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Classification of weevils as a data-driven science: leaving opinion behind

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Abstract

Data and explicit taxonomic ranking criteria, which minimize taxonomic change, provide a scientific approach to modern taxonomy and classification. However, traditional practices of opinion-based taxonomy (i.e., mid-20th century evolutionary systematics), which lack explicit ranking and naming criteria, are still in practice despite phylogenetic evidence. This paper discusses a recent proposed reclassification of weevils that elevates bark and ambrosia beetles (Scolytinae and Platypodinae) to the ranks of Family. We demonstrate that the proposed reclassification 1) is not supported by an evolutionary systematic justification because the apparently unique morphology of bark and ambrosia beetles is shared with other unrelated wood-boring weevil taxa; 2) introduces obvious paraphyly in weevil classification and hence violates good practices on maintaining an economy of taxonomic change; 3) is not supported by other taxonomic naming criteria, such as time banding. We recommend the abandonment of traditional practices of an opinion-based taxonomy, especially in light of available data and resulting phylogenies.

Keywords

Curculionoidea, Scolytinae, Platypodinae, weevil phylogeny, taxonomic naming criteria, Evolutionary systematics, Scolytidae, Platypodidae

Introduction

Catalogues of plant and animal species are for many scientists essential tools in biodiversity related research, ecology and wildlife management. Publications of this nature include the compilation of large amounts of data from thousands of different literature sources. Without the time and effort devoted to such research activity, most evolutionary and ecological studies are undoubtedly more difficult given the fragmented distribution of literature relevant to any projects on a particular group of organisms. Major taxonomic reviews and taxonomic catalogues organize their contents according to a classification scheme chosen by the author, which may not follow the best evidence for higher level relationships. This creates an unfortunate situation as comprehensive catalogues are frequently cited sources for taxon relationships and as such, may misrepresent the evolution of a group of organisms.

In a recent supplement to the catalogue on the worldwide fauna and taxonomy of Scolytinae and Platypodinae (bark and ambrosia beetles), Bright (2014) delivers a much needed resource on these groups of weevils. This third supplemental volume to the main catalogue (Wood and Bright 1992) contains references to recently published information on a large number of species and higher taxa. As in previous volumes by the same author (Bright and Skidmore 1997, 2002), the level of detail and accuracy is impressive, and presents a very important contribution towards efficient biodiversity and taxonomic research. Within this publication, Bright also presents a radically new classification based on evolutionary systematic philosophy of the mid-20th century (Mayr et al. 1953), including groups of tribes elevated to new subfamilies which are at odds with the current phylogenetic knowledge of these beetles, and reintroduces the archaic scheme that gives Scolytinae and Platypodinae family ranks outside Curculionidae.

Our philosophical debate began over 50 years ago with the growing use of phylogenies to infer classifications. The greatest arguments occurred between the evolutionary systematists who recognized taxa and their rank based on evolutionary uniqueness, including paraphyletic groups, and the cladists (phylogeneticists) who recognized monophyletic (i.e., holophyletic) taxa and their rank based on group hierarchy (Wiley 1979). Currently, there is a consensus among systematists that monophyly is the most important criterion for the recognition of taxa because the resulting taxonomic classification has evolutionary context (Wiley and Lieberman 2011). Unfortunately, most taxonomists have not been explicit about their criteria for naming taxa at various ranks and have been content to leave the decision to their expert opinion. However, explicit taxonomic naming conventions or criteria would help remove this subjectivity (Vences et al. 2013; Wiley and Lieberman 2011). Three primary criteria assure that named groups are monophyletic and well-supported, phenotypically identifiable, and promote an economy of nomenclatural change (Vences et al. 2013). In addition, several secondary criteria, such as time banding, have been suggested as helpful in the recognition of ranks (Vences et al. 2013). As we review here, there is ample data that support the monophyly of scolytines and platypodines and these groups are phenotypically identifiable. The issue is the recognition of these groups as families because this solution does

Table 1. List of taxa mentioned in the text, with author and year of publication.

Name	Author & date
Anthonomini	Thompson 1859
Araucariini, *Araucarius*	Kuschel 1966
Attelabidae	Billberg 1820
Bagoinae	Thompson 1859
Baridinae	Schoenherr 1836
Bostrichidae	Erichson 1836
Brachyceridae, -inae	Billberg 1820
Brentidae	Billberg 1820
Conoderinae	Schoenherr 1833
Cossoninae	Schoenherr 1825
Cryphalinae	Lindemann 1877
Cryphalus	Erichson 1836
Curculionoidea, -idea, -inae	Latreille 1802
Cyclominae	Schoenherr 1826
Dactylipalpus	Chapuis 1869
Dryocoetini	Lindemann 1877
Dryophthoridae, -inae	Schoenherr 1825
Entiminae	Schoenherr 1823
Hexacolidae, -inae, ini	Eichhoff 1878
Homoeometamelus	Hustache 1936
Hylastes	Erichson 1836
Hylesininae	Erichson 1836
Hylurgops	LeConte 1876
Hyorrhynchini	Hopkins 1915
Hyperinae	Marseul 1863
Hypocryphalus	Hopkins 1915
Ipinae, -ini	Bedel 1888
Mesoptiliinae	Lacordaire 1863
Molytinae	Schoenherr 1823
Phrixosoma	Blandford 1897
Platypodidae, -inae	Shuckard 1840
Premnobiini, -ina	Browne 1962
Scolitarii, Scolytoidea, -idae, -inae, ini,	Latreille 1804
Scolytoplatypodini	Blandford 1893
Scolytus	Geoffroy 1762
Xyleborini	LeConte 1876
Xyloctonini	Eichhoff 1878
Xyloterini	LeConte 1876

not promote an economy of nomenclatural change when the ranks of other weevil groups are considered.

We argue that the application of family category on these two weevil groups is unjustified because: i) evolutionary systematic justification for family rank is unsupported, i.e., the apparently unique morphology of bark and ambrosia beetles is in

part shared with other unrelated wood-boring weevil taxa, ii) the suggested classification does not promote an economy of nomenclatural change, i.e., it creates massive paraphyly of the remaining Curculionidae; and, iii) the suggested classification is not supported by other taxonomic naming criteria, i.e., it elevates two relatively young lineages of weevils to the same rank as much older groups.

History of weevil classification in reference to scolytines and platypodines

Bark and ambrosia beetles were treated separately from other weevils from the beginning of binominal nomenclature (see e.g. Wood (1978) and Alonso-Zarazaga and Lyal (2009) for extensive reviews). Initially, scolytines and platypodines were placed within the family Bostrichini (Erichson 1836; Latreille 1802) and were each later recognized as the families Scolitarii (Latreille 1804) and Platypodidae (Shuckard 1840). Some authors (Eichhoff 1864; Ratzeburg 1837) proposed a non-Linnean nomenclature (Xylophaga), but it was rarely used. After the first major taxonomic review of these beetles (Lacordaire 1865), scolytines and platypodines were viewed either as separate families (Bright 2014; Chamberlin 1939; Chapuis 1869; Schedl 1952; Schedl 1959; Schedl 1972; Wood 1973, 1978), as three families (Lindemann 1877), a superfamily Scolytoidea (Hopkins 1915) that was later adopted by Chamberlin (1939, 1958) and Schedl (e.g. 1941), or as a single family comprised of both scolytines and platypodines (Blandford 1897). Various authors suggested a close relationship between scolytines, platypodines and cossonines and that these taxa were more distantly related to the 'true weevils' (Lindemann 1877; Wood 1973), although the view of scolytines as weevils was previously proposed (Latreille 1806).

Crowson (1955) proposed a radically different relationship by placing each of the Platypodinae and Scolytinae as subfamilies of Curculionidae – the 'advanced weevils' which possess geniculate antennae. The new scheme was adopted by other leading Coleopterists such as Lawrence and Newton (1995), and weevil specialists, e.g. Thompson (1992), Zimmerman (1993), Kuschel (1995), and Oberprieler et al. (2007). Alonso-Zarazaga and Lyal (1999) viewed scolytines as a subfamily of Curculionidae but recognized platypodines as a family, an opinion that they later changed (2009) following Oberprieler et al. (2007). This classification was supported by a wide range of morphological characters, particularly from the larvae (Lekander 1968; May 1993; Viedma 1963), and was supported by phylogenetic analyses of both adult and larval character (Kuschel 1995; Marvaldi 1997). The original Crowson scheme therefore has been adopted with only minor emendations in worldwide databases such as ITIS, GBiF, NCBI and EoL. Current disagreement is mainly confined to the number of subfamilies in Curculionidae, and the status of Brachycerinae (-idae) and Dryophthorinae (-idae) (Table 2).

While entomologists in general have accepted the modern definition of Curculionidae, many forest entomologists that actively work on bark and ambrosia beetle ecology and forest health tend to oppose Crowson's system. The most prominent op-

Table 2. Comparison of weevil classification of extant families as more broadly defined by Oberprieler et al. (2007) and more narrowly defined by Alonso-Zarazaga and Lyal (1999).

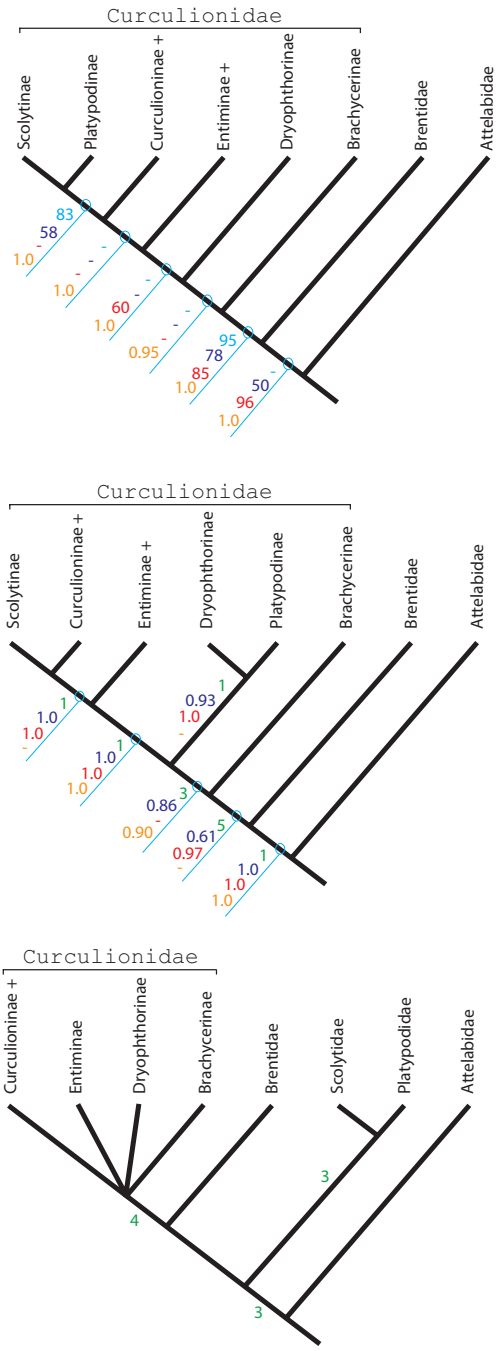
Oberprieler et al. 2007		**Alonso-Zarazaga and Lyal 1999**	
Nemonychidae	Nemonychinae	Nemonychidae	Nemonychinae
	Cimberidinae		Cimberidinae
	Rhinorhynchinae		Rhinorhynchinae
Anthribidae	Anthribinae	Anthribidae	Anthribinae
	Choraginae		Choraginae
	Urodontinae		Urodontinae
Belidae	Belinae	Belidae	Belinae
	Oxycoryninae		Oxycoryninae
Attelabidae	Attelabinae	Attelabidae	Attelabinae
	Rhynchitinae		Rhynchitinae
			Archolabinae
			Isotheinae
			Pterocolinae
		Eurhynchidae	Eurhynchinae
Caridae	Carinae	Caridae	Carinae
Brentidae	Brentinae	Brentidae	Brentinae
	Apioninae		Antliarhininae
	Eurhynchinae		Cyladinae
	Ithycerinae		Cyphagoginae
	Microcerinae		Pholidochlamydinae
	Nanophyinae		Taphroderinae
			Trachelizinae
			Ulocerinae
		Nanophyidae	Nanophyinae
		Ithyceridae	Ithycerinae
		Apionidae	Apioninae
			Myrmacicelinae
			Rhinorhynchidiinae
Curculionidae	Brachycerinae	Brachyceridae	Brachycerinae
			Microcerinae
			Ocladiinae
		Erirhinidae	Erirhininae
			Tadiinae
		Raymondionymidae	Raymondionymidae
			Myrtonyminae
		Cryptolaryngidae	Cryptolarynginae
	Dryophthorinae	Dryophthoridae	Dryophthorinae
			Cryptodermatinae
			Orthognathinae
			Stromboscerinae
			Rhynchophorinae
	Entiminae	**Curculionidae**	Entiminae
	Curculioninae		Curculioninae

Oberprieler et al. 2007		Alonso-Zarazaga and Lyal 1999	
	Baridinae		Baridinae
			Conoderinae
			Ceutorhynchinae
	Molytinae		Molytinae
			Cryptorhynchinae
			Magdalinae
			Mesoptiliinae
			Lixinae
	Cyclominae		Cyclominae
			Hyperinae
			Bagoinae
	Cossoninae		Cossoninae
	Scolytinae		Scolytinae
			(2009: Platypodinae)
	Platypodinae	Platypodidae	

ponent was Stephen L. Wood who published a series of influential monographs and reviews (Wood 1973, 1978, 1982, 1986, 1993, 2007; Wood and Bright 1992). Wood argued for a close relationship between Scolytinae and Platypodinae and placed them outside Curculionidae, closer to the origin of the more primitive weevil lineages. However, much of his evidence came from a rather biased selection of characters, mainly from the head region and Wood's (2007) desire to recognize their striking phenotypic differences (see also Morimoto and Kojima 2003). A number of concurrent publications rejected Wood's hypothesis, and clearly showed that scolytines and platypodines were nested within Curculionidae, hence the subfamily rank.

Weevil phylogenetics

This brings us to the crux of the matter, namely that weevil relationships and rank can only be objectively assessed through the inclusion of the broadest possible range of characters in a phylogenetic analysis. Bright's change in rank for bark and ambrosia beetles is not based on carefully designed hypothesis testing of monophyly, but through the use of arguments, similar to Wood (1986), which cite certain sets of possibly uniquely derived morphological characters to justify the rank of family (Wood 1973, 1978, 1982, 1986, 1993, 2007). This evolutionary systematic perspective does not fully consider the results of weevil phylogenetic studies, which are based on large and fairly unbiased data sets. The resulting phylogenies from these inclusive datasets demonstrate the monophyly of Scolytinae and Platypodinae and their placement within Curculionidae (Fig. 1). The nested position in Curculionidae is supported by morphology-based (Kuschel 1995; Lawrence et al. 2011; Marvaldi 1997) as well as molecular-based phylogenetic studies (Gillett et al. 2014; Haran et al. 2013; Hundsdoerfer et al. 2009; McKenna et al. 2009), and combined morphological and molecular studies



Kuschel, 1995: morphology (no support values)

Marvaldi et al, 2002: DNA (1 gene) + morphology)

Lawrence et al, 2011: morphology

Farrell, 1998: DNA (1 gene) + morphology

Jordal et al, 2011: DNA (5 genes) + morphology (in part)

Marvaldi, 1997: morphology (larvae)

McKenna et al, 2009: DNA (6 genes)

Haran et al, 2013: DNA (mt genomes)

Gillett et al, 2014: DNA (mt genomes)

- Hundsdoerfer et al, 2009: DNA (2 genes) - unresolved
- Jordal et al, 2011: DNA (5 genes) + morphology (in part)

Morimoto and Kojima, 2003: morphology (head)

Wood, 1982, 1986: morphology, but no analysis

Figure 1. Three alternative phylogeny-based classifications. Numbers on nodes indicate support values according to the method reported in the publication listed in the same colour to the right. Low integers (1-9) indicate Bremer support or number of apomorphic characters, higher integers (>50) indicate parsimony bootstrap support, and proportions (>0.50) indicate posterior probabilities from Bayesian analyses.

which included thousands of nucleotides from 5-6 genes (nuclear and mitochondrial) and hundreds of morphological characters (Farrell 1998; Jordal et al. 2011; Marvaldi et al. 2002). The placement of some Curculionidae subfamilies is still uncertain due to their relatively simultaneous origin (see Gillett et al. 2014; Jordal et al. 2011; McKenna et al. 2009), but all studies clearly indicate a nested position of Scolytinae within a narrowly defined Curculionidae (*sensu* Alonso-Zarazaga and Lyal 1999).

Platypodinae may also belong to a similarly defined Curculionidae, but the long phylogenetic branches that characterise Platypodinae make placement of this subfamily less certain. In several purely molecular phylogenetic studies, they tend to group with Dryophthorinae, but still well inside a more broadly defined Curculionidae (*sensu* Oberprieler et al. 2007) that includes Brachycerinae and Dryophthorinae (Fig. 2). The family status of Platypodinae has been suggested (e.g. Thompson 1992) and is an issue that potentially interferes less with an economical approach to taxon name changes although the assessment of platypodines is premature given the absence of robust phylogenetic data. Our concerns are therefore mainly with the status of Scolytinae.

An evolutionary systematic argument for Scolytidae and Platypodidae is unsupported

Bright rejects the current classification scheme for weevils mainly based on what he describes as overwhelming morphological differences between Scolytinae and Platypodinae and the remaining Curculionidae. However, phylogenetic analyses of morphological data do not support his view, and both larval (Marvaldi 1997) and adult characters (Kuschel 1995; Lawrence et al. 2011) support a nested position of Scolytinae and Platypodinae within Curculionidae. Most of the evidence cited by Bright includes head features such as the lack of a rostrum and hypostomal spine, and the pregular sutures defining the pregular sclerite (Wood 1973, 1978). Certainly, if a phylogenetic analysis is based on head features only, and coded according to Wood's (1973, 1978) interpretation of these features, it will likely result in a more basal position of bark and ambrosia beetles (Morimoto and Kojima 2003). However, Lyal (1995) – in a very detailed anatomical study of the weevil head – clearly refuted this as evidence, showing that pregular sutures are not at all unique and not much different from other advanced weevils with less developed rostrum. He also showed that head features in Platypodinae and Scolytinae are not homologous.

