle	Insecta	51.281	4.756
KBVE-SRB	PreservedSpecim	39694	Anergates atratulus (Scher	Hymenopte	Oostmalle	Insecta	51.281	4.756
KBVE-SRB	HumanObservatic	27302	Anergates atratulus (Scher	Hymenopte	Marchin	Insecta	50.463	5.219
KBVE-SRB	PreservedSpecim	40020	Anergates atratulus (Scher	Hymenopte	Ampsin	Insecta	50.552	5.294
KBVE-SRB	PreservedSpecim	30491	Aphaenogaster subterrane	Hymenopte	Marche-les-Da	Insecta	50.513	4.939
KBVE-SRB	PreservedSpecim	23543	Aphaenogaster subterrane	Hymenopte	Neuville-sous	Insecta	50.552	5.294
KBVE-SRB	HumanObservatic	37771	Aphaenogaster subterrane	Hymenopte	Nismes	Insecta	50.069	4.572
KBVE-SRB	HumanObservatic	37771	Aphaenogaster subterrane	Hymenopte	Treignes	Insecta	50.113	4.643
KBVE-SRB	PreservedSpecim	7561	Aphaenogaster subterrane	Hymenopte	Trooz	Insecta	50.589	5.649
KBVE-SRB	HumanObservatic	39327	Aphaenogaster subterrane	Hymenopte	Treignes	Insecta	50.113	4.643
KBVE-SRB	PreservedSpecim	3873	Aphaenogaster subterrane	Hymenopte	Beez	Insecta	50.468	4.938
KBVE-SRB	PreservedSpecim	3867	Aphaenogaster subterrane	Hymenopte	Samson	Insecta	50.467	5.008
KBVE-SRB	PreservedSpecim	3886	Aphaenogaster subterrane	Hymenopte	Samson	Insecta	50.467	5.008
KBVE-SRB	PreservedSpecim	7561	Aphaenogaster subterrane	Hymenopte	Trooz	Insecta	50.588	5.72

Figure 7. A small preview of the Darwin Core-Archive

Additional information

This dataset was originally created to develop the Belgian Ants Atlas. However, the dataset can be reused for a variety of purposes. Since the link between individual data records and underlined specimens (stored in multiple collections) is not recorded, we doubt if the dataset can be used for taxonomic or systematic studies. However, this being an occurrence dataset, it can be used for understanding species richness, distribution pattern and modeling studies such as ecological niche modeling. In order to enhance the confidence of use, we have documented the metadata as well as subjected the data records to a series of quality assessment and enhancement processes as described in the earlier section quality control description.

Acknowledgments

The authors would like to thank all the contributors to this data paper. Especially all the volunteers who spend hours in the field collecting ants. We would also like to thank the Entomology Department of RBINS (Dr. Patrick Grootaert), the Cercle des Entomologistes Liégeois (P. Lays) and Gembloux Agro-Bio Tech, Unité d'Entomologie

fonctionnelle et évolutive for giving us access to the collections and the Belgian Biodiversity Platform and GBIF to make this work possible. Last but not least we would like to thank Thomas Little for making sure that the English language was respected during the creation of this paper.

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ZooKeys 306: 71–81 (2013)
doi: 10.3897/zookeys.306.5198
www.zookeys.org

RESEARCH ARTICLE

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A new *Haptoclinus* blenny (Teleostei, Labrisomidae) from deep reefs off Curaçao, southern Caribbean, with comments on relationships of the genus

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Academic editor: *Nina Bogutskaya* | Received 23 March 2013 | Accepted 27 May 2013 | Published 4 June 2013

urn:lsid:zoobank.org:pub:3E19FCB4-29D8-4C7F-B9C3-C3AE1C65050B

Citation: Baldwin CC, Robertson RD (2013) A new *Haptoclinus* blenny (Teleostei, Labrisomidae) from deep reefs off Curaçao, southern Caribbean, with comments on relationships of the genus. ZooKeys 306: 71–81. doi: 10.3897/zookeys.306.5198