Moreover, Bright argues that socketed denticles on the tibiae are synapomorphic for Scolytinae, which in fact they are not. Socketed denticles are found throughout the insect world in burrowing species, particularly so in wood-boring beetles. Strong socketed denticles along the lateral margins of all tibiae are found in unrelated wood-boring groups such as the conoderine genus *Homoeometamelus* (see Jordal et al. 2011) and in the cossonine genus *Araucarius* (see Mecke 2005). At the other end of this character continuum there are entire scolytine lineages without socketed denticles, such as the Scolytini and most Hyorrhynchini, and in the entire Platypodinae. Furthermore it is incorrect that all scolytines lack corbels on the apical end of the metatibiae. There is

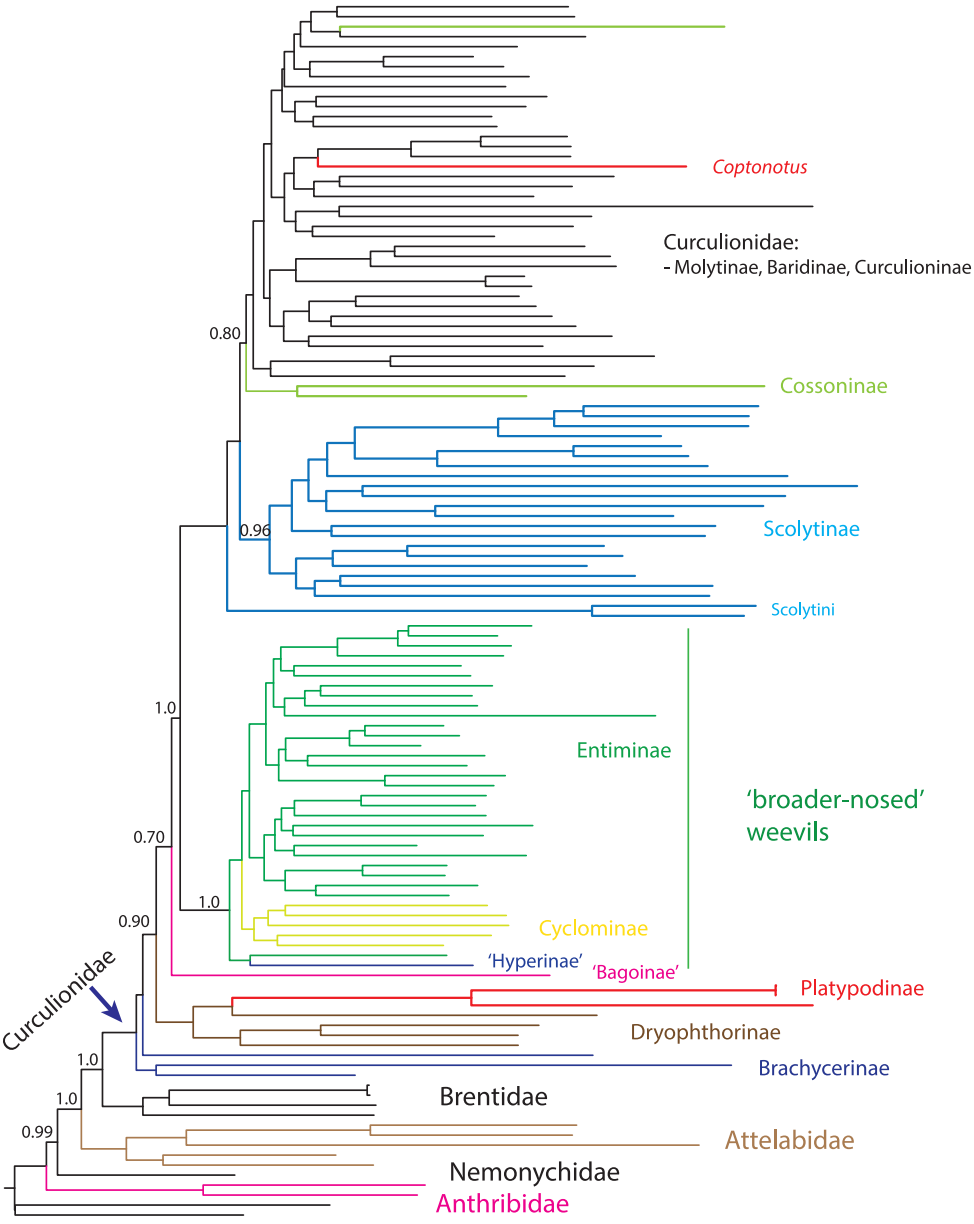


Figure 2. Mitochondrial genome phylogeny redrawn from Gillett et al. (2014), with various families and subfamilies marked in different colours. Node support values are posterior probabilities >0.70.

clearly an inner flange present between the inner tibial insertion area and the outer edge that is fringed by rough setae or denticles, matching the definition for the open type corbels in *Phrixosoma*, *Dactylipalpus* and *Hylastes*/*Hylurgops* (Jordal 2012).

Bright also referred to differences in larval head features between Scolytinae and other Curculionidae. This is entirely at odds with published sources showing

that Scolytinae is indistinguishable from many other Curculionidae based on larval characters (Gardner 1934; Lekander 1968; May 1993; Viedma 1963). The features referred to by Bright are atypical and likely confined to the genus *Scolytus* which actually shows several similarities with larvae in the molytine tribe Mesoptiliini (Lekander 1968; May 1993; Viedma 1963). Phylogenetic analyses including diverse weevil larval characters strongly supports a close relationship between Scolytinae and Cossoninae and to the broad nosed Entiminae, while these three groups are more distantly related to Dryophthorinae and Platypodinae, and even more so to Brentidae (Marvaldi 1997).

Overall, the morphological uniqueness in Scolytinae and Platypodinae fades rapidly when all body parts and all life stages are studied simultaneously in a phylogenetic analysis. The strong arguments for a separate position of Scolytinae and Platypodinae hinges upon the study of few characters which are apparently under strong adaptive selection for optimizing tunnelling behaviour in dead wood. The characters most frequently used to argue for an early separate standing of these groups all appear to be losses or modifications of plesiomorphic features. Optimisation of these features on the best supported phylogenetic topologies (e.g. Fig. 2), demonstrates that the hypostomal teeth are lost multiple times, including certain Cossoninae and Entiminae (Kuschel et al. 2000), the metatibial corbel is lost in connection with a strongly flattened tibiae as in Cossoninae and Conoderinae (e.g. Thompson 1992), particularly in the Araucariini and the wood boring conoderine genus *Homoeometamelus* (Jordal et al. 2011; Mecke 2005), and the rostrum is strongly reduced to entirely absent in many wood boring cossonines (Jordal 2014).

The recognition of Scolytidae and Platypodidae does not support an economy of taxonomic change

The recognition of Scolytidae, and in most classification schemes also Platypodidae, would render Curculionidae paraphyletic and as a result create more nomenclatural issues and work for current and subsequent weevil taxonomists. In order to maintain monophyly of Curculionidae, many if not most current weevil subfamilies would need to change rank to family given the phylogenetic position of scolytines and platypodines (Fig. 2). Some of these subfamilies are paraphyletic; thus, their change in rank would require the recognition of additional currently unnamed clades as families. As illustrated by the most recent and well sampled study to date (Fig. 2), the mitochondrial genome phylogeny indicates a separate clade of the 'broader-nosed' weevils (Entiminae, Cyclominae, Hyperinae) as sister to *Scolytus* (Scolytini), the remaining Scolytinae, and most other Curculionidae except Brachycerinae, Dryophthorinae and Platypodinae. This means that the erection of Scolytinae to a family would require a similar elevation in status for several Curculionidae subfamilies as families (e.g. Entiminae, Cyclominae and Hyperinae) to restore the monophyletic status of Curculionidae. Without a coor-

dinated change in ranks of equivalent weevil groups, the isolated act on Scolytinae and Platypodinae will cause instability in weevil classification.

There is still much phylogenetic ambiguity in even the most well-sampled weevil phylogenies, thus with greater phylogenetic resolution in future analyses, many of these new recognized families would likely be demoted in rank or synonymized and forgotten. The recognition of Scolytidae and Platypodidae also results in the loss of taxonomic information. As families these groups can only be inferred as beetles with some distinguishing characters. But as weevil subfamilies, these groups are recognised as distinguished weevils, namely as snout-less.

In addition, with the elevation of Scolytinae to full family status, Bright promotes 13 new subfamilies, 10 containing a single tribe, and 3 with a collection of 2, 6 or 12 tribes. Even if everyone accepted 'Scolytidae', the change in categories is premature. Bright states that "the ultimate goal of phylogenetic systematics is the development and recognition of monophyletic lineages. As stated above, I herein recognize 13, supposedly monophyletic, subfamilies." However, he does not cite a phylogeny or discuss synapomorphic characters that would support his supposition of monophyletic subfamilies. Although we share Bright's view that Wood's (1986) system includes many paraphyletic and polyphyletic groups, we do not see the evidence presented for how Bright's alternative groupings should increase the number of monophyletic taxa. Published Scolytinae phylogenies generally lack the phylogenetic resolution to suggest a stable classification based on monophyly. Jordal and Cognato's phylogeny (2012) is the best sampled phylogeny to date (200 taxa; 4,000 bp from 5 genes) and still many intergeneric and intertribal relationships are unresolved. There is no evidence for the monophyly of Bright's proposed subfamilies Hexacolinae (phylogenetic data indicate paraphyly with respect to Scolytoplatypodini), Hylesininae (a mixture of unrelated tribes and genera), Ipinae (Xyloctonini and Xyloterini belong elsewhere), and Cryphalinae (*Cryphalus* and *Hypocryphalus* distinctly different from other Cryphalini).

There are also issues concerning monophyly and their corresponding category. Bright does not include criteria for deciding which monophyletic groups should be considered subfamilies. We assume his decision is based on large differences among morphological features (a main tenant in evolutionary systematic philosophy) but the classification is subjective without quantifying these differences. For example, Cactopinini and Micracidini are sister (or nested) clades (Jordal and Cognato 2012; Jordal et al. 2008). Bright proposed separate subfamilies for these groups, but one could justify placing both tribes in one subfamily. Similarly, nomenclatural revision that combines the ranks of Xyleborini and Dryocoetini appears necessary. This is the group where most detailed research has been done, showing that both morphological and molecular data strongly support a nested position of xyleborines within the dryocoetine clade (Farrell et al. 2001; Jordal et al. 2002; Jordal and Cognato 2012; Normark et al. 1999). The same applies to Premnobiini which was recently moved to Ipini as Premnobiina based on molecular and morphological evidence in a phylogenetic context (Cognato 2013).

Other taxonomic naming criteria do not support the recognition of Scolytidae and Platypodidae

Of the other proposed taxonomic naming criteria, time banding (the use of evolutionary age to determine rank) is most applicable to this issue (Vences et al. 2013). Bright suggests that the origin of scolytines occurred in the late Jurassic and derived from "basal" Curculionoidea families such as Brentidae or Attelabidae. Neither the hierarchical structure (Fig. 2) nor molecular dating of weevils suggests that Scolytinae and Platypodinae are derived from these groups or from other groups of comparable age (Farrell 1998; Jordal et al. 2011; McKenna et al. 2009). While these more primitive weevil clades originated in the early Cretaceous or late Jurassic, Scolytinae and Platypodinae are more derived in the molecular analyses and hence much younger lineages of mid-Cretaceous origin.

The oldest scolytine and platypodine fossils are both of mid-Cretaceous age around 100 (Burmese amber) and 116 Ma (Lebanese amber), and fit nicely with these time estimates (Cognato and Grimaldi 2009; Kirejtshuk et al. 2009). Although the weevil fossil record is not particularly rich, it nevertheless follows a sequence of older basal nongeniculate weevils in early Cretaceous deposits, with more modern geniculate forms appearing no earlier than in the mid-Cretaceous. The fossil records in Scolytinae or in Platypodinae are not older than other Curculionidae, including Curculioninae. A fossil of the latter subfamily was recently discovered from the Santana formation in Brazil, likely a member of the tribe Anthonomini, which again indicates a minimum age of 116 Ma for this fairly modern group of weevils (Santos et al. 2011). These fossil ages seems to be close to the maximum age for the advanced weevils as indicated by the shallow phylogenetic internodes characterising the entire clade consisting of Scolytinae, Molytinae, Cossoninae, Baridinae and Curculioninae and related subfamilies or tribes, which implies a rapid radiation just after the origin of the broad nosed weevils (Entiminae, Cyclominae, Hyperinae) (Gillett et al. 2014; Jordal et al. 2011; McKenna et al. 2009).

Recommendations

For the 21st century, taxonomic classification should be based on well-supported, character-rich phylogenies and clear taxonomic ranking (naming) criteria. Instead, the newly proposed classification scheme is derived from an evolutionary systematic perspective, which, despite the phylogenetic evidence to the contrary, is biased by a selection of apparently unique characters. The resulting high cost of change to Curculionidae taxonomy further undermines the proposed classification. We strongly recommend current and subsequent researchers to evaluate classifications conservatively to maintain stability and encourage an economy of taxonomic change that is based on well-supported phylogenies reconstructed with various sources of data. Awaiting the great overhaul of curculionid classifications, the catalogue published by Alonso-Zarazaga and Lyal (1999, 2009) best preserves nomenclatural stability by heeding to

the current phylogenetic evidence and by maintaining a link to well-established Scolytinae tribes *sensu* Wood (1978, 1986). We understand that many users of weevil classification are comfortable with the tradition of subjective assessment and authority in taxonomy. We, on the other hand, do not see comfort in tradition, and would like to see modern scolytine taxonomy evolve into a data-driven science guided by explicit taxonomic naming criteria.

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New Chinese record of the genus *Spinonychiurus* (Collembola, Onychiuridae), with the description of a new species

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Abstract

A new collembolan species is described, *Spinonychiurus sinensis* **sp. n.**, which has seven chaetae in the distal row of the tibiotarsi. It is placed in the genus *Spinonychiurus* due to two important characters: the two subsegments on Abd. III sternum and the absence of d0 on the head. This is the first report of the genus *Spinonychiurus* in China. The diagnosis of *Spinonychiurus* is broadened and the key to the world species is provided.

Keywords

Taxonomy, Thalassaphorurini, tibiotarsi, key

Introduction

The genus *Spinonychiurus* was established by Weiner (1996) for the Scottish species *Onychiurus edinensis* Bagnall, 1935, and it was assigned to the tribe Onychiurini Börner, 1901 as having compound vesicles on the postantennal organ. Kaprus' and Tsalan (2009) revised the diagnosis characters of the genus and moved the genus into the tribe Thalassaphorurini Pomorski, 1998 by the structure of the furcal area and the distinct S-chaeta on the antennae. So far, only four species of the genus *Spinonychiurus* are

reported throughout the world: *S. edinensis*, *S. epaphius* Kaprus' & Tsalan, 2009 from Ukraine, *S. subedinensis* (Arbea & Jordana, 1985) from Spain and *S. vandeli* (Cassagnau, 1960) from France.

During our study on specimens collected from Changbai Mountain Range, we found a new species closest to the genus *Spinonychiurus* Weiner, 1996 but having 7 chaetae in the distal row of tibiotarsi (there are 11 in *Spinonychiurus* according to Kaprus' and Tsalan (2009)). In the present paper, we assign the new species to the genus *Spinonychiurus* with two important characters: two subsegments on Abd. III sternum and the absence of d0 on the head. The description of the new species and the broadened diagnosis of the genus are given below. An updated key to the species of the genus *Spinonychiurus* is provided.

Material and methods

Specimens were mounted in Marc André II solution, after clearing in lactic acid, and were studied using a Nikon Eclipse 80i microscope. Material is deposited in the Key Laboratory of Wetland Ecology and Environment, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun (NEIGAE).

Labial types are identified after Fjellberg (1999). Labium areas and chaetal nomenclature follow Massoud (1967) and D'Haese (2003). Chaetae on anal valves are recognised after Yoshii (1996). Furcal area is classified after Weiner (1996). Tibiotarsus chaetotaxy formula follows Deharveng (1983), and is expressed as: total number of chaetae (number of chaetae in row C, number of chaetae in row B, number of basal chaetae in rows A+T).

Abbreviations used in descriptions and figures:

Ant. – antennal segments, PAO – postantennal organ, Th. – thoracic segments, Abd. – abdominal segments, pso – pseudocellus, psp – pseudopore, psx – parapseudocelli, psx^m – unpaired parapseudocelli, ms – microsensillum, p-chaeta – chaeta of row p, S – S-chaeta, Sp – posterior S-chaeta on Abd. V, AIIIO – sensory organ of antennal segment III.

The pseudocelli and pseudopores formulae are the number of pseudocelli or pseudopores per half-tergum or half-sternum. The S-chaetae formula is the number of S-chaetae per half-tergum or half-sternum from head to Abd. VI.

Systematics

Family Onychiuridae Börner, 1913
Tribe Thalassaphorurini Pomorski, 1998

Genus *Spinonychiurus* Weiner, 1996

Type species. *Onychiurus edinensis* Bagnall, 1935: 117.

Diagnosis. Postantennal organ oval, with numerous compound vesicles perpendicular to the long axis; clubs of AIIIO smooth, ribbed or granulated; Ant. IV with differentiated S-chaetae; posterior pso on head present; chaeta d0 on head absent; S-chaetae on the body well marked; Abd. V tergum with or without spines; Abd. VI with one or two axial chaetae; anal spines present or absent; distal whorl of tibiotarsal chaetae as 7 or 11; Abd. III sternum divided into two subsegment; furcal rudiment as a finely granulated area with 4 small dental chaetae in two rows posteriorly, one manubrial row of chaetae present posteriorly to dental chaetae.