Abstract

A second species of the blenniiform genus *Haptoclinus* is described from deep reefs off Curaçao, southern Caribbean. *Haptoclinus dropi* **sp. n.** differs from the northwestern Caribbean *H. apectolophus* Böhlke and Robins, 1974, in having 29 total dorsal-fin elements—III-I-XIII, 12 (vs. 31—III-I-XIV, 13 or III-I-XIII, 14); 19 anal-fin soft rays (vs. 20-21); 12 pectoral-fin rays (vs. 13); 12 precaudal vertebrae (vs. 13); and the first dorsal-fin spine longer than the second (vs. the second longer than the first). It further differs from *H. apectolophus* in lacking scales (vs. three-quarters of body densely scaled), in having a distinctive pattern of spotting on the trunk and fins in preservative (vs. no spotting), and in lacking a fleshy flap on the anterior rim of the posterior nostril (vs. flap present). Color in life is unknown for *H. apectolophus,* and the color description presented for the new species constitutes the first color information for the genus. Familial placement of *Haptoclinus* remains questionable, but the limited relevant information obtained from morphological examination of the new species provides additional support for a close relationship with the Chaenopsidae. *Haptoclinus dropi* represents one of numerous new teleost species emerging from sampling to 300 m off Curaçao as part of the Smithsonian Institution's Deep Reef Observation Project (DROP).

Keywords

Blenniiformes, submersible, Substation Curaçao, *Haptoclinus apectolophus,* Deep Reef Observation Project (DROP)

Introduction

Diving to 300 m off Curaçao in the southern Caribbean using Substation Curaçao's (http://www.substation-Curacao.com) manned submersible *Curasub* is expanding our knowledge of the deep-reef Caribbean fish fauna. Targeted fish specimens are collected with the sub's two flexible, hydraulic arms, one of which is equipped with a quinaldine-ejection system and the other with a suction hose. Occasionally, small, inconspicuous, non-targeted fishes are collected along with the target specimens. One bycatch specimen collected between 157 and 167 m represents a new species and the second known species referable to the blenniiform genus *Haptoclinus* Böhlke and Robins, 1974. *Haptoclinus apectolophus* Böhlke and Robins, 1974 was described based on two specimens that were trawled from depths of 174–366 m at Arrowsmith Bank in the northwestern Caribbean. The new species is similar to *H. apectolophus* in having the dorsal fin consisting of four parts (three spinous, one soft) and represents a southern range extension for the genus of 9° latitude and an eastern range extension of 17° longitude. In this paper we describe the new species, compare it with *H. apectolophus,* and comment on the familial placement of *Haptoclinus.*

Materials and methods

The specimen was collected by submersible using the fish anesthetic quinaldine pumped from a reservoir through a tube attached to one hydraulic arm and a suction hose (that uses the same pump as the anesthetic-delivery apparatus) attached to the other arm. The latter empties into a vented plexiglass cylinder attached to the outside of the sub. At the surface, the fish was measured, photographed, tissue sampled (right eye removed), and preserved. It was later photographed to document preserved pigment pattern and x-rayed with a digital radiography system. Counts and measurements included in the description are those described for *H. apectolophus* by Böhlke and Robins (1974). Measurements were made to the nearest 0.1 mm with an ocular micrometer fitted into a Wild stereomicroscope. Institutional abbreviations follow Sabaj Pérez (2012).

Results

***Haptoclinus dropi*, sp. n.**
urn:lsid:zoobank.org:act:3091C7AF-C686-4317-AD7E-43D8C8D86357
http://species-id.net/wiki/Haptoclinus_dropi
Figs 1–2
Four-fin blenny

Type locality. Curaçao, southern Caribbean

Figure 1. *Haptoclinus dropi,* sp. n., holotype, USNM 414915, 21.5 mm SL, female. Both photographs were taken after the fish was in preservation for several months, the top image against a white background, the bottom against a black background. Photographs by Ian Silver-Gorges.

Holotype. USNM 414915, 21.5 mm SL, female, *Curasub* submersible, sta. 12-7, southern Caribbean, Curaçao, east of downline off Substation Curaçao dock, near 12°05.069'N, 68°53.886'W, 157–167 m, quinaldine, 13 Aug 2012, D. R. Robertson, A. Schrier, B. Brandt, C. Castillo.

Diagnosis. A species of *Haptoclinus* distinguished from its congener by the following combination of characters: dorsal-fin elements III-I-XIII, 12; anal-fin soft rays 19; pectoral-fin rays 12; precaudal vertebrae 12; first dorsal-fin spine longer than second dorsal-fin spine; scales absent; posterior nostril without fleshy flap; and trunk, dorsal- and anal fins with spotted pigment pattern in preservative.