***Spinonychiurus sinensis* sp. n.**
http://zoobank.org/BC4B8586-C7AE-4DB2-A1FB-E02B17174A8A
Figs 1–2

Type material. Holotype: female; paratypes: 3 females and 1 male on slides - China, Jilin, Changbai Mountain Range (alt. 689 m, 43.0376°N, 128.9965°E), 3.Oct.2011, litter and soil, Berlese extraction, leg. Tang Xuguang.

Diagnosis. Pso formula as 32/133/33343 dorsally, absent ventrally, subcoxa 1 of legs I-III with 1, 1 and 1 pso respectively; psx formula as 11/000/122211^{m} ventrally, absent dorsally, subcoxa 1 of legs I-III with 1, 1 and 1 psx respectively; S-chaetae formula as 1/011/111021 dorsally, 11/000/000110 ventrally; sterna of Th. I, II, and III with 0+0, 2+2, 2+2 chaetae respectively; Abd. IV tergum with axial chaeta p0, Abd. V tergum with a0 and m0, Abd. VI tergum with a0; the distal row of tibiotarsi with 7 chaetae; male ventral organ absent; anal spines present, 0.8 times as long as inner edge of hind unguis.

Description. Body white in alcohol. Size 970–1200 μm in females, 900 μm in male; holotype: 1200 μm. Body subcylindrical, body sides parallel.

Pseudocellar formula: 32/133/33343 dorsally, absent ventrally (Figs 1A, G, 2A), subcoxa 1 of legs I–III with 1, 1 and 1 pso respectively. Parapseudocellar formula: 11/000/122211^{m} ventrally, absent dorsally (Figs 1A, 1G, 2A), subcoxa 1 of legs I–III with 1, 1 and 1 psx respectively. Pseudopore formula: 0/011/11110 dorsally, -/111/- ventrally (Figs 1A, G, 2A).

Head. Antennae short and distinctly segmented, as long as head. Length ratio of Ant. I: II: III: IV as about 1: 2: 2: 2. Ant. IV with two distinct thickened S-chaetae, subapical organite with globular apex; basolateral ms at approx. half length from base, above the second proximal row of chaetae (Fig. 1E). AIIIO composed of 5 papillae, 5 guard chaetae, 2 sensory rods and 2 smooth sensory clubs, the inner bigger than the outer, and a lateral ms (Fig. 1E). Ant. II with 15 chaetae. Ant. I with 9 chaetae. Antennal base not marked (Fig. 1D). PAO with 12–13 compound vesicles (Fig. 1D). Dorsal cephalic chaeta d0 absent (Fig. 1A). 3+3 p-chaetae present between two inner posterior pso, p1 in line with others (Fig. 1E). Mandible with strong molar plate and 4 apical teeth. Maxilla bearing 3 teeth and 6 lamellae. Maxillary palp simple with 1 basal chaeta, without sublobal hair (Fig. 1B). Labral formula 4/1,4,2; labium with 6 proxi-

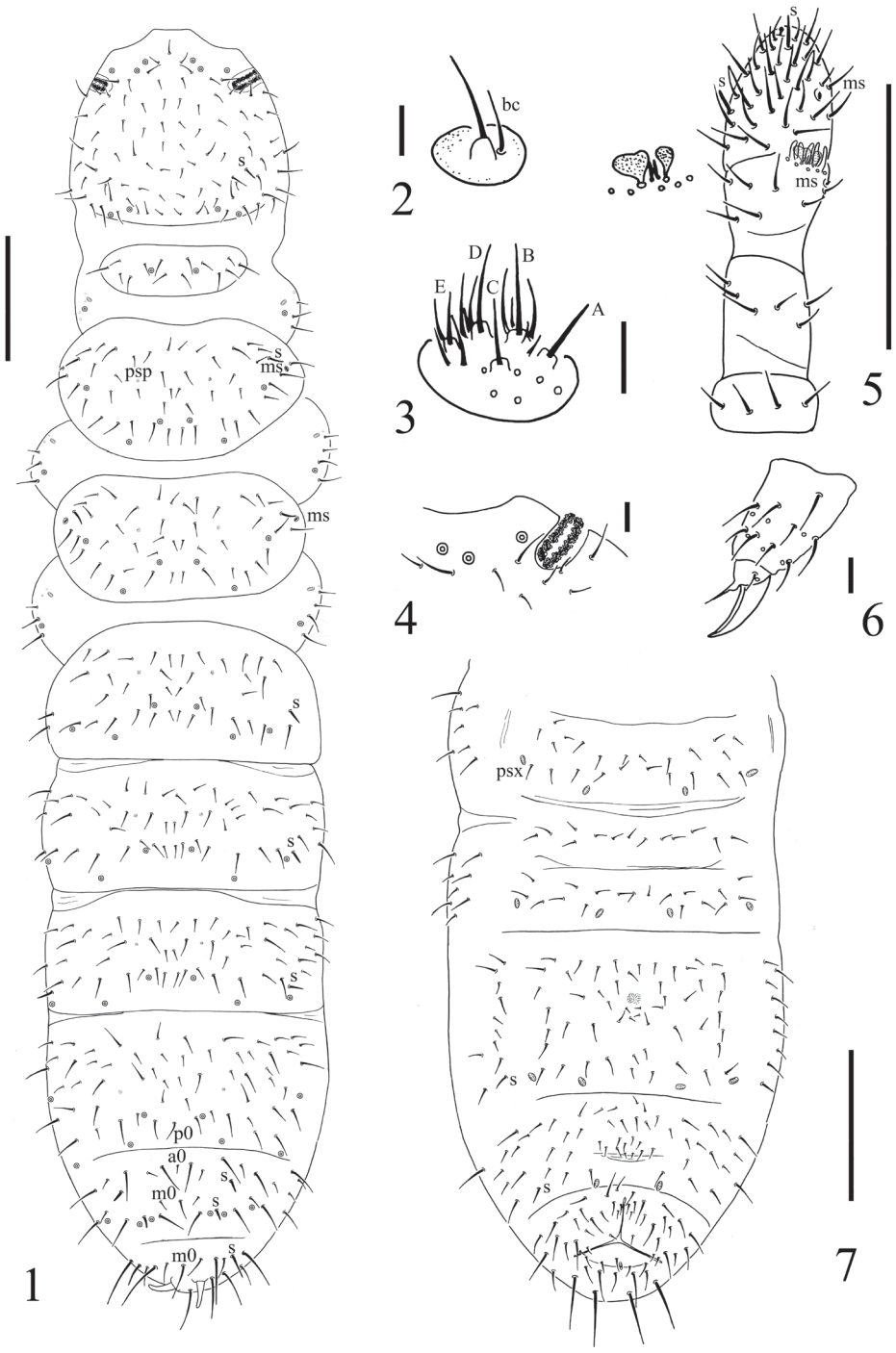

Figure 1. *Spinonychiurus sinensis* sp. n. **A** dorsal chaetotaxy of body **B** maxillary palp **C** labium **D** postantennal organ **E** antenna **F** distal part of leg III **G** chaetotaxy of Abd. II–VI sterna. Scale bars: 0.1 mm (**A, E, G**), 0.01 mm (**B–D, F**).

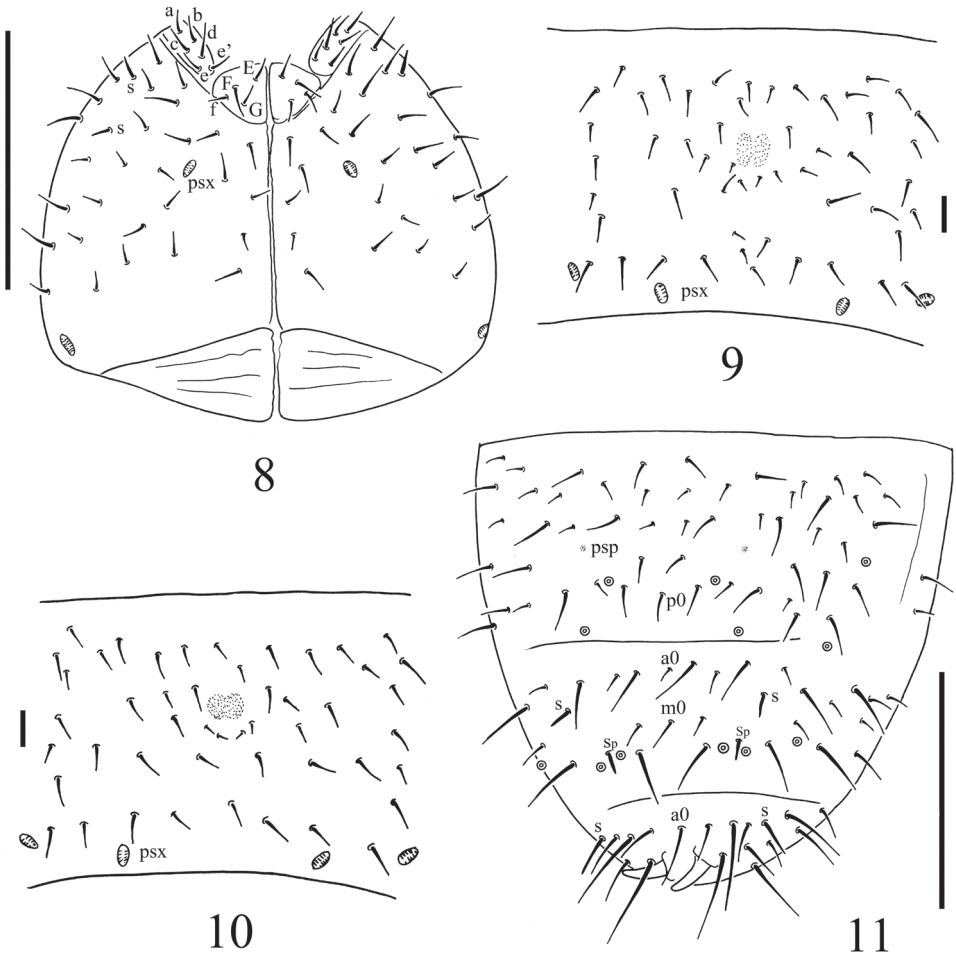

Figure 2. *Spinonychiurus sinensis* sp. n. **A** ventral chaetotaxy of head **B–C** central part of abdominal sternum IV **D** dorsal chaetotaxy of Abd. IV–VI. Scale bars: 0.1 mm (**A, D**), 0.01 mm (**B–C**).

mal, 4 basomedian (E, F, G, f) and 6 basolateral (a, b, c, d, e, e') chaetae (Fig. 2A); labial type A, papillae A–E respectively with 1, 4, 0, 3 and 3 guard chaetae (Fig. 1C). Head ventrally with 4+4 postlabial chaetae along ventral groove (Fig. 2A).

Body chaetotaxy. S-chaetae subcylindrical, apically rounded, 1/011/111021 dorsally, 11/000/000110 ventrally (Fig. 1A, G); subcoxae 2 of legs I, II and III with 0, 0, 1 S-chaeta respectively. Tiny and blunt ms, present on Th. II–III (Fig. 1A). Ordinary chaetae differentiated into meso- and macrochaetae, ratio Sp: m1: p1 on Abd. V tergum = 1: 1: 2.5. Th. I tergum with 7+7 dorsal chaetae. Th. II–Abd. III terga with 3+3 chaetae along axis respectively (Fig. 1A). Abd. IV tergum with one axial chaeta (p0), Abd. V tergum with two axial chaetae (a0 and m0), Abd. VI tergum with one axial chaeta (a0) (Figs 1A, 2D). Sterna of Th. I, II, and III with 0+0, 2+2, 2+2 chaetae respectively.

Table 1. Main diagnostic characters of world species of *Spinonychiurus*.

	S. sinensis sp. n.	*S. edinensis**	*S. epaphius*	*S. subedinensis***	*S. vandeli*
Dorsal pso formula	32/133/33343	32/223/1(?)1(?)3(?)43	5-6,5/4-5,8,8-10/9-13,9-12,9-14,9-14,7-10	34/233/44454	32/233/33343
Ventral pso formula	absent	absent	1/000/00000	1/000/01110	1/000/00000
Number of vesicles on PAO	12–13	14–16	13–16	18–22	22–25
Sensory clubs on AIIIO	smooth	smooth	smooth	smooth	granulated
Chaetae in distal row of tibiotarsi	7	11***	11	11	11***
Male ventral organ	absent	?	present on ventral tube	present on ventral tube	absent
Spines on Abd. V	absent	present	absent	absent	absent
Anal spines	present	present	absent	present	present

* The details of *S. edinensis* follow Bagnall (1935) and Weiner (1996); ** the ventral pso formula has been verified by Javier Arbea (based on the type materials collected in University of Navarra); *** the number of chaetae in distal row of tibiotarsi in *S. edinensis* and *S. vandeli* has been verified by Louis Deharveng (based on the collections in Muséum National d'Histoire Naturelle).

Appendages. Subcoxa 1 of legs I–III with 4, 5 and 5 chaetae, subcoxa 2 with 1, 4 and 4 chaetae respectively. Tibiotarsi of legs I, II and III with 16 (1, 8, 7), 16 (1, 8, 7) and 15 (1, 7, 7) chaetae each (Fig. 1F). Unguis without teeth. Unguiculus approx. 0.6 times as long as inner edge of unguis, with inner basal lamella (Fig. 1F). Ventral tube with 4+4 basal and 7+7 distal chaetae. Furca reduced to a field of fine granulation with 4 small dental chaetae arranged in 2 rows posteriorly; only one manubrial row of chaetae posterior to dental chaetae (Figs 1G, 2B, C).

Genital plate with 9–11 chaetae in females, 32 chaetae in male. Male ventral organ absent. Anal valves with numerous acuminate chaetae; each lateral valve with a0, 2a1, 2a2; upper valves with chaetae a0, 2b1, 2b2, c0, 2c1, 2c2. Anal spines set on distinct papillae, 0.8 times as long as inner edge of hind unguis.

Derivatio nominis. Named for the first recordof the genus *Spinonychiurus* in China.

Ecology. Found in the coniferous forest.

Discussion. The new species is closest to the genus *Spinonychiurus* in two important characters: two subsegments on Abd. III sternum and the absence of d0 on the head. However, it does not fit the current definition of the genus as proposed by Kaprus' and Tsalan (2009) in having 7 chaetae in the distal row of tibiotarsi instead of 11. The distal tibiotarsal chaetae have been verified to be an unstable character in the generic level (Sun et al. 2010; Sun et al. 2011; Sun and Zhang 2012; Sun et al. 2013), so we propose the placement of the new species in the genus *Spinonychiurus* and broaden its diagnosis accordingly. The main diagnostic characters of all known species of the genus are given in Table 1 and a key to these species is provided below.

Key to the known species of the genus *Spinonychiurus*

1	Spines on Abd. V tergum present	***S. edinensis* (Bagnall, 1935)**
–	Spines on Abd. V tergum absent	**2**
2	Chaetae in distal row of tibiotarsi as 7	***S. sinensis* sp. n.**
–	Chaetae in distal row of tibiotarsi as 11	**3**
3	Anal spines absent	***S. epaphius* Kaprus' & Tsalan, 2009**
–	Anal spines present	**4**
4	Dorsal pso formula as 34/233/44454	***S. subedinensis* (Arbea & Jordana, 1985)**
–	Dorsal pso formula as 32/233/33343	***S. vandeli* (Cassagnau, 1960)**

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RESEARCH ARTICLE

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A taxonomic review of the *Neoserica* (sensu lato) *abnormis* group (Coleoptera, Scarabaeidae, Sericini)

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Abstract

The present paper revises the species belonging to the *Neoserica* (sensu lato) *abnormis* group, so far known only with two nominal species. Twenty new species are herein described from Indochina and southern China: *N. abnormoides* **sp. n.** (Vietnam, China), *N. allolaotica* **sp. n.**, *N. namthaensis* **sp. n.**, *N. simplicissima* **sp. n.** (Laos), *N. thailandensis* **sp. n.** (Thailand), *N. alloputaoana* **sp. n.**, *N. kanphantensis* **sp. n.**, *N. natmatoungensis* **sp. n.**, *N. putaoana* **sp. n.**, *N. taunggyiana* **sp. n.** (Myanmar), *N. lamellosa* **sp. n.**, *N. tonkinea* **sp. n.** (Vietnam), *N. bairailingshanica* **sp. n.**, *N. euyunnanica* **sp. n.**, *N. huangi* **sp. n.**, *N. jiangxiensis* **sp. n.**, *N. trifida* **sp. n.**, *N. yaoi* **sp. n.**, *N. yingjiangensis* **sp. n.** (China), *N. cardamomensis* **sp. n.** (Indochina and southern China). One new combination is established: *Neoserica ponderosa* Arrow, 1946, comb. n. The lectotypes of *Neoserica abnormis* Moser, 1908 and the taxonomically uncertain *N. inclinata* Brenske, 1898, which very likely also belongs to this species group, are designated herein. A key to the species and to species groups is given, the genitalia of all species including their habitus are illustrated. Maps of species distribution are included.

Keywords

Beetles, chafers, *Neoserica*, Indochina, China, new species

Introduction

Neoserica Brenske, 1897 comprises ca. 200 taxa and is one of the most species-rich groups of Sericini. Since the revision of the type species (Pope 1960) and the redefinition of the genus (Ahrens 2003), many other species so far grouped under *Neoserica* and being not directly related to *Neoserica* sensu stricto (Ahrens 2003). They are currently grouped preliminarily as *Neoserica* sensu lato (e.g. Ahrens 2004), a collective group that was found to be not monophyletic (Ahrens and Vogler 2008) and being neither related to *Neoserica* sensu stricto (Ahrens 2003). This paper is part of a series of taxonomic revisions (Ahrens et al. 2014, Ahrens et al. in press) based on which hopefully their relationship and their right classification can be subsequently established.

In the current study, we investigated all the taxa closely related to *Neoserica abnormis* Moser, 1908, which is among the largest species of Sericine chafers worldwide, with a body size up to 17 mm. According to our present knowledge, the species group is distributed in southern China and Indochina being mainly restricted to the higher elevated regions. While the *Neoserica abnormis* group was identified as the sister of *Chrysoserica* Brenske, 1897 by a morphology-based phylogenetic analysis (Ahrens 2012), a molecular phylogeny (Ahrens and Vogler 2008) placed it (with a single included species) as sister of *Nepaloserica* Frey, 1965.

Material and methods

Terms and methods used for measurements, specimen dissection and preparation of genitalia are the same as used by Ahrens (2004). Data from specimens examined are cited in the text with original label contents given in quotation marks, multiple labels are separated by a "/". Measurements refer to the maximum extension of the specimen or the named structure. Male genitalia were glued to a small pointed card and photographed in both lateral and dorsal views using a stereomicroscope Leica M125 with a Leica DC420C digital camera. In the automontage software as implemented in Leica Application Suite (V3.3.0), a number of single focused images were combined in order to obtain an entirely focused image. The resulting images were subsequently digitally edited edited to eliminate the background. The distribution maps were generated using Q-GIS 2.0.1 and Adobe Photoshop CS4 software. The key to species groups of *Neoserica* (sensu lato) provided here is currently suitable only for the series of specimens containing both sexes.

Abbreviations used in the text for collection depositories are as follows:

BMNH The Natural History Museum, London, UK;
CPPB Collection P. Pacholátko, Brno, Czech Republic;
CNAR Collection A. Napolov, Riga, Latvia;
HBUM Museum of Hebei University, Baoding (Hebei Prov.), China;

IZAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China;
MNHN Museum national d'Histoire naturelle, Paris, France;
NHMB Naturhistorisches Museum, Basel, Switzerland;
NHRS Naturhistoriska Riksmuseet Stockholm, Sweden;
NKUT Nankai University, Tianjin, China;
NMPC National Museum Prague (Natural History), Czech Republic;
NUYS Northwest A & F University, Yangling (Shaanxi Prov.), China.
SMTD Staatliches Museum für Tierkunde, Dresden; Germany.;
ZFMK Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn; Germany;
ZMHB Zoologisches Museum der Humboldt-Universität, Berlin; Germany;
ZSMC Zoologische Staatssammlung, München; Germany.

Results

Key to species groups of *Neoserica* (sensu lato)

1 Hypomeron not carinate..... ***Tetraserica* Ahrens, 2004**
1' Hypomeron carinate..... **2**
2 Antennal club in female composed of 3 antennomeres ..... ***Neoserica vulpes* group, *N. lubrica* group, *N. pilosula* group, *N. calva* group, *Anomalophylla* Reitter, 1887, *Gynaecoserica* Brenske, 1896, *Leuroserica* Arrow, 1946, *Sericania* Motschulsky, 1860, *Calloserica* Brenske, 1894, *Lasioserica* Brenske, 1896, *Gastroserica* Brenske, 1897, *Neoserica* (s.str.) Brenske, 1894, *Trioserica* Moser, 1922, *Microserica* Brenske, 1894, *Oxyserica* Brenske, 1900, other *Neoserica* (s. l.)**
2' Antennal club in female composed of more than 3 antennomeres..... **3**
3 Metatibia slender and long..... **4**
3' Metatibia shorter and wide ..... ***Neoserica* (s. l.) *uniformis* group & *N. multifoliata* group** (from Indochina)
4 Antennal club of males with 7 antennomeres..... **5**
4' Antennal club of males with 7, 6 or less antennomeres. **6**
5 Metafemur with a continuously serrated line adjacent to its anterior margin. Protibia more or less distinctly tridentate ...***Neoserica septemlamellata* group**
5' Metafemur without a continuously serrated line adjacent to the anterior margin. Protibia always distinctly bidentate. ..... ***Nepaloserica* Frey, 1965**
6 Base of labroclypeus dull. Antennal club of males with 6 antennomeres..... **7**
6' Antennal club of males with 5 or 4 antennomeres..... **8**
7 Angle between base of hypomeron and that of pronotum strongly rounded, angle of surfaces of hypomeron and pronotum basally blunt. Hypomeron basally strongly produced ventrally and transversely sulcate .... ***Lepidoserica* Nikolaev, 1979**

7’ Angle between base of hypomeron and that of pronotum sharp, angle between surfaces of hypomeron and pronotum sharp. Hypomeron basally not produced ventrally and not sulcate..... ***Neoserica abnormis* group**

8 Body surface strongly shiny. Body small: 5.7–6.6 mm ..... ***Neoserica speciosa* group**

8’ Body surface dull. Body larger 8 mm ..... ***Chrysoserica* Brenske, 1897**

Key to species of the *Neoserica abnormis* group (males)

1 Dorsal surface without numerous long semi-erect setae. Antennal club composed of 6 or 7 antennomeres. **2**

1’ Dorsal surface with numerous long semi-erect setae. Antennal club composed of 5 antennomeres. ..... ***N. natmatoungensis* sp. n.**

2 Odd intervals of elytra without white, scale-like setae. Antennal club composed of 6 antennomeres. **3**

2’ Odd intervals of elytra with sparse short, white, scale-like setae. Eyes small, ratio diameter/interocular width < 0.5. Antennal club composed of 6 or 7 antennomeres. 7

3 Left paramere subdivided in three lobes. **4**

3’ Left paramere compact, without lobes. **6**

4 Lobes of left paramere directed all distally. Eyes large, ratio diameter/interocular width > 0.5. ..... **5**

4’ Basal and median lobe of left paramere directed basally. Basal half of parameres ..... subsymmetrical. Eyes small, ratio diameter/interocular width < 0.5. ..... ***N. huangi* sp. n.**

5 Body oblong-oval. Eyes smaller, ratio diameter/interocular width: 0.75. Dorsal lobe of left paramere at base bent laterally and evenly curved ventrally. Antennomere 5 subequal to half of length of club..... ***N. trifida* sp. n.**

5’ Body slender. Eyes larger, ratio diameter/interocular width: 0.92. Dorsal lobe of left paramere straight, parallel to the two remaining lobes of left paramere, abruptly curved ventrally at apex. Antennomere 5 subequal to length of club. ..... ***N. yingjiangensis* sp. n.**

6 Right paramere compact, without lobes..... ***N. bairailingshanica* sp. n.**

6’ Right paramere subdivided into a basal (dorsal) and distal (ventral) lobe ..... ***N. ponderosa* Arrow**

7 Antennal club composed of 6 antennomeres. **8**

7’ Antennal club composed of 7 antennomeres. **20**

8 Left paramere long and slender **9**

8’ Left paramere of various shape but not long and slender **10**

9 Right paramere long and slender, phallobase without apical process ..... ***N. putaoana* sp. n.**

9' Right paramere extremely short. Phallobase with long lateral process on right apex ..... ***N. alloputaoana* sp. n.**

10 Apical margin of elytra slightly concave before apical angle..... ..... ***N. thailandensis* sp. n.**

10' Apical margin of elytra slightly convex or straight before apical angle **11**

11 Basal process of right paramere present **12**

11' Basal process of right paramere absent. ..... ***N. simplicissima* sp. n.**

12 Basal process of right paramere directed basally..... **14**

12' Basal process of right paramere directed distally. **13**

13 Left paramere in median cross section wider than high (e.g. flattened in lateral view). Antennal club twice as long as remaining antennomeres combined .... ***N. kanphantensis* sp. n.**

13' Left paramere in median cross section higher than wide (e.g. flattened in dorsal view). Antennal club shorter. **18**

14 Left paramere trifid. **15**

14' Left paramere bifid. **16**

15 Three lobes of left paramere of nearly same size..... ***N. jiangxiensis* sp. n.**

15' Dorsal lobe of left paramere much smaller than other two .... ***N. euyunnanica* sp. n.**

16 Basal (i.e. dorsal) lobe of right paramere nearly half as long as distal one..... ..... ***N. tonkinea* sp. n.**

16' Basal (i.e. dorsal) lobe of right paramere much shorter than distal one..... **17**

17 Ventral portion of right paramere (divided by strong bent) shorter than basal and dorsal part combined. ..... ***N. taunggyiana* sp. n.**

17' Ventral portion of right paramere (divided by strong bent) subequal to basal and dorsal part combined ..... ***N. allolaotica* sp. n.**

18 Dorsal (i.e. basal) lobe of right paramere small, less than a quarter of length of ventral (i.e. distal) one ..... ***N. abnormoides* sp. n.**

18' Dorsal (i.e. basal) lobe of right paramere large, subequal in size to ventral (i.e. distal) one..... **19**

19 Dorsal lobe of left paramere large, subtriangular, distinctly wider than ventral one ..... ***N. abnormis* Moser**

19' Dorsal lobe of left paramere narrow, as wide as ventral one..... ***N. yaoi* sp. n.**

20 Parameres compact, not subdivided in lobes. ..... ***N. lamellosa* sp. n.**

20' Parameres subdivided in lobes..... **21**

21 Parameres strongly asymmetrical..... ***N. cardamomensis* sp. n.**

21' Parameres nearly symmetrical. ..... ***N. namthaensis* sp. n.**

***Neoserica* (s. l.) *abnormis* Moser, 1908**
Figs 1A–D, 8

Neoserica abnormis Moser, 1908: 329 [type locality: Vietnam, Mt. Mauson (Tonkin)].

Type material examined. Lectotype (here designated): ♂ "Tonkin Montes Mauson April, Mai 2-3000' H. Fruhstorfer / abnormis Mos. [handwritten Moser]" (ZMHB). Paralectotypes: 3 ♂♂, 3 ♀♀ "Tonkin Montes Mauson April, Mai 2-3000' H. Fruhstorfer" (ZMHB).

Additional material examined. 1 ♂ "Tonkin Montes Mauson April, Mai 2-3000' H. Fruhstorfer / Museum Paris ex. Coll. R. Oberthür / 95 Sericini: Asia spec." (MNHN), 1 ♂ "N. Vietnam (Tonkin) Tamdao 12.–24.5.1989 Pacholátko leg." (CPPB).

Redescription. Lectotype. Body length: 13 mm, length of elytra: 9.6 mm, width: 7.2 mm. Body oblong, dark brown, antennal club brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a fine terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.49. Antenna with ten antennomeres, club with six antennomeres, straight, only slightly longer than the remaining antennomeres combined; antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and strongly convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with convex sides and with the apex slightly rounded, with fine, moderately dense punctures, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, intervals nearly flat, with moderately dense evenly spaced, fine punctures, intervals with a few fine white setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender

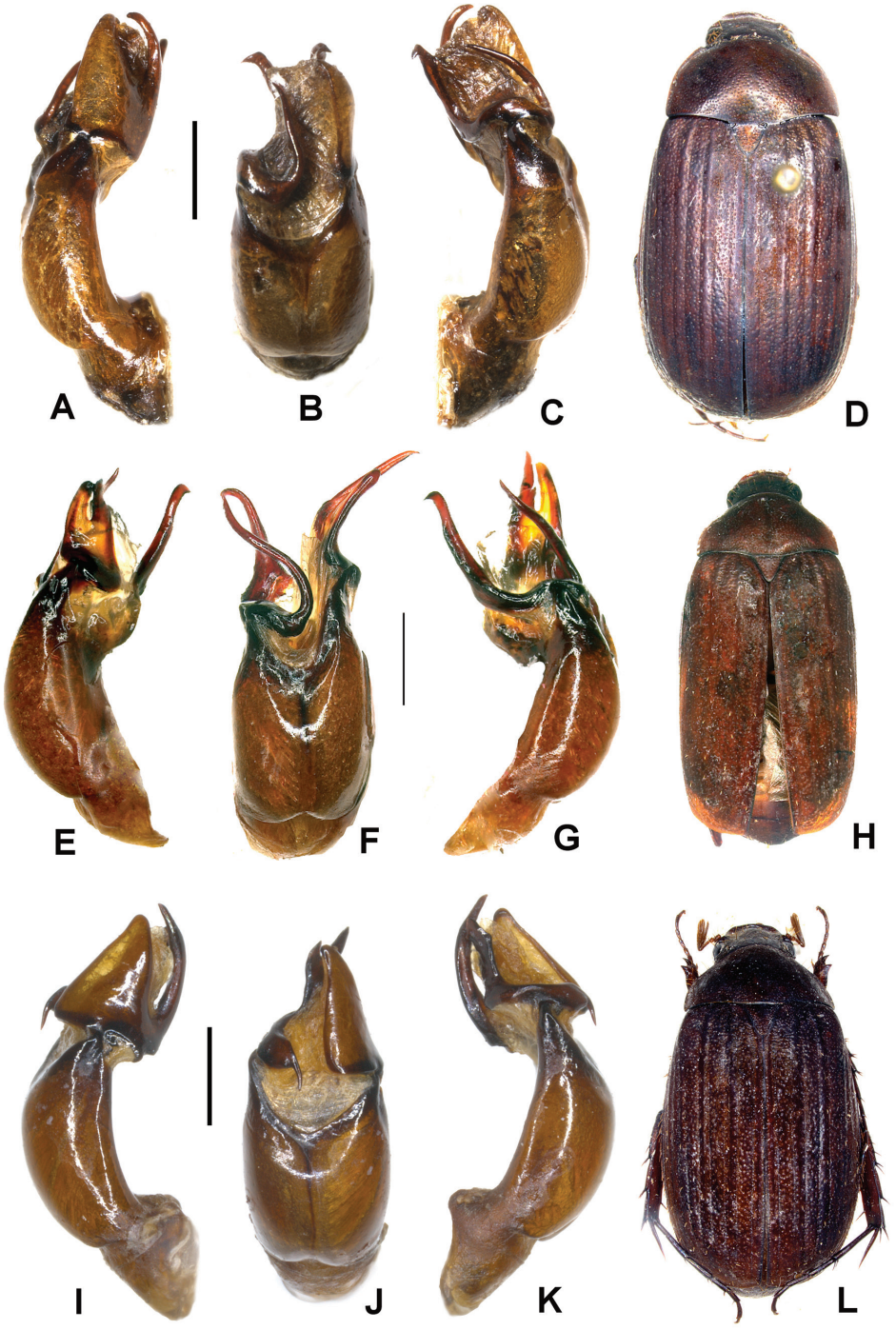

Figure 1. A–D *Neoserica abnormis* Moser (lectotype) **E–H** *N. yaoi* sp. n. (holotype) **I–L** *N. allolaotica* sp. n. (holotype) **A, E, I** Aedeagus, left side lateral view **C, G, K** Aedeagus, right side lateral view **B, F, J** parameres, dorsal view **D, H, L** Habitus. Scale: 1 mm. Habitus not to scale.

mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.79. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few semi-erect setae beside the apical margin.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.5, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 1A–C.

Variation. Body length: 13–17 mm, length of elytra: 9.6–12 mm, width: 7.2–8.5 mm. Female: antennal club composed of four lamellae, as long as remaining antennomeres combined.

***Neoserica* (s. l.) *yaoi* sp. n.**

http://zoobank.org/1307EF7F-090A-45FE-A7CB-63AF950B20D5

Figs 1E–H, 8

Type material examined. Holotype: ♂ "Defu, Napo, Guangxi, 19.VI.2000, 1350m, leg. Yao Jian" (IZAS). Paratypes: 1 ♂ "Defu, Napo, Guangxi, 19.VI.2000, 1350m, leg. Zhu Chaodong " (ZFMK), 1 ♂ "Mengla, Yunnan, 21.IV.1982, leg. Jiang Shengqiao" (IZAS).

Description. Body length: 14.4 mm, length of elytra: 10.3 mm, width: 6.9 mm. Body oblong, dark brown, antennal club brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta;

frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a fine terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.53. Antenna with ten antennomeres, club with six antennomeres, straight, 1.2 times as long as the remaining antennomeres combined; antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins weakly convex, convexly bent at middle, in basal half subparallel, in apical half strongly convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with convex sides and with the apex slightly rounded, with fine, moderately dense punctures, with only minute setae.

Elytra oblong, apex slightly truncate, widest at middle, striae weakly impressed, finely and moderately densely punctate, intervals nearly flat, with moderately dense evenly spaced, fine punctures, intervals with a few fine white setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.79. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few semi-erect setae on apical half.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.7, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex

moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures dorsally; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 1E–G. Female unknown.

Diagnosis. The new species differs from the most closely related *N. abnormis* by the narrow dorsal lobe of left paramere, which is as wide as the ventral lobe; in *N. abnormis*, the dorsal lobe of left paramere is much wider than the ventral one.

Variation. Body length: 13.5–14.4 mm, length of elytra: 10.0–10.3 mm, width: 6.5–6.9 mm.

Etymology. The species is named after one of its collectors, Yao Jian.