Description. Dorsal-fin elements: III-I-XIII, 12; anal-fin elements II, 19; ultimate pterygiophore of dorsal and anal fins supporting a single segmented soft ray. Pectoral-fin rays 12, 12. Pelvic-fin rays I, 3. Segmented caudal-fin rays 7+6, procurrent caudal-fin rays 6+5. All fin rays unbranched. Vertebrae 12+24=36. Three anal-fin pterygiophores anterior to first haemal spine.

Measurements (in mm): head length 6.6, snout length 1.3, eye diameter 1.0, body depth at fourth dorsal-fin spine 3.5, depth at caudal peduncle 1.0, greatest head width 5.4, body width at anus 2.0, width of bony interorbital 0.4, length of upper jaw 2.6, length of caudal peduncle 2.0, distance from snout to origin of dorsal fin 4.1, distance from snout to upper pectoral-fin base 5.9, distance from snout to insertion of pelvic fin 4.4, distance from snout to origin of anal fin 9.2, length of first dorsal-fin spine 4.1, length of second dorsal-fin spine 3.8, length of third dorsal-fin spine 1.5, length of fourth dorsal-fin spine 0.7, length of longest pectoral-fin ray 4.2, length of pelvic fin 4.1, length of longest caudal-fin ray 3.4.

Figure 2. *Haptoclinus dropi,* sp. n., holotype, USNM 414915, 21.5 mm SL, female. Both photographs were taken soon after the fish was captured, the top image against a white background, the bottom against a black background.

Body without scales or scale pockets. Small, pointed teeth present in both jaws and on vomer and palatines; teeth uniserial except on anterior portion of premaxilla and dentary, where several teeth form an inner row. Anterior nostril with long tube; posterior nostril a simple opening with minute fleshy rim anteriorly but no fleshy flap; posterior nostril situated closer to eye than to anterior nostril. Mouth terminal and jaws equal. Upper edge of maxilla not sheathed by lacrimal when mouth closed; maxilla reaching vertical through posterior margin of orbit. Gill membranes broadly joined across but free of isthmus. Dorsal margin of upper lip free and continuous across tip of snout. Head lacking cirri. Pores of cephalic lateralis system as drawn for *H. apectolophus* (Böhlke and Robins 1974: Fig. 3).

Dorsal fin originating on head about half way between verticals through posterior margins of eye and operculum; fin terminating slightly anterior to vertical through base of ultimate anal-fin ray. Small membrane connecting last dorsal- and anal-fin rays to caudal peduncle. First dorsal-fin spine longest, reaching base of seventh spine when depressed. Fourth dorsal-fin spine short, separated by gaps from anterior three and posterior thirteen spines. Low membrane connecting last dorsal-fin spine to first segmented soft ray. First anal-fin spine shorter than second. Membranes of pectoral fin notched; in dorsal portion of fin (dorsal to longest ray), membranes extending

from distal tip of one fin ray to distal tip of adjacent fin ray; in ventral portion of fin, membranes extending from distal tip of one fin ray dorsally to point well proximal of distal tip of adjacent fin ray. Ninth pectoral-fin ray (from top of fin, fourth from bottom) longest (broken on left side of holotype), this ray on right side of body reaching posteriorly to vertical through base of third segmented anal-fin ray. Pelvic fin reaching posteriorly to anus when straightened; innermost (third) pelvic soft ray very small, about half length of small (0.5-mm long), pelvic-fin spine. Caudal fin truncate.