***Neoserica* (s. l.) *allolaotica* sp. n.**
http://zoobank.org/19ACCAF9-59F9-40EE-9E83-229685F582FA
Figs 1I–L, 8

Type material examined. Holotype: ♂ "N. Thailand, Doi Pui, near Chiang Mai; 09.V.1085; leg. H. Nara" (ZFMK). Paratypes: 1 ♂ "[BMNH] 703021 Laos, Phongsaly, Phongsaly env., 21°41.2'N 102°6-8'E, leg. P. Pacholátko/ DA21/ =246 Sericini Asia" (ZFMK), 1 ♂ "Thai Chiang Mai prov. 18°49'N, 98°54'E 1600m, Doi Pui mt., 2.-6.v. Vit Kubáň leg., 1996/ Coll. P. Pacholátko Invt. No./ TS114" (CPPB), 8 ♂♂, 1 ♀ "N. Thailand, Doi Pui, near Chiang Mai; 09.V.1085; leg. H. Nara" (ZFMK), 39 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54''-104°00'03"E, 1480–1510m Phou Pane Mt., 22.IV.-14.V.2008 Vit Kubáň leg./ 875 Sericini Asia spec." (ZFMK, NMPC), 4 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"–104°00'03"E, 1480–1510m Phou Pane Mt., 22.4.–14.5.2008 Vit Kubáň leg./ 875 Sericini Asia spec." (ZFMK, NMPC), 1 ♂ „NE-Laos: Hua Phan prov., Ban Saleui, Phou Pan (Mt.) - 20°12'N, 104°01'E; 14.iv.–15.v.2012; 1300–1900m; leg. C. Holzschuh Ankauf ZFMK Bonn 2012/13" (ZFMK), 2 ♂♂ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500–1900m, 17.5.–3.6.2007, leg. C. Holzschuh" (ZFMK), 4 ♂♂ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500–1900m, 17.5.–3.6.2007, leg. Vit Kuban" (ZFMK), 8 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"-104°00'03"E, 1480–1550m Phou Pane Mt., 9.–16.vi.2009, David Hauck leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 16 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"-104°00'03"E, 1480–1550m Phou Pane Mt., 1.–16.vi.2009, Zdenek Kraus leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 11 ♂♂ "Laos-NE, Houa Phan prov., ~20°13'N 104°00'E, Phou Pane Mt., 1.–16.vi.2009,

1350–1500 m, M. Brancucci leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 1 ♂ "Laos-NE, Houa Phan prov., ~20°12–13.5'N, 103°59.5'–104°01'E, Ban Saluei - Phou Pane Mt., 10.-16.vi.2009, 1340–1870 m, M. Brancucci & local collectors leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 3 ♂♂ "Laos-NE, Houa Phan prov., ~20°12–13.5'N 103°59.5'–104°01'E, Ban Sauei - Phou Pane Mt., 1340–1870 m, 15.iv–15.v.2008, Lao collectors leg." (NHMB), 30 ♂♂ "Laos-NE, Houa Phan prov., 20°11–13'N 103°59'-104°01'E, Ban Sauei - Phou Pane Mt., 9.–17.vi.2009, 1300–1900 m, Michael Geiser leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 1 ♂ "Laos-NE, Xieng Khouang prov., 19°38.20'N, 103°20.20'E, Phonsavan (30 km NE); Phou Sane Mt., 1420 m, 10.–30.v.2009, D. Hauck leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 11 ♂♂ "Laos-NE, Xieng Khouang prov., 19°38.20'N, 103°20.20'E, Phonsavan (30 km NE): Phou Sane Mt., 1420 m, 10.–30.v.2009, Z. Kraus leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 9 ♂♂ "Laos-NE, Xieng Khouang prov., 19°37–38'N, 103°20'E, 30 km NE Phonsavan: Ban Na Lam - Phou Sane Mt., 1300–1500 m, 10.-30.v.2009, M. Brancucci leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 15 ♂♂ "Laos-NE, Xieng Khouang prov., 19°37–38'N, 103°20'E, 30 km NE Phonsavan: Ban Na Lam - Phou Sane Mt., 1300–1500 m, 10.–30.v.2009, M. Geiser leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB).

Description. Body length: 12.3 mm, length of elytra: 9.6 mm, width: 7.4 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin distinctly sinuate medially, margins moderately reflexed; surface slightly convex and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a fine terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.49. Antenna with ten antennomeres, club with six antennomeres, straight, 1.5 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 distinctly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and strongly convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, distinctly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals narrower and distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.67. Pygidium weakly convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with a few semi-erect setae basally on sides, at apex with short, fine, moderately dense setae.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.9, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 1I–K.

Diagnosis. *Neoserica allolaotica* is similar to *N. taunggyiana* externally and in the general shape of male genitalia. It differs in the shape of the parameres: the ventral lobe of left paramere is subtrapezoidal (in lateral view) and truncate at apex, and the ventral portion (distal to the strong bent) of right paramere is subequal in length to the basal and dorsal portion, while in *N. taunggyiana* it is shorter.

For the paratype specimen with BMNH code 703021 DNA data are available for the markers Cox1, 16S, and 28S under Genbank accession numbers EU084100, EF487898, and EU084238, respectively.

Variation. Body length: 12.3–14.4 mm, length of elytra: 9.6–10.4 mm, width: 7.4–7.6 mm.

Etymology. The new species is named according to its occurrence in Laos ('*laotica*') with the [Greek] prefix *allo-* (different, other) to avoid potential secondary homonymy with *N. laotica* Frey.

Remarks. As the species occurs syntopically with several other species (in particular with *N. cardamomensis*) in its distribution range, it was not possible to assign female specimens to the type series unambiguously based on morphological characters alone. They were therefore omitted from species description so far.

***Neoserica* (s. l.) *tonkinea* sp. n.**
http://zoobank.org/474E9936-D7F4-4B2E-A780-13379E92D641
Figs 2A–E, 8

Type material examined. Holotype: ♂ "N Vietnam (Tonkin) pr. Vinh Phu 1990 Tam Dao 6.–9.v. P. Pacholátko leg./ Coll. P. Pacholátko Invt. No./ VS74" (CPPB). Paratypes: 3 ♂♂ "Vietnam N (Sa Pa) Lao Cai Prov., 250km from Hanoi bearing 31°, Sa Pa vill. Env. Hoang Lien Son Nat. Res. 27.5.–3.6.1998 1250m leg. A. Napolov" (CNAR, ZFMK), 1 ♂ "Vietnam N (Sa Pa) Lao Cai Prov., 250km from Hanoi bearing 31°, Sa Pa vill. Env. Hoang Lien Son Nat. Res. 21.–23.6.1998 1250m leg. A. Napolov" (CNAR).

Description. Body length: 13.0 mm, length of elytra: 9.8 mm, width: 7.8 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface slightly convex and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and moderately long (length = 1/3 of ocular diameter), glabrous, with a fine terminal seta. Frons dull, with fine and dense punctures, beside the eyes and

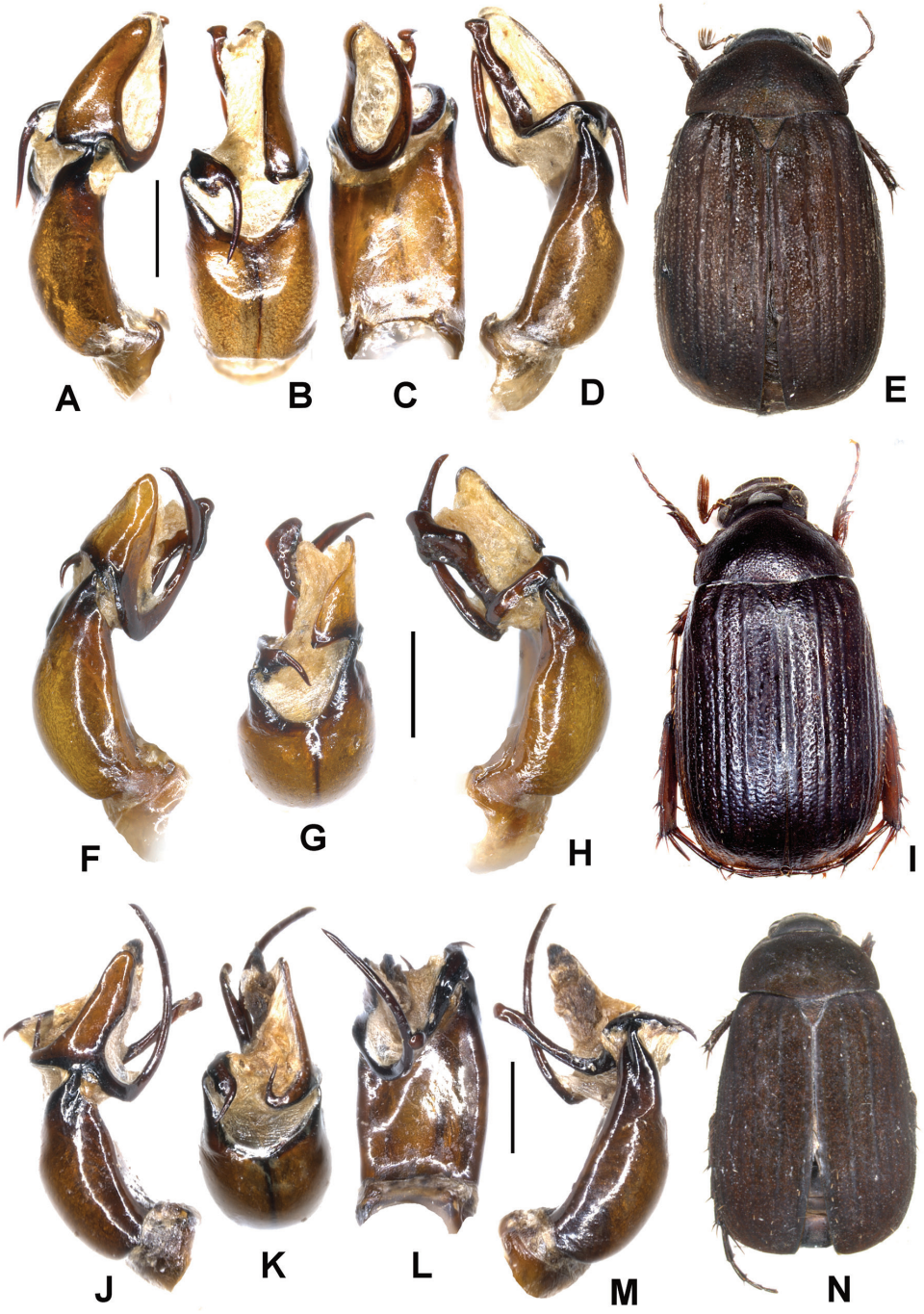

Figure 2. A–E *Neoserica tonkinea* sp. n. (holotype), **F–I** *N. taunggyiana* sp. n. (holotype) **J–N** *N. euyunnanica* sp. n. (holotype) **A, F, J** Aedeagus, left side lateral view **D, H, M** Aedeagus, right side lateral view **B, G, K** parameres, dorsal view **C, L** aedeagus, ventral view **E, I, N** Habitus. Scale: 1 mm. Habitus not to scale.

the frontoclypeal suture with a few erect setae. Eyes small, ratio diameter/interocular width: 0.48. Antenna with ten antennomeres, club with six antennomeres, straight, 1.2 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, strongly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, basally impunctate at middle, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals narrower and distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura densely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.77. Pygidium moderately convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with a few setae beside the margin.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.7, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, mesotarsomeres with a few very fine punctures; metatarsomeres lacking in holotype. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 2A–D. Female unknown.

Diagnosis. *Neoserica tonkinea* sp. n. is very similar to *N. allolaotica* and *N. taunggyiana* externally and in the general shape of male genitalia. It differs principally by the shape of the parameres: the dorsal lobe of left paramere is narrower than in *N. allolaotica* and the ventral lobe is not extended basally as in *N. taunggyiana*; the right paramere is much longer and less widened apically than in either of the species (in lateral view), the basal lobe is directed basally as well but much longer being more than half as long as the distal portion of the right paramere.

Variation. Body length: 12.5–13.0 mm, length of elytra: 9.4–9.8 mm, width: 7.2–7.8 mm.

Etymology. The new species is named according to its occurrence in northern Vietnam, formerly during colonial times, called Tonkin.

Neoserica (s. l.) *taunggyiana* sp. n.

http://zoobank.org/7A8ABD11-3E21-4D8A-9544-B5FE998A67CC
Figs 2F–I, 9

Type material examined. Holotype: ♂ "Burma (Myanmar) SW Shan state Taunggyi J. Rejsek 1.–18.6.1997/ Coll. Dirk Ahrens" (ZFMK).

Description. Body length: 12.0 mm, length of elytra: 8.9 mm, width: 6.6 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin distinctly sinuate medially, margins moderately reflexed; surface slightly convex and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a fine terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.52. Antenna with ten antennomeres, club with six antennomeres, straight, 1.2 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 distinctly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex in the basal half, in anterior third nearly straight, throughout strongly convergent anteriorly, anterior angles very sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in

punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals narrower and distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.7. Pygidium weakly convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with a few semi-erect setae basally on sides, at apex with short, fine, moderately dense setae.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.9, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 2F–H. Female unknown.

Diagnosis. *Neoserica taunggyiana* is similar to *N. abnormis* externally and in the general shape of male genitalia. It differs by the straight anterior margins of pronotum

and, principally, by the shape of the parameres: the ventral lobe of left paramere is much longer and the basal (dorsal) lobe of right paramere is directed basally, rather than distally.

Etymology. The new species is named according to the type locality, Taunggyi.

Neoserica (s. l.) *euyunnanica* sp. n.

http://zoobank.org/86938D3C-EF12-49CB-8206-E4E652F2B271
Figs 2J–N, 8

Type material examined. Holotype: ♂ "China: E-Yunnan Damaidi 2500m, Guangnan near Vietnam VII-2003 leg. Li et al." (ZFMK). Paratypes: 1 ♂ "China, SE Yunnan, Xichou – E env., 1400-1700m, 13.–18.5.95 23°22-26'[N]/ 104°41-49'[E] L.+R. Businský lgt." (CPPB), 1 ♂, 1 ♀ "CH, Guizhou prov., ~650m, Jiangkou (ca 50km SW), 27°32.83'N, 108°36.45'E, Shidu vill. env., 29.vi.-6.vii.2001, C. Holzschuh leg." (CPPB).

Description. Body length: 13.0 mm, length of elytra: 10.0 mm, width: 8.0 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface slightly convex and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and moderately long (length = 1/3 of ocular diameter), glabrous, with a robust terminal seta. Frons dull, with fine and dense punctures, beside the eyes and behind the frontoclypeal suture with a few erect setae. Eyes small, ratio diameter/interocular width: 0.48. Antenna with ten antennomeres, club with six antennomeres, straight, 1.1 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club , antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border abrased in holotype; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, basally impunctate at middle, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals narrower and distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly

flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura only sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.73. Pygidium moderately convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with numerous long setae on apex, otherwise with minute setae in punctures.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.8, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 2J–N.

Diagnosis. *Neoserica euyunnanica* sp. n. is very similar to the previous three species externally and in the general shape of male genitalia. It differs by the shape of the parameres: the ventral lobe of left paramere is extended distally far beyond the apex of the dorsal lobe which produces dorsally a long hook, that is rudimentally present also in *N. tonkinea* as a small sharply pointed tooth; the dorsal lobe of right paramere is slightly shorter than in *N. tonkinea*.

Variation. Body length: 13.0–13.5 mm, length of elytra: 10.0–10.3 mm, width: 8.0–9.0 mm. Female: Antennal club composed of four antennomeres, as long as remaining antennomeres combined.

Etymology. The new species is named "*euyunnanica*" according to its occurrence in Yunnan (China).

***Neoserica* (s. l.) *jiangxiensis* sp. n.**
http://zoobank.org/55031ED2-31BA-4024-8452-62641AF4716B
Figs 3A–D, 8

Type material examined. Holotype: ♂ "China, W-Jiangxi Jingang Shan- Ciping 2–14.VI.1994 E. Jendek & O. Šauša leg./ Coll. P. Pacholátko Invt. No./ CS10" (CPPB). Paratypes: 2 ♂♂ "China, W-Jiangxi Jingang Shan- Ciping 2-14.VI.1994 E. Jendek & O. Šauša leg." (CP, ZFMK), 1 ♂ "Tongzhong Forestry Farm, Fangcheng, Guangxi, 9.IV.2002, light trap, leg. Xue Huaijun" (NKUT).

Description. Body length: 14.0 mm, length of elytra: 10.5 mm, width: 8.2 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins nearly straight and convergent anteriorly, anterior angles strongly rounded, anterior margin distinctly sinuate medially, margins moderately reflexed; surface slightly convex and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and moderately long (length = 1/3 of ocular diameter), glabrous, with one or two robust terminal setae. Frons dull, with fine and dense punctures, beside the eyes and behind the frontoclypeal suture with a few erect setae. Eyes small, ratio diameter/interocular width: 0.47. Antenna with ten antennomeres, club with six antennomeres, straight, as long as remaining antennomeres combined; antennomere 5 distinctly shorter than the club, antennomere 4 slightly widened but not transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest just before base, lateral margins evenly convex and convergent anteriorly, slightly convergent also towards the strongly rounded posterior angles, anterior angles sharp and distinctly produced; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals narrower and slightly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura only sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.84. Pygidium apically strongly convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with numerous long setae on apex, otherwise with minute setae in punctures.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.9, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 3A–C. Female unknown.

Diagnosis. *Neoserica jiangxiensis* is very similar to *N. euyunnanica* externally and in the general shape of male genitalia. It differs by the left paramere being deeply subdivided into three lobes, the dorsal one is more than half as long as the median one and has a strong hook directed ventrally; the dorsal lobe of the right paramere is slightly shorter and basally narrower than in *N. euyunnanica*.

Variation. Body length: 13.5–14.0 mm, length of elytra: 10.0–10.5 mm, width: 8.0–8.2 mm.

Etymology. The new species is named "*jiangxiensis*" according to its occurrence in Jiangxi (China).