Color Prior to Preservation (Fig. 2).—When photographed against a white background (Fig. 2, top), the following visible on the fresh holotype: ground color of body pale grey; side of belly with rectangular-shaped patch of orange-brown pigment with indistinct whitish diagonal bar across center; spinal column with series of eight internal, irregular orange blotches; dorsalmost region of trunk (beneath dorsal fin) and ventralmost region of trunk (above anal fin) each with row of eight to nine orange/brown spots; head grey, densely speckled with fine black melanophores; nape orange-brown, with several yellow blotches; iris orange, grading to yellowish inner ring; yellow bar extending anteroventrally from anteroventral corner of orbit to anterolateral aspect of upper jaw and anterior tip of lower jaw; operculum pale orange, with two yellow-orange spots on lower edge; anterior dorsal finlet (spines I-III) creamy yellow, with four irregular dark brown horizontal cross-bars; second dorsal finlet (spine IV) translucent; remainder of dorsal fin translucent, with two or three irregular rows of round orange-brown spots on both spinous and soft portions; anal fin translucent, with two rows of round orange-brown spots;caudal fin translucent, with row of round, mostly orange spots along dorsal and ventral fin margins and two vertical rows of such spots across posterior third of fin pectoral and pelvic finswithout obvious pigment. When photographed against a black background (Fig. 2, bottom), the following also visible on the fresh holotype: series of long, yellow/white, roughly vertical bars on dorsal fin—one on second finlet (spine IV), three on main portion of spinous dorsal fin, four on soft dorsal fin; bars extending onto dorsal portion of trunk as small white blotches; a series of tiny white spots beneath dorsal-fin base just ventral to white blotches; row of small white spots on trunk just above anal-fin base between dark spots, several extending onto rear of anal fin as short white bars; thin white bar across caudal-fin base; several white spots on outer portion of upper caudal lobe.

Color in Alcohol (Fig. 1).—Trunk pale, central region with midlateral row of four small, rounded blotches of melanophores; additional small blotch present at center of posterior end of caudal peduncle; eight internal blotches of pigment present on dorsal portion of trunk beneath dorsal fin: first blotch beneath origin of main portion of spinous dorsal fin (spine V); last blotch on caudal peduncle; eight similar internal blotches present on ventral portion of trunk above anal fin, posterior markings darker and including a few external melanophores. Head tan, covered entirely with fine melanophores. First dorsal finlet with four dark blotches on membrane between first and second spines; some of this pigment extending onto membrane between second and third spines; second dorsal finlet (spine IV) unpigmented; remainder of fin with two or three rows of small, rounded spots. Anal fin with rounded spots in single row on most

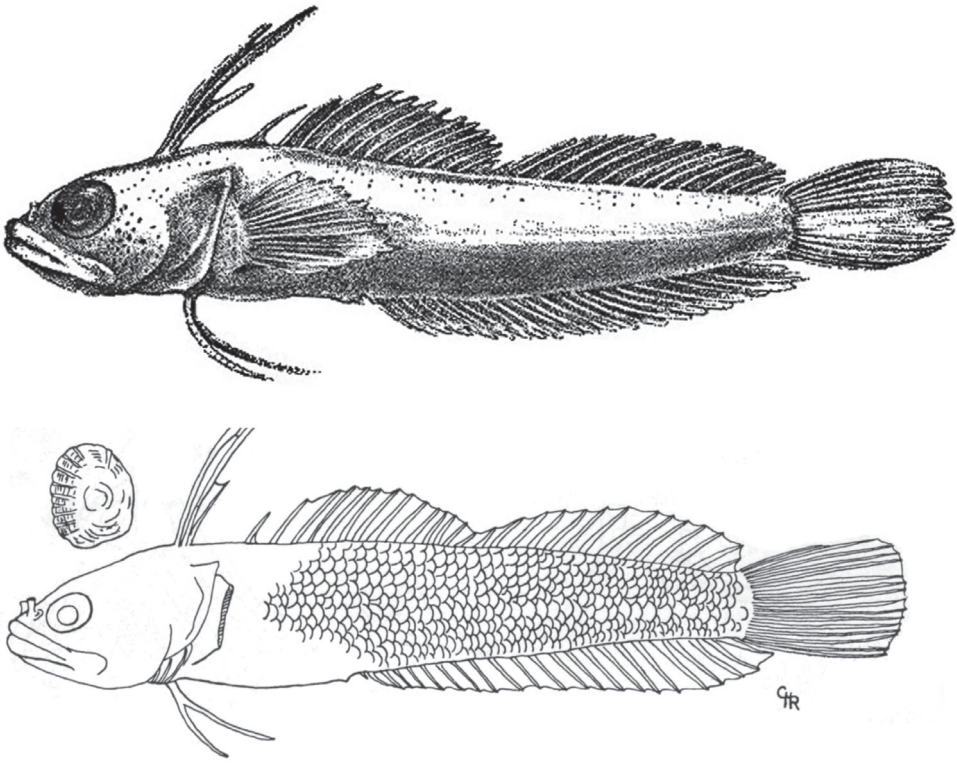

Figure 3. *Haptoclinus apectolophus,* holotype, ANSP 121251, 25.2 mm SL, male. Modified from Böhlke and Robins (1974).