Neoserica (s. l.) *kanphantensis* sp. n.

http://zoobank.org/B98BCC41-9654-4E6C-834E-1A2E69F84703
Figs 3E–H, 8

Type material examined. Holotype ♂ "Myanmar (Burma), Province Kachin State Kanphant/ Grenze to China, 29–30.05.2006, N26°08'51.2', E098°34'58.2"

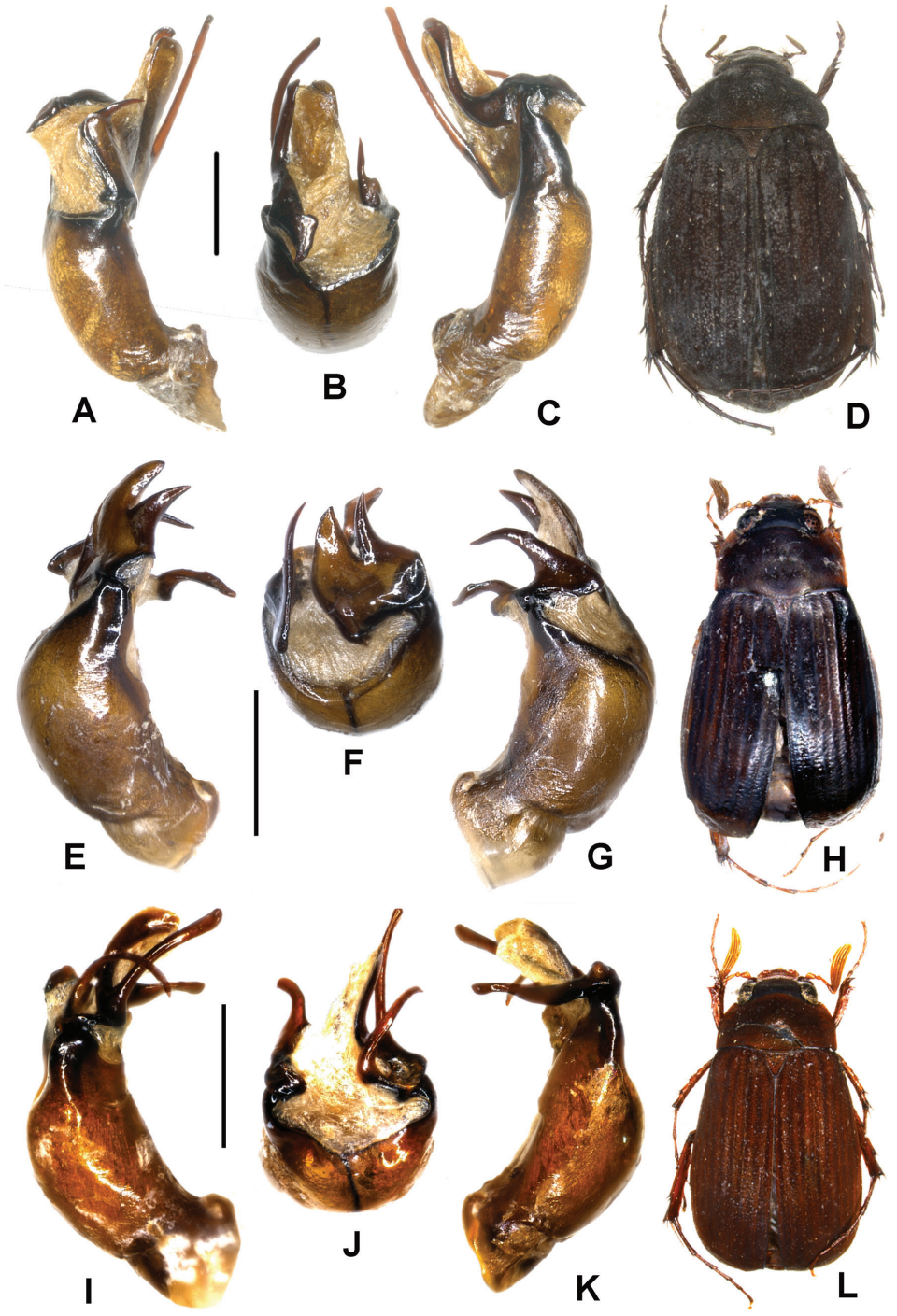

Figure 3. A–D: *Neoserica jiangxiensis* sp. n. (holotype) **E–H** *N. kanphantensis* sp. n. (holotype) **I–L** *N. trifida* sp. n. (holotype) **A, E, I** Aedeagus, left side lateral view **C, G, K** Aedeagus, right side lateral view **B, F, J** parameres, dorsal view **D, H, L** Habitus. Scale: 1 mm. Habitus not to scale.

Nachtfang Leg. M. Langer, S. Naumann, & S. Loeffler/ Coll. M. Langer" (ZFMK). Paratypes. 1 ♂ "Myanmar (Burma), Province Kachin State Kanphant/ Grenze to China, 29–30.05.2006, N26°08'51.2', E098°34'58.2" Nachtfang Leg. M. Langer, S. Naumann, & S. Loeffler/ Coll. M. Langer" (ZFMK), 1 ♂ "Myanmar (Burma), Kachin State, Hpiman; 21.–23.V.2002; leg. A. Azuma" (ZFMK), 1 ♂ "[China] Yunnan, Pianma, 2011-V-10, N: 26.018 E: 98.625, 1970m" (IZAS).

Description. Body length: 11 mm, length of elytra: 7.6 mm, width: 5.2 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, nearly glabrous.

Labroclypeus subtrapezoidal, little wider than long, widest at base, lateral margins weakly convex and convergent anteriorly, anterior angles weakly rounded, anterior margin weakly sinuate medially, margins strongly reflexed; surface flat and shiny, basis without dull toment, punctation dense, behind the anterior margin with coarser punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately twice as wide as long; ocular canthus long and slender, glabrous, with a few minute and superficial punctures, with a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes and behind the frontoclypeal suture with a few erect setae. Eyes large, ratio diameter/interocular width: 0.69. Antenna with ten antennomeres, club with six antennomeres, moderately reflexed, twice as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 strongly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum weakly produced medially, with a moderate median sinuation.

Pronotum transverse, subrectangular, widest at base, lateral margins in basal half straight and nearly subparallel, evenly convex and strongly convergent in anterior half, anterior angles sharp and strongly produced, posterior angles right-angled, slightly rounded at the tip; anterior margin strongly convexly produced medially, marginal line incomplete medially; surface densely and finely punctate, with minute setae in punctures; setae of lateral border nearly absent; hypomeron basally distinctly carinate, but carina not produced. Scutellum moderately wide and short, with fine, moderately dense punctures, smooth on basal midline, with only minute setae.

Elytra oblong, widest shortly behind middle, striae weakly impressed, finely and moderately densely punctate, intervals weakly convex with punctures concentrated along the striae, odd intervals with a few fine, white, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura densely setose, apical border narrowly membraneous, with a fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and unevenly and not densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/meta-

coxa: 1/1.47. Pygidium weakly convex and dull, finely and densely punctate, without a smooth midline, with a few longer setae on posterior half.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, punctures and setae of anterior longitudinal row completely reduced, posterior margin in apical half ventrally smooth and not widened but slightly serrate in apical quarter, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/4.3, sharply carinate dorsally, with two groups of spines, basal group at one third, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length, but not very distinct; ventral edge finely serrated, with three robust setae of which the two distal ones are widely separated; medial face smooth, apex moderately distinctly concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few fine punctures; metatarsomeres with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere distinctly longer than following two tarsomeres combined and distinctly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 3E–G. Female unknown.

Diagnosis. The new species is in external morphology rather similar to *N. trifida*. It differs (as from all other species of the *N. abnormis* group) in the flattened and bifid left paramere (lateral view).

Variation. Body length: 10.4–11.0 mm, length of elytra: 7.6–8.2 mm, width: 5.2–5.6 mm.

Etymology. The new species is named after its type locality, Kanphant.

***Neoserica* (s. l.) *trifida* sp. n.**
http://zoobank.org/59A8C716-2B48-4A23-A8D1-D6FA7F1DD621
Figs 3I–L, 9

Type material examined. Holotype: ♂ "China, Yunnan prov.; Gaoligongshan mts.; 90km W of Baoshan; S. Bečvář leg.; 26–29.v.1995/ Coll. P. Pacholátko Invt. No." (CPPB). Paratypes: 5 ♂♂ "China, Yunnan prov.; Gaoligongshan mts.; 90km W of Baoshan; S. Bečvář leg.; 26–29.v.1995/ Coll. P. Pacholátko Invt. No." (ZFMK), 32 ♂♂ "China, W Yunnan prov., mts. 60Km E Tengchong, 2300m 14.–19.v.2006, S. Murzin & I. Shokhin leg." (CP, ZFMK).

Description. Body length: 10.7 mm, length of elytra: 7.8 mm, width: 6.1 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, nearly glabrous.

Labroclypeus subrectangular, little wider than long, widest at base, lateral margins straight and weakly convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins strongly reflexed; surface flat and shiny, basis with dull toment, punctation dense, behind the anterior margin with coarser punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately twice as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a few minute and superficial punctures, with a long terminal seta. Frons dull, in posterior half weakly shiny, with fine and sparse punctures, beside the eyes and behind the frontoclypeal suture with a few erect setae. Eyes large, ratio diameter/interocular width: 0.75. Antenna with ten antennomeres, club with six antennomeres, strongly reflexed, twice as long as remaining antennomeres combined; antennomere 5 subequal to half of length of club, antennomere 4 strongly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum weakly produced medially, with a moderate median sinuation.

Pronotum transverse, subrectangular, widest at base, lateral margins in basal half straight and nearly subparallel, evenly convex and strongly convergent in anterior half, anterior angles moderately sharp and moderately produced, posterior angles blunt, slightly rounded at the tip; anterior margin strongly convexly produced medially, with a medially incomplete marginal line; surface densely and finely punctate, with minute setae in punctures; setae of lateral border fine and sparse; hypomeron basally distinctly carinate, but carina not produced. Scutellum moderately wide and long, with fine, moderately dense punctures, smooth on basal midline, with only minute setae.

Elytra oblong, widest in posterior third, striae weakly impressed, finely and moderately densely punctate, intervals weakly convex with punctures concentrated along the striae, odd intervals with a few fine, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura densely setose, apical border narrowly membraneous, with a fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and unevenly and not densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.4. Pygidium weakly convex and dull, finely and densely punctate, without a smooth midline, with a few longer setae on posterior half.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, punctures and setae of anterior longitudinal row completely reduced, posterior margin in apical half ventrally smooth and not widened but slightly serrate in apical quarter, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/5.1, sharply carinate dorsally, with two groups of spines, basal group just be-

fore the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length, but not very distinct; ventral edge finely serrated, with three robust setae of which the two distal ones are widely separated; medial face smooth, apex moderately distinctly concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few fine punctures; metatarsomeres with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 3I–K. Female unknown.

Diagnosis. The new species differs from all other species of the *N. abnormis* group by the convexly produced anterior margin of pronotum, the lacking scale-like setae on elytra and the serrate ventral posterior margin of metafemur.

Variation. Body length: 10.5–10.7 mm, length of elytra: 7.5–7.8 mm, width: 5.9–6.1 mm.

Etymology. The new species is named "*trifida*" with reference to its trifid left paramere.

Neoserica (s. l.) *yingjiangensis* sp. n.

http://zoobank.org/41EFFEC9-1266-4FBE-89EA-4FE0FAF56744
Figs 4A–D, 9

Type material examined. Holotype: ♂ "Yingjiang, Yunnan, 13.IV.1980, 1300m, leg. Li Hongxing" (IZAS). Paratypes: 1 ♂ "Yingjiang, Yunnan, 13.IV.1980, 1700m, leg. Gao Ping" (ZFMK), 1 ♂ "Yingjiang, Yunnan, 13.IV.1980, 300m, leg. Song Shimei" (IZAS).

Description. Body length: 10.5 mm, length of elytra: 7.5 mm, width: 4.9 mm. Body oblong and slender, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, nearly glabrous.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins straight and moderately convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins strongly reflexed; surface flat and shiny, basis with dull toment, punctation dense, behind anterior margin with a transversal row of coarser punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately twice as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a few minute and superficial punctures and a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes large, ratio diameter/interocular width: 0.92. Antenna with ten antennomeres, club with six antennomeres, strongly reflexed, twice as long as remaining anten-

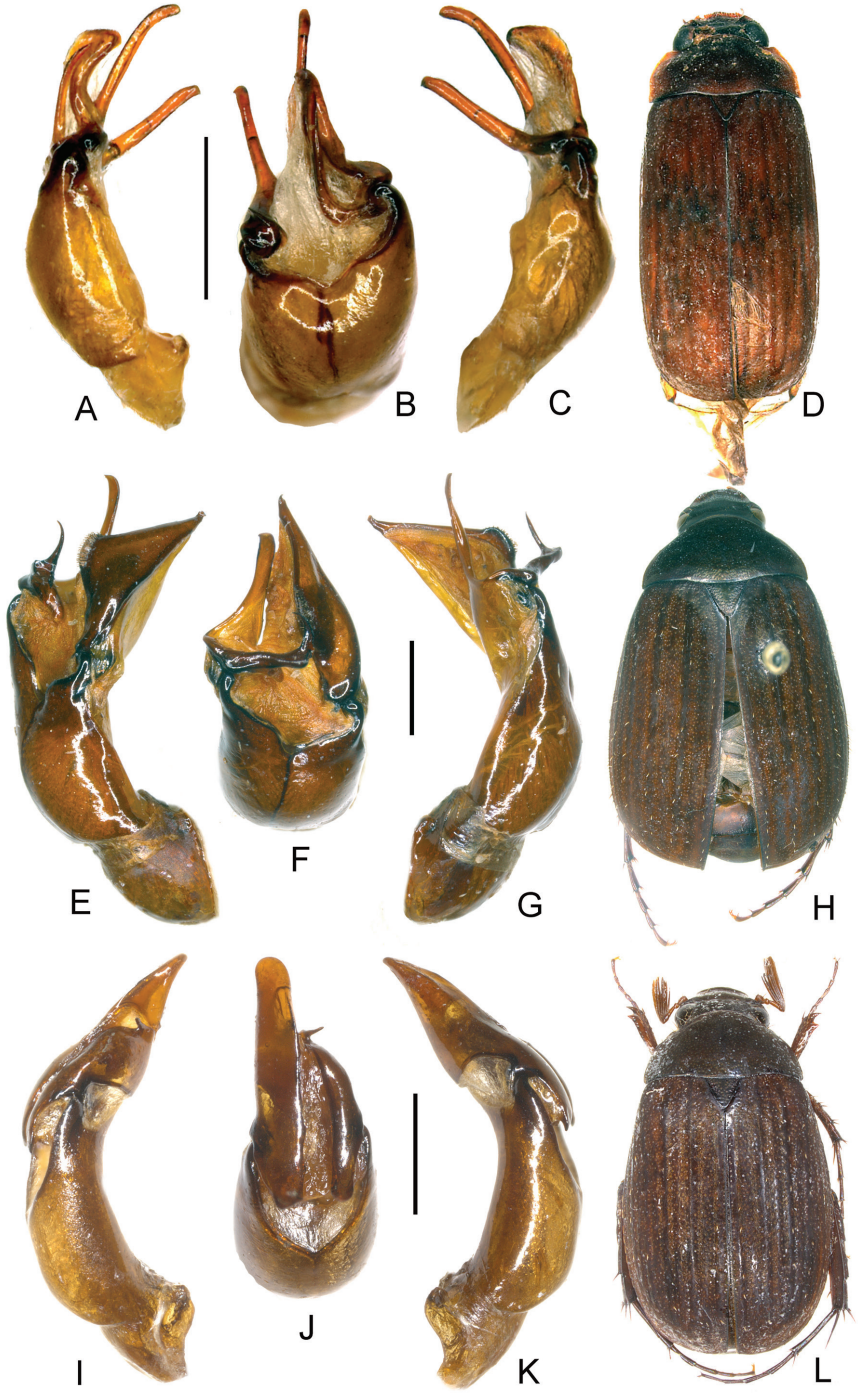

Figure 4. A–D *Neoserica yingjiangensis* sp. n. (holotype) **E–H** *N. thailandensis* sp. n. (holotype) **I–L** *N. lamellosa* sp. n. (holotype) **A, E, I** Aedeagus, left side lateral view **C, G, K** Aedeagus, right side lateral view **B, F, J** parameres, dorsal view **D, H, L** Habitus. Scale: 1 mm. Habitus not to scale.

nomeres combined; antennomere 5 subequal to length of club, antennomere 4 strongly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum weakly produced medially, with a moderate median sinuation.

Pronotum transverse, subrectangular, widest at base, lateral margins in basal half straight and nearly subparallel and slightly concavely sinuate, evenly convex and strongly convergent in anterior half, anterior angles sharp and distinctly produced, posterior angles right-angled, slightly rounded at the tip; anterior margin strongly convexly produced medially, with a medially incomplete marginal line; surface densely and finely punctate, with minute setae in punctures; setae of lateral border fine and sparse; hypomeron basally distinctly carinate, but carina not produced. Scutellum moderately wide and long, with fine, moderately dense punctures, smooth on basal midline, with only minute setae.

Elytra oblong and very slender, widest just before posterior third, striae weakly impressed, finely and moderately densely punctate, intervals weakly convex with punctures concentrated along the striae, odd intervals with a few fine, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura densely setose, apical border narrowly membraneous, with a fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and unevenly and not densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.38. Pygidium weakly convex and dull, finely and densely punctate, without a smooth midline, with a few longer setae on posterior half.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, punctures and setae of anterior longitudinal row completely reduced, posterior margin in apical half ventrally smooth and not widened but slightly serrate in apical quarter, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/4.7, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length, but nearly longitudinally convex and very indistinct; ventral edge finely serrated, with three robust setae of which the two distal ones are widely separated; medial face smooth, apex moderately distinctly concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few fine punctures; metatarsomeres with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 4A–C. Female unknown.

Diagnosis. The new species differs from *N. trifida* in the more slender body, the straight dorsal lobe of the left paramere, the slightly shorter median lobe, as well as the larger eyes.

Variation. Body length: 10.5–11.0 mm, length of elytra: 7.5–7.9 mm, width: 4.9–5.0 mm.

Etymology. The new species is named after its type locality, Yingjiang.

***Neoserica* (s. l.) *thailandensis* sp. n.**

http://zoobank.org/8B12B98E-0A20-4256-9136-74802A14F362

Figs 4E–H, 8

Type material examined. Holotype: ♂ "N-Thailand 25.-29.5.1990 Doi Inthanon leg. Malicky" (ZSMC). Paratype. 1 ♂ "N-Thailand 27.III.1990 Doi Inthang [sic, = Doi Inthanon] lg. Malicky" (ZFMK), 1 ♂ "N. Thailand Doi Pui, near Chiang Mai; 09.V.1985; leg. H. Nara" (ZFMK).

Description. Body length: 14.5 mm, length of elytra: 10.7 mm, width: 8.3 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins weakly convex and strongly convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.48. Antenna with ten antennomeres, club with six antennomeres, straight, as long as remaining antennomeres combined; antennomere 5 subequal to half of length of club, antennomere 4 strongly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and moderately convergent anteriorly, in anterior half more strongly convergent, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately wide and long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, smooth along the middle, with only minute setae.

Elytra oblong, apex slightly truncate and slightly concavely sinuated before the apical angle, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals slightly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border narrowly membraneous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.54. Pygidium weakly convex and dull, coarsely and densely punctate, with a very narrow smooth midline, with a few longer setae on sides and along the apical margin, otherwise only with minute setae in punctures.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row with very sparse and short setae only, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and moderately long, widest at apex, ratio of width/length: 1/4.0, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 4E–G. Female unknown.

Diagnosis. *Neoserica thailandensis* sp. n. differs from all other species of the *N. abnormis* group by the apex of elytra being slightly concave before the apical angle; furthermore, it differs in shape of parameres: the left paramere is triangular and robust not being subdivided in lobes.

Variation. Body length: 12.9–14.5 mm, length of elytra: 9.9–10.7 mm, width: 7.8–8.3 mm.

Etymology. The new species is named "*thailandensis*" with reference to its occurrence in Thailand.

***Neoserica* (s. l.) *lamellosa* sp. n.**
http://zoobank.org/B7AD7304-5B7B-477C-866F-09FD51EB5391
Figs 4I–L, 9

Type material examined. Holotype: ♂ "N-Vietnam Tam Dao, Vinh Phu Prov. 21°27'18"N, 105°38'58"E 1050–1200m 2.–6.VI.1999 leg. Fabrizi, Jäger, Ahrens" (ZFMK). Paratypes: 1 ♀ "N-Vietnam Tam Dao, Vinh Phu Prov. 21°27'18"N, 105°38'58"E 1050–1200m 2.–6.VI.1999 leg. Fabrizi, Jäger, Ahrens" (ZFMK), 1 ♂ "Vietnam N. 15.5.–16.6. 75 km NW from Hanoi Tam Dao E. Jendek leg." (CA), 1 ♂ "N. Vietnam/ Tonkin/ Tamdao/ pr. Vinhphu/ 2.–11.6.1985 Vit Kubáň leg./ VS 50" (CPPB).

Description. Body length: 10.6 mm, length of elytra: 7.8 mm, width: 6.1 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subrectangular, distinctly wider than long, widest at base, lateral margins nearly straight and weakly convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface convexly elevated at middle and shiny, basis with dull toment, punctation moderately dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and long (length = 1/3 of ocular diameter), glabrous, with a fine terminal seta. Frons dull, with fine and dense punctures, beside the eyes a with a few erect setae. Eyes small, ratio diameter/interocular width: 0.48. Antenna with ten antennomeres, club with seven antennomeres, straight, nearly twice as long as remaining antennomeres combined; antennomere 5 equal to length of club, antennomere 4 subequal to three quarter of length of club, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, strongly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura densely setose, apical border chitinous, with nearly invisible fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.77. Pygidium weakly convex and dull, densely punctate, fine punctures mixed with coarser ones, with a narrow smooth midline, nearly glabrous, only with minute setae in punctures.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia moderately slender and long, widest at apex, ratio of width/length: 1/3.7, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 4I–K.

Diagnosis. *Neoserica lamellosa* sp. n. differs from *N. cardamomensis* and *N. namthaensis* in the slightly longer antennal club and the shape of parameres being not subdivided into separate lobes but being robust and compact.

Variation. Body length: 10.25–13.6 mm, length of elytra: 7.8–9.6 mm, width: 6.1–7.1 mm. Female: Antennal club composed of four antennomeres, as long as remaining antennomeres combined; pygidium less convex.

Etymology. The new species is named "*lamellosa*" with reference to its antennal club in males composed of many (seven) lamellae.

Neoserica (s. l.) *putaoana* sp. n.

http://zoobank.org/37411B0C-A144-46DA-937E-EC3154D61F05
Figs 5A–D, 8

Type material examined. Holotype: ♂ "Myanmar N (Burma) 25km E Putao, H-800m Nan Sa Bon vill. 06–09.05.1998 leg. S. Murzin & V. Siniaev/ Coll. Takeshi Itoh Osaka (Japan)" (ZFMK). Paratype: 1 ♀ "Myanmar N (Burma) 25km E Putao,

H-800m Nan Sa Bon vill. 06–09.05.1998 leg. S. Murzin & V. Siniaev/ Coll. Takeshi Itoh Osaka (Japan)" (ZFMK).

Description. Body length: 13.5 mm, length of elytra: 10.0 mm, width: 8.3 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.5. Antenna with ten antennomeres, club with six antennomeres, straight, only slightly longer than the remaining antennomeres combined; antennomere 5 subequal to two thirds of length of club, antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins straight in the basal half and slightly weakly convergent anteriorly, convex and strongly convergent in anterior half, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum wide and moderately long, triangular with nearly straight sides, apex slightly rounded, with fine, moderately dense punctures, basally smooth at middle, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals slightly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border narrowly membraneous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.73. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few semi-erect setae basally on sides and along the apical margin.

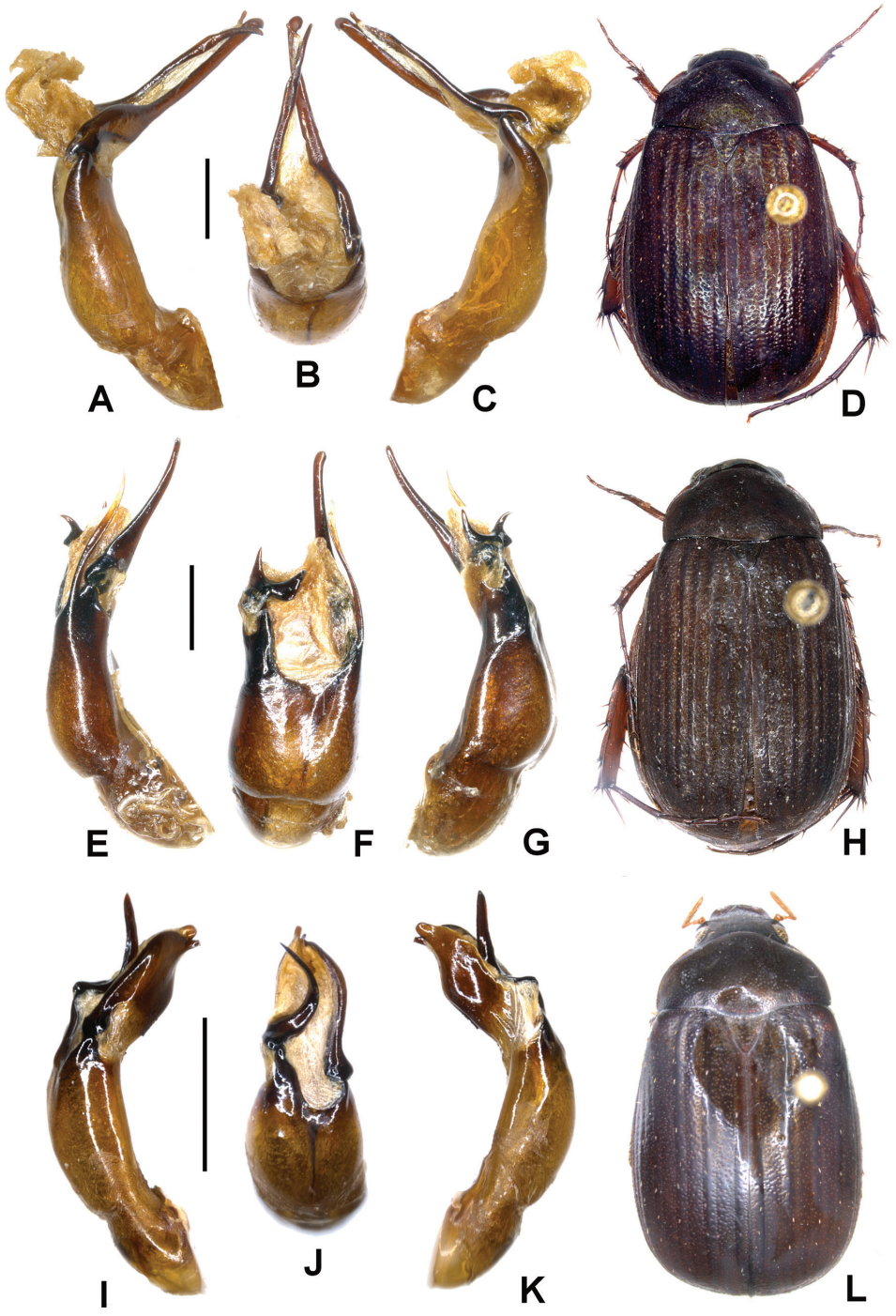

Figure 5. A–D *Neoserica putaoana* sp. n. (holotype) **E–H** *N. alloputaoana* sp. n. (holotype) **I–L** *N. simplicissima* sp. n. (holotype) **A, E, I** Aedeagus, left side lateral view **C, G, K** Aedeagus, right side lateral view **B, F, J** parameres, dorsal view **D, H, L** Habitus. Scale: 1 mm. Habitus not to scale.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and moderately long, widest at apex, ratio of width/length: 1/3.4, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 5A–D.

Diagnosis. *Neoserica putaoana* sp. n. differs from *N. abnormis* and related species by the narrow, long and slender parameres.

Variation. Female: Club with four antennomeres, 6th antennomere distinctly transverse but much shorter than the club.

Etymology. The new species is named according its type locality Putao.

***Neoserica* (s. l.) *alloputaoana* sp. n.**
http://zoobank.org/A496E9B8-2781-48B3-B57A-49736BA3499D
Figs 5E–H, 9

Type material examined. Holotype: ♂ "Myanmar N (Burma) 25km E Putao, H-800m Nan Sa Bon vill. 06–09.05.1998 leg. S. Murzin & V. Siniaev" (ZFMK). Paratypes: 1 ♀ "Myanmar N (Burma) 25km E Putao, H-800m Nan Sa Bon vill. 06-09.05.1998 leg. S. Murzin & V. Siniaev" (ZFMK), 4 ♂♂ "Myanmar N (Burma) 65 km NE Putao, 1250 m Zi Yar Dam vill. 18/21.05.1998 leg. S. Murzin & V. Sinaev" (ZFMK).

Description. Body length: 13.0 mm, length of elytra: 9.9 mm, width: 7.7 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; fron-

toclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.64. Antenna with ten antennomeres, club with six antennomeres, straight, only slightly longer than the remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 strongly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and moderately convergent anteriorly, in anterior half more strongly convergent, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately wide and long, triangular with nearly straight sides, apex slightly rounded, with fine, moderately dense punctures, smooth along the middle, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals slightly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border narrowly membraneous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.67. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few short setae on sides and along the apical margin.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and moderately long, widest at apex, ratio of width/length: 1/3.9, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex

moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 5E–G.

Diagnosis. *Neoserica alloputaoana* sp. n. differs from *N. putaoana* by the extremely short right paramere and the long lateral process of the right apical phallobase.

Variation. Female: antennal club with four antennomeres, 6th antennomere distinctly transverse but distinctly shorter than club.

Etymology. The name of the new species is composed of the Greek prefix allo- and "*putaoana*" underlining it distinctiveness from the syntopically co-occurring *N. putaoana*.

***Neoserica* (s. l.) *simplicissima* sp. n.**
http://zoobank.org/347436CF-68CC-4DE0-895E-55D9726DBF29
Figs 5I–L, 9

Type material examined. Holotype ♂ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500-1900m, 17.5.-3.6.2007, leg. C. Holzschuh" (ZFMK). Paratypes: 2 ♂♂ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500-1900m, 17.5.-3.6.2007, leg. Vit Kubáň" (NMPC), 1 ♂, 1 ♀ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500-1900m, 17.5.-3.6.2007, leg. C. Holzschuh" (ZFMK).

Description. Body length: 12.2 mm, length of elytra: 8.8 mm, width: 7.3 mm. Body oblong, dark brown, antennal club brown, anterior labroclypeus shiny, dorsal surface dull, partially dull toment lost and moderately shiny, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with a transverse row of coarse punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a fine terminal seta. Frons dull, with fine and sparse punctures, beside eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.53. Antenna with ten antennomeres, club with six antennomeres, straight, as long as remaining antennomeres combined; antennomere 5 half as long as the club, antennomere 6 three quarters as long as club, antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and strongly convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, triangular with convex sides and with the apex slightly rounded, with fine, moderately dense punctures, with only minute setae.

Elytra oblong, widest shortly behind middle, striae weakly impressed, finely and moderately densely punctate, intervals nearly flat, with moderately dense evenly spaced, fine punctures, intervals with a few fine white setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.59. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few semi-erect setae beside the apical margin.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/4.0, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 5I–K.

Diagnosis. *N. simplicissima* differs from all species with an antennal club composed of six antennomeres and a non-elongate left paramere in the absence of the basal process of the right paramere.

Variation. Body length: 12.2–12.8 mm, length of elytra: 8.8–9.6 mm, width: 7.3–8.2 mm. Female: antennal club composed of fives antennomeres, slightly shorter than remaining antennomeres combined, 6th antennomere one third as long as club, 7th one slightly transversely produced.

Etymology. The new species is named "*simplicissima*" (Latin adjective, meaning "very simple") with reference to the lacking basal lobe of the right paramere.

***Neoserica* (s. l.) *abnormoides* sp. n.**
http://zoobank.org/5745F0AC-09CA-483C-9D54-B7CA159A0B18
Figs 6A–D, 8

Type material examined. Holotype: ♂ "N. Vietnam (Tonkin) Tamdao 12.-24.5.1989 Pacholátko Leg./ Coll. P. Pacholátko Invt. No./ VS 45" (CPPB). Paratype: 1 ♂ "Mt. Wuyanling, Zhejiang, 3.VIII.2007, light trap, leg. Zhu Weibing" (NKUT).

Description. Body length: 12.7 mm, length of elytra: 9.2 mm, width: 7.6 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, sparsely setose.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a long terminal seta. Frons dull, with fine and sparse punctures, beside the eyes with a few erect setae. Eyes small, ratio diameter/interocular width: 0.52. Antenna with ten antennomeres, club with six antennomeres, straight, only slightly longer than the remaining antennomeres combined; antennomere 5 subequal to two thirds of length of club , antennomere 4 slightly transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex, in the basal half only weakly convergent, strongly convergent in anterior half, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin nearly straight, with a distinct and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of anterior and lateral border sparse; hypomeron basally distinctly carinate, but

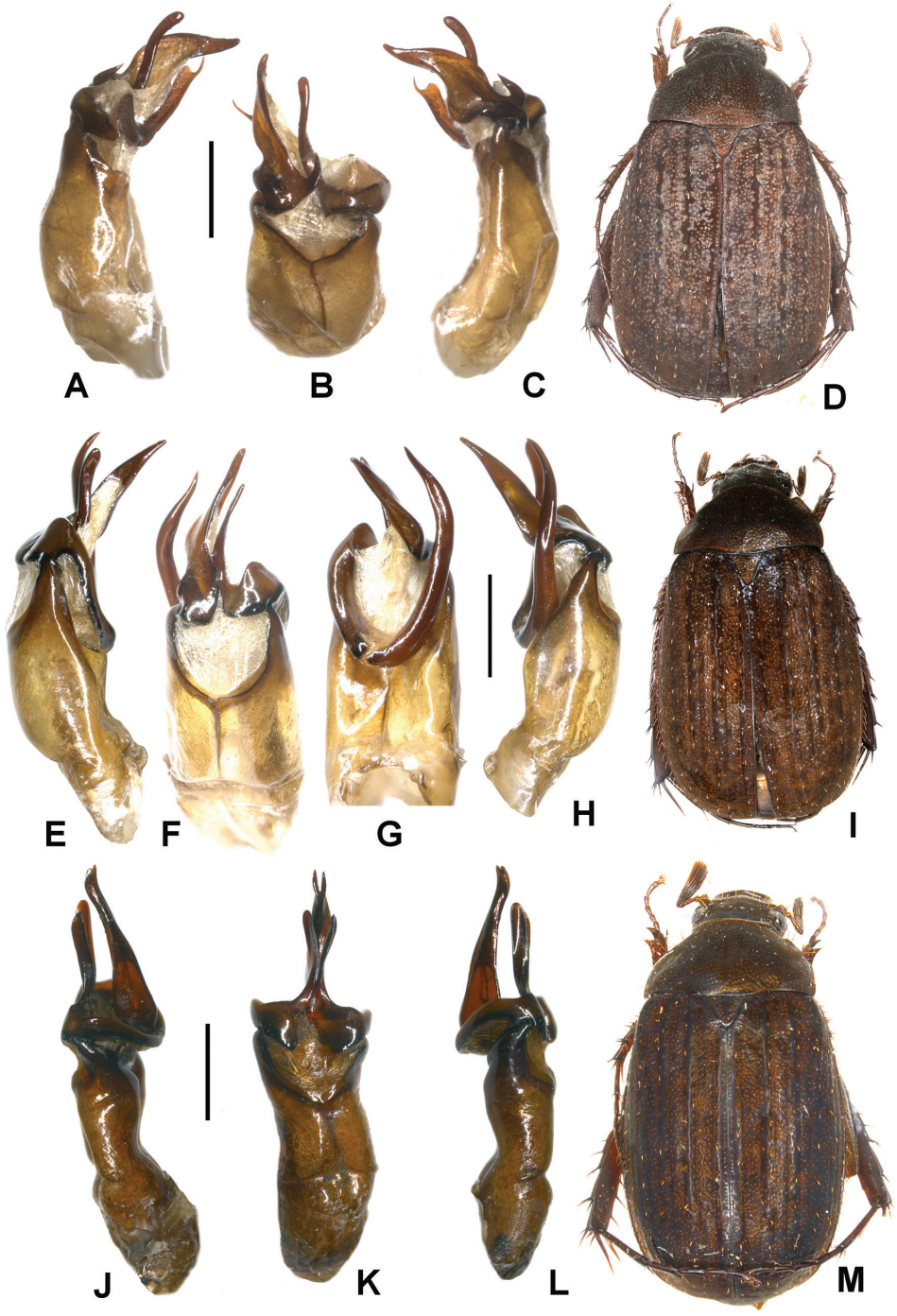

Figure 6. A–D *Neoserica abnormoides* sp. n. (holotype) **E–I** *N. cardamomensis* sp. n. (holotype) **J–M** *N. namthaensis* sp. n. (holotype) **A, E, J** Aedeagus, left side lateral view **C, H, L** Aedeagus, right side lateral view **B, F, K** parameres, dorsal view **G** aedeagus, ventral view **D, I, M** Habitus. Scale: 1 mm. Habitus not to scale.

carina only weakly produced. Scutellum wide and moderately long, triangular with nearly straight sides, apex slightly rounded, with fine, moderately dense punctures, with only minute setae.