of fin, posterior portion of fin with two rows; spots in distal row smaller than those in proximal row. Caudal fin with small pigment blotch on bases of dorsal procurrent rays and another on bases of ventral procurrent rays; remainder of fin mostly pale except with several small, dark markings on dorsal portion of dorsal lobe. Pectoral fin pale, with a few dark spots on membrane between lowermost third and fourth rays. Pelvic fin pale.

Distribution. Known only from Curaçao, southern Caribbean.

Etymology. The specific name is in reference to the acronym for the Smithsonian Institution's Deep Reef Observation Project (DROP), which is treated here as a noun in the genitive case. *Haptoclinus dropi* is the first of numerous new species that will be described from DROP submersible research in the southern Caribbean.

Common Name. "Four-fin blenny" is in reference to the configuration of the dorsal fin.

Comparisons. For comparative purposes, counts and measurements of the holotypes of *H. dropi* and *H. apectolophus* (Fig. 3) are given in Table 1, along with distinguishing features of general morphology. *Haptoclinus dropi* has two fewer dorsal-fin elements than *H. apectolophus* (29 vs. 31), the differences occurring in the third spinous dorsal finlet and soft dorsal fin (III-I-XIII, 12 in *H. dropi,* III-I-XIII, 14 or III-I-XIV,

Table 1. Counts and measurements of the holotypes of *Haptoclinus dropi,* sp. n., and *H. apectolophus* and distinguishing characters of general morphology. Data for *H. apectolophus* are from Böhlke and Robins (1974) or from examination of radiographs of the type (see Comparative Material in the text). Standard length is in mm, other measurements are in % SL.

	Haptoclinus dropi	***Haptoclinus apectolophus***
Catalog number	USNM 414915, Holotype	ANSP 121251, Holotype
SL	21.5	25.2
Dorsal-fin elements	III-I-XIII, 12	III-I-XIV, 13
Total dorsal-fin elements	29	31
Anal-fin elements	II, 19	II, 20
Pectoral-fin rays	12/12	13/13
Pelvic-fin rays	I, 3	I, 3
Segmented caudal-fin rays	7 + 6	7 + 6
Procurrent caudal-fin rays	6 + 5	6 + 5
Vertebrae	12 + 24	13 + 24
Head Length	30.7	29.8
Snout Length	6.0	6.7
Eye Diameter	6.6	7.9
Body depth at 4th dorsal spine	16.3	17.9
Depth at caudal peduncle	6.6	9.1
Greatest head width	25.1	15.9
Body width at anus	9.3	10.3
Bony interorbital width	1.9	2.3
Upper jaw length	12.1	15.1
Caudal-peduncle length	9.3	8.7
Snout to origin of dorsal fin	19.1	21.4
Snout to upper pectoral-fin base	27.4	29.8
Snout to insertion of pelvic fin	20.5	24.2
Snout to origin of anal fin	42.8	46.8
First dorsal-fin spine length	19.1	22.2
Second dorsal-fin spine length	17.7	26.2
Third dorsal-fin spine length	7.0	11.9
Fourth dorsal-fin spine length	3.3	8.3
Longest pectoral-fin ray	19.5	23.0
Pelvic-fin length	19.1	21.4
Longest caudal-fin ray	21.5	20.2
Body squamation	None	Posterior 3/4 scaled
Spotted pigment pattern	Present	Absent
Posterior nostril	No fleshy flap	Fleshy flap anteriorly

13 in *H. apectolophus*). *Haptoclinus dropi* also has one or two fewer soft anal-fin rays (19 vs. 20-21), one fewer pectoral-fin ray (12 vs. 13), and one fewer precaudal vertebra (12 vs. 13). The shape of the first dorsal finlet is different in the two species because of differences in relative sizes of the first three dorsal-fin spines: the first dorsal-fin spine

is the longest of the three elements in *H. dropi* (length of first three dorsal spines 18, 7 and 3% SL, respectively); the second dorsal spine is longest in *H. apectolophus* (length of first three dorsal-fin spines 22, 26, and 12% SL, respectively).

Haptoclinus dropi and *H. apectolophus* have very different preserved pigment patterns. In *H. dropi,* the trunk is uniformly pale with a row of external blotches along the lateral midline, a row of mostly internal blotches just beneath the dorsal fin, and a row of mostly internal blotches just above the anal fin. In *H. apectolophus,* there is much more pigment on the ventral portion of the body than there is dorsally, and there are no obvious internal or external blotches of pigment. In *H. dropi,* the first dorsal finlet has four dark blotches, the fourth dorsal-fin spine is unpigmented, and the remainder of the fin is pale with two or three rows of small dark spots. In *H. apectolophus,* the first dorsal finlet is uniformly dark and both the spinous and soft portions of the dorsal fin are peppered with fine melanophores in no apparent pattern. The anal fin is uniformly pale with one or two rows of small dark spots in *H. dropi.* In *H. apectolophus,* the basal three-quarters of that fin are heavily and uniformly pigmented, and the distal quarter is pale. The caudal fin has dark spots dorsally in *H. dropi,* and the pectoral fin has a few dark spots ventrally. In *H. apectolophus,* the caudal and pectoral fins lack melanophores. *Haptoclinus dropi* differs from *H. apectolophus* in other minor ways: *H. dropi* lacks a fleshy flap on the posterior nostril (vs. fleshly flap extending from anterior margin and covering anterior half of nostril) and has a more slender body (body depth 16.3% SL at the fourth dorsal spine vs. 17.9% SL, depth at caudal peduncle 6.6% SL vs. 9.1% SL).

Discussion and conclusions

The configuration of the dorsal fin in *Haptoclinus*, in which the anterior spinous finlet is separated from the main spinous portion by a gap that contains a single isolated spine (the fourth)—thus resulting in a dorsal fin that consists of four parts, is unique among blenniiforms (Böhlke and Robins 1974, Springer 1993). The presence of this configuration in the new species provides solid evidence for its placement in *Haptoclinus.* Furthermore, of the diagnostic characters listed by Böhlke and Robins (1974) for *Haptoclinus* that could be assessed from examination of the preserved holotype and a radiograph of the new species, it deviates only in some fin-ray counts and in completely lacking scales. Fin-ray counts often vary intragenerically among species of fishes, but the presence or absence of scales typically does not. However, in the blenniiform genus *Stathmonotus*, five species in the Caribbean and eastern Pacific are naked (Springer 1955), whereas the Caribbean *S. stahli* (Evermann and Marsh) is fully scaled (Hastings and Springer 1994). Other characters of the two *Haptoclinus* blennies that exhibit interspecific variability are preserved pigment pattern, number of precaudal vertebrae, configuration of the posterior nostril, and some aspects of morphometry (Table 1). Relative differences in the lengths of the first two dorsal-fin spines in *H. dropi* and *H. apectolophus* (the first spine is the longest in the former, the second in

the latter) result in different finlet shapes in the two species, but whether these reflect interspecific or intersexual differences is unknown. The holotype of *H. apectolophus* is a male, and the measurements and illustrations of the first dorsal finlet provided by Böhlke and Robins (1974, also see Fig. 3) are for that specimen. The cleared and stained paratype is disarticulated, and neither sex nor lengths of the first two dorsal-fin spines can be determined. The single specimen of *H. dropi* is a female, and no males are currently known.

Familial placement of *Haptoclinus* is uncertain. Böhlke and Robins (1974) assigned *Haptoclinus* to the Clinidae, but they expanded that family to include all blenniiform genera except those in the Blenniidae of Springer (1968). George and Springer (1980) redefined the Clinidae and restricted it to genera previously placed in the Ophiclinidae, Peronedysidae, and Clininae of Hubbs (1952), Penrith (1969) and Springer (1970). All other fishes previously considered clinids in those three publications, plus the more recently described *Haptoclinus, Nemaclinus* Böhlke and Springer*, Cottoclinus* McCosker, Stephens and Rosenblatt, and *Xenomedea* Rosenblatt andTaylor, are now placed in the family Labrisomidae [see Hastings and Springer (2009) for a review of the history and current status of blenniiform classification]. In their discussion of *Haptoclinus* affinities, Böhlke and Robins (1974) observed that except for the configuration of its dorsal fin and reduced-but-present squamation, *Haptoclinus* looks like a chaenopsid. The discovery of *H. dropi,* which shares with most chaenopsids the complete absence of scales, lends further phenetic support to their observation.

The Chaenopsidae were not defined phylogenetically until Springer (1993) listed synapomorphies of each blenniiform family and Hastings and Springer's (1994) reviewed the genus *Stathmonotus* and provided a cladistic analysis of chaenopsids. Hastings and Springer (1994) commented on a possible relationship between *Haptoclinus* and the Chaenopsidae and indicated (their Table 1) that of eight chaenopsid synapomorphies, *Haptoclinus* has two: (*2*) *ventral arm of the posttemporal is well separate from the neurocranium* and (*4*) *upper jaw of males extends to or beyond a vertical through the posterior margin of the orbit*. It lacks (*1*) *a long palatine* and (*6*) *a posterior shift in the relative position of the hyomandibula.* They were unable to determine if *Haptoclinus* has (*3*) *no lateral-line ossifications*, (*5*) *a long upper jaw in females*, (*7*) *a sphenotic spine,* and (*8*) *a thin dorsal scapular region that is well separated from the cleithrum*. Citing insufficient information, Hastings and Springer (1994) did not assign *Haptoclinus* to the Chaenopsidae and retained it as an enigmatic member of the Labrisomidae. Hastings and Springer (2009) noted that the Labrisomidae may not be monophyletic and that of the component genera, only *Haptoclinus* and *Nemaclinus* have not been assigned to a labrisomid tribe.

Morphological examination of *H. dropi* enables us to add Hastings and Springer's (1994) characters (*3*) and (*5*) to the list of synapomorphic features shared by *Haptoclinus* and chaenopsids, but characters (*7*) and (*8*) cannot yet be assessed. Hastings and Springer (1994) noted that *Haptoclinus* also shares several derived characters with lineages within the Chaenopsidae, two of which—(*20*) *absence of mandibular pore 1B* and (*21*) *absence of an otic pore*—characterize no other labrisomids. Several characters tabulated by Böhlke and Springer (1975) that separate *Haptoclinus* from other labrisomid

genera they examined may warrant additional study because of their presence in some Chaenopsidae. In particular, the complete absence of head cirri is uncommon among blenniiforms but occurs in some chaenopsids (e.g., *Lucayablennius*), and the presence of three (vs. one or two) anal-fin pterygiophores anterior to the first haemal spine occurs in *Lucayablennius* and *Neoclinus* (Springer and Smith-Vaniz 2008). Further comparative morphological work is needed but is hampered by the paucity of *Haptoclinus* specimens. If additional samples of the genus are collected in the future that can be cleared-and-stained and dissected, a more complete assessment of relationships based on morphology can be attempted. The new species has provided the first fresh-tissue sample of *Haptoclinus* for genetic analysis, and future research plans include incorporating genetic data from *H. dropi* into a molecular phylogeny of blenniiformes in hopes of shedding light on the phylogenetic affinities of this poorly known genus.

Comparative material

Haptoclinus apectolophus, holotype, ANSP 121251, 25.2 mm SL, male; paratype, ANSP 121252, cleared and stained (disarticulated and in poor condition). Radiograph of holotype examined on the ANSP website: http://clade.ansp.org/ichthyology/FTIP/view.php?mode=details&id=121251.

Acknowledgments

We thank Adriaan (Dutch) Schrier, Cristina Castillo, Bruce Brandt, Barbara van Bebber, Laureen Schenk, Lee Weigt, and Amy Driskell for assistance in the field; Sandra Raredon and Ian Silver-Gorges for providing the radiograph and images of the preserved holotype; and Mark Sabaj Pérez for sending the type material of *H. apectolophus* on loan to the first author. Funding for the Smithsonian Institution's *Deep Reef Observation Project* is provided internally by the Consortium for Understanding and Sustaining a Biodiverse Planet and by National Geographic Society's Committee for Research and Exploration (Grant #9102-12). Victor Springer, Philip Hastings, and Jeffrey Williams provided helpful comments on drafts of this manuscript.

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