Elytra oblong, apex slightly truncate, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals slightly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the blunt external apical angle of elytra, epipleura only sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.9. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, with a few semi-erect setae basally on sides, at apex with short, fine, very dense setae.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and moderately long, widest at apex, ratio of width/length: 1/3.3, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with four robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 6A–C.

Diagnosis. *Neoserica abnormoides* is in shape of aedeagus very similar to the next species, *N. cardamomensis*. It differs from this species by a small basal hook present at right paramere, and the ventral lobe of the left paramere being distinctly shorter and less strongly curved; the antennal club is composed in male only of six instead of seven antennomeres (as in *N. cardamomensis*).

Variation. Body length: 12.5–12.7 mm, length of elytra: 9.0–9.2 mm, width: 7.5–7.6 mm.

Etymology. The species is named with reference to the externally similar *N. abnormis*.

***Neoserica* (s. l.) *cardamomensis* sp. n.**
http://zoobank.org/8275FD66-7C1B-40CB-96BF-EA6C3F531FB3
Figs 6E–I, 9

Type material examined. Holotype: ♂ "Cambodia Cardamom Mts., Tumpor area, 12°22'N, 103°02'E, 1250m, Submontane forest, 27.ii-5.iii.2000, leg. M. Nuss" (SMTD). Paratypes: **Cambodia:** 1 ♂ Cambodia Cardamom Mts., Tumpor area, 12°22'N, 103°02'E, 1250m, Submontane forest, 27.ii-5.iii.2000, leg. M. Nuss" (ZFMK). **Thailand:** 1 ♂ "N-Thailand V.1990 Doi Inthanon lg. Malicky" (ZSMC), 1 ♂ "Thai 24–29.IV.1993 Doi Suithep Pacholátko & Dembicky leg./ TS73" (CPPB), 1 ♂ "Thai, 17–24.V.1991 Chiang Dao 1000m 19°25'N, 98°52'E Vit Kuban leg./ Thailand '91 "Thanon Thong Cha" D. Král & V. Kubáň" (ZFMK). **Laos:** 1 ♂ "Laos-NE Hua Phan prov., 20°12'N, 104°01'E, Phu Phan Mt., 1500–1900m, 17.5.–3.6.2007, leg. Vit Kuban" (ZFMK), 4 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"-104°00'03"E, 1480–1510m Phou Pane Mt., 22.4.–14.5.2008 Vit Kubáň leg. (NMPC, ZFMK), 2 ♂♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"-104°00'03"E, 1480–1510m Phou Pane Mt., 22.IV.–14.V.2008 Vit Kuban leg. (ZFMK), 1 ♂ "Laos-N, Louang Namtha circ., 04.05.1996 I. Pljushtch lg." (ZFMK), 1 ♂ "Laos-NE, Houa Phan prov., ~20°12–13.5'N, 103°59.5'–104°01'E, Ban Sauei - Phou Pane Mt., 10.–16.vi.2009, 1340–1870 m, M. Brancucci & local collectors leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 2 ♂♂ "Laos-NE, Houa Phan prov., ~20°12–13.5'N, 103°59.5'–104°01'E, Ban Sauei - Phou Pane Mt., 1340–1870 m, 15.iv-15.v.2008, Lao collectors leg." (NHMB), 1 ♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"–104°00'03"E, 1480–1550m Phou Pane Mt., 1.-16.vi.2009, Zdenek Kraus leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 1 ♂ "Laos-NE, Houa Phan prov., 20°11–13'N, 103°59'-104°01'E, Ban Sauei - Phou Pane Mt., 9.–17.vi.2009, 1300–1900 m, Michael Geiser leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 2 ♂♂ "Laos-NE, Xieng Khouang prov., 19°38.20'N, 103°20.20'E, Phonsavan (30 km NE); Phou Sane Mt., 1420 m, 10.–30.v.2009, D. Hauck leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 1 ♂ "Laos-NE, Houa Phan prov., 20°13'09–19"N, 103°59'54"–104°00'03"E, 1480–1550m Phou Pane Mt., 9.-16.vi.2009, David Hauck leg./ NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 2 ♂♂ "Laos-NE, Xieng Kh-

ouang prov., 19°38.20'N, 103°20.20'E, Phonsavan (30 km NE): Phou Sane Mt., 1420 m, 10.-30.v.2009, Z. Kraus leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 3 ♂♂ "Laos-NE, Xieng Khouang prov., 19°37–38'N, 103°20'E, 30 km NE Phonsavan: Ban Na Lam - Phou Sane Mt., 1300–1500 m, 10.-30.v.2009, M. Geiser leg. / NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň" (NHMB), 12 ♂♂, 2 ♀♀ "Laos, Attapeau prov.; Annam Highlands Mts Dong Amphan; NBCA, ca. 1160 m Nong Fa (crater lake) env., 15°05.9'N, 107°25.6'E St. Jakl lgt, 30.4.–6.5.2010" (ZFMK), 9 ♂♂, 4 ♀♀ "Laos, Attapeau prov.; Annam Highlands Mts. Dong Amphan NBCA, ca. 1160 m Nong Fa (crater lake) env., 15°05.9'N, 107°25.6'E Jiří Hájek leg. 30.iv.-6.v.2010" (NMPC). **China:** 3 ♂♂ "Mengla, Yunan, 21.IV.1982, leg. Jiang Shengqiao" (IZAS), 1 ♂, 2 ♀♀ "Caiyanghe, Pu'er, Yunnan, 28.VII.2007, leg. Ren Guodong, Hou Wenjun, Li Yalin"(HBUM), 1 ♂ "Mengla, Xishuangbanna, Yunnan, 4.IV.1982, leg. Wang Sumei, Zhou Jingruo" (NUYS), 1 ♂ "Mengla, Yunnan, 20.IV.1982, 670m, light trap, leg. Yu Peiyu" (IZAS).

Description. Body length: 12.0 mm, length of elytra: 9.6 mm, width: 7.6 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus slightly subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and moderately convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface convexly elevated at middle and shiny, basis with dull toment, punctation dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and long (length = 1/3 of ocular diameter), glabrous, with a fine terminal seta. Frons dull, with fine and dense punctures, beside the eyes a with a few erect setae. Eyes small, ratio diameter/interocular width: 0.48. Antenna with ten antennomeres, club with seven antennomeres, straight, 1.2 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 more than half as long as the club, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, strongly rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, impunctate along the middle, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura densely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.77. Pygidium moderately convex and dull, densely punctate, fine punctures mixed with coarser ones, without smooth midline, with a few setae beside apical margin.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.7, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 6E–H.

Diagnosis. *Neoserica cardamomensis* sp. n. differs from all other species of the *N. abnormis* group by an antennal club of males composed of seven antennomeres.

Variation. Body length: 11.4–14.1 mm, length of elytra: 8.5–10.5 mm, width: 6.1–7.6 mm. Female: Antennal club composed of five antennomeres, club as long as remaining antennomeres combined, 6th antennomere subequal three quarters of club length, 7th antennomere slightly transverse; disc of pygidium less convex than in male, only at apex strongly convex.

Etymology. The new species is named after the Cardamom Mountains (Cambodia) where its type locality is situated.

***Neoserica* (s. l.) *namthaensis* sp. n.**
http://zoobank.org/1782971E-9F1C-4855-AE23-71E9F5A6BCEE
Figs 6J–M, 8

Type material examined. Holotype: ♂ "Laos, 21°09'N, 101°19'E, Louangnamtha pr. Namtha-> MuangSing, 5.–31.v.1997, 900-1200m Vit Kubáň leg./ LS19" (CPPB).

Description. Body length: 11.8 mm, length of elytra: 8.2 mm, width: 6.5 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, opaque toment on elytra and pronotum less thick, with a light trace of shine, sparsely setose.

Labroclypeus subrectangular, distinctly wider than long, widest at base, lateral margins moderately convex and very little convergent anteriorly, anterior angles strongly rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface convexly elevated at middle and shiny, basis with dull toment, punctation moderately dense, anteriorly more sparse, behind the anterior margin with coarse punctures each bearing a long erect seta; frontoclypeal suture distinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately 1.5 times as wide as long; ocular canthus moderately wide and long (length = 1/3 of ocular diameter), glabrous, with a fine terminal seta. Frons dull, with fine and dense punctures, beside the eyes a with a few erect setae, otherwise with minute setae only. Eyes small, ratio diameter/interocular width: 0.5. Antenna with ten antennomeres, club with seven antennomeres, straight, 1.2 times as long as remaining antennomeres combined; antennomere 5 subequal to length of club, antennomere 4 0.7 times as long as the club, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins weakly convex and in basal half weakly convergent anteriorly, at middle more convex and in anterior half weakly convex and strongly convergent, anterior angles moderately sharp and distinctly produced, posterior angles blunt, moderately rounded at the tip; anterior margin nearly straight, with a fine and complete marginal line; surface densely and finely punctate with minute setae in punctures; setae of lateral border sparse; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum long, triangular with nearly straight sides, apex slightly rounded, with fine, dense punctures, impunctate along the middle, with only minute setae.

Elytra oblong, widest shortly behind the middle, striae weakly impressed, finely and moderately densely punctate, odd intervals distinctly convex with punctures concentrated along the striae, others evenly punctate and nearly flat, odd intervals with white scale-like, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, very narrow behind the middle, ending at the moderately rounded external apical angle of elytra, epipleura densely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum sparsely covered with setae on the disc, glabrous on sides; metacoxa glabrous, with a few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly dense-

ly punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.8. Pygidium moderately convex and dull, densely punctate, fine punctures mixed with coarser ones, with a narrow smooth midline, with a few longer setae on disc and beside the apical margin.

Legs moderately slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, setae of anterior longitudinal row nearly completely lacking, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia moderately slender and long, widest at apex, ratio of width/length: 1/3.2, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 6J–L.

Diagnosis. *Neoserica namthaensis* sp. n. differs from all other species (except the previous one) of the *Neoserica abnormis* group by having an antennal club in male composed of seven antennomeres. From *N. cardamomensis* it can be distinguished by the nearly symmetrical parameres.

Etymology. The new species is named according to its type locality in the environment of Namtha (Laos).

Neoserica (s. l.) *bairailingshanica* sp. n.

http://zoobank.org/6EB277CE-503A-46DE-9539-FCE098EDB267
Figs 7A–D, 9

Type material examined. Holotype: ♂ "China: N-Yunnan, Baiyungshan (Bai Railing Mts.) 2400m, Yong Ren, VII-2003 leg. Ying et al." (ZFMK).

Description. Body length: 11.7 mm, length of elytra: 8.1 mm, width: 6.6 mm. Body oblong, dark brown, antennal club yellowish brown, anterior labroclypeus shiny, dorsal surface dull, nearly glabrous.

Labroclypeus subrectangular, little wider than long, widest at base, lateral margins straight and weakly convergent anteriorly, anterior angles moderately rounded, anterior margin distinctly sinuate medially, margins strongly reflexed; surface flat

and shiny, basis with dull toment, punctation dense, behind the anterior margin with coarser punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately twice as wide as long; ocular canthus moderately long (length = 1/3 of ocular diameter) and slender, glabrous, with a few minute and superficial punctures, with a long terminal seta. Frons dull, in posterior half weakly shiny, with fine and sparse punctures, beside the eyes and behind the frontoclypeal suture with a few erect setae. Eyes large, ratio diameter/interocular width: 0.76. Antenna with ten antennomeres, club with six antennomeres, moderately reflexed, 1.5 times as long as remaining antennomeres combined; antennomere 5 subequal to half of length of club, antennomere 4 moderately transverse, antennomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum weakly produced medially, with a moderate median sinuation.

Pronotum transverse, subrectangular, widest just before base, lateral margins in basal half straight and nearly subparallel, slightly narrowed towards the base, evenly convex and strongly convergent in anterior half, anterior angles moderately sharp and moderately produced, posterior angles blunt, slightly rounded at the tip; anterior margin strongly convexly produced medially, with a medially incomplete marginal line; surface densely and finely punctate, with minute setae in punctures; setae of lateral border fine and sparse; hypomeron basally distinctly carinate, but carina not produced. Scutellum moderately wide and long, with fine, moderately dense punctures, smooth on basal midline, with only minute setae.

Elytra oblong, widest in posterior third, striae weakly impressed, finely and moderately densely punctate, intervals weakly convex with punctures concentrated along the striae, odd intervals with fine, adpressed setae, otherwise only with very minute setae in punctures; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura densely setose, apical border narrowly membraneous, with a fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, metasternum glabrous; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and unevenly and not densely punctuate, nearly glabrous, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.4. Pygidium weakly convex and dull, finely and densely punctate, without a smooth midline, with a few longer setae between the minute setae.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, punctures and setae of anterior longitudinal row completely reduced, posterior margin in apical half ventrally smooth and not widened and smooth in apical quarter, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/5.1, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust

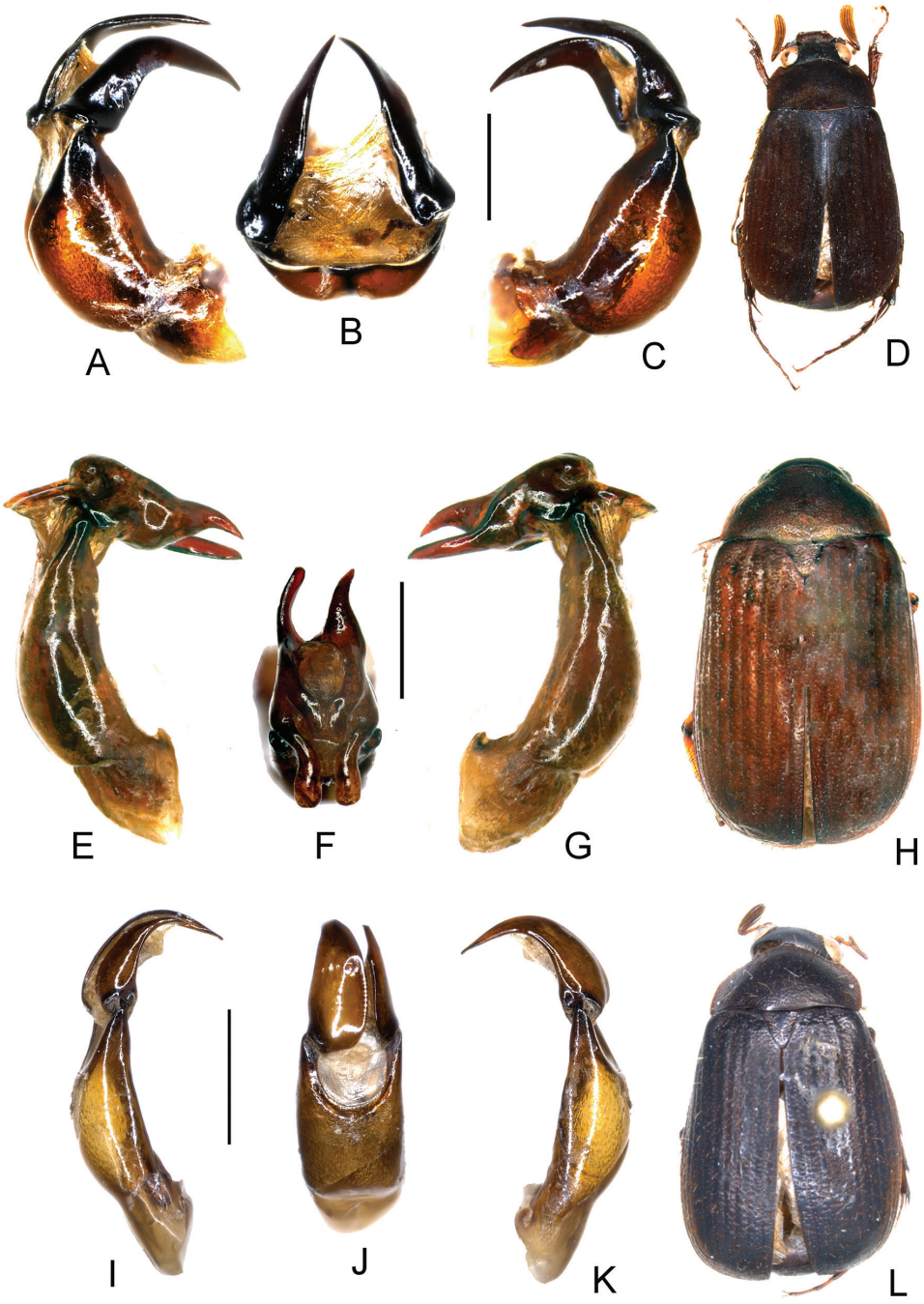

Figure 7. A–D *Neoserica bairailingshanica* sp. n. (holotype) **E–H** *N. huangi* sp. n. (holotype) **I–L** *natmatoungensis* sp. n. (holotype) **A, E, I** Aedeagus, left side lateral view **C, G, K** Aedeagus, right side lateral view **B, F, J** parameres, dorsal view **D, H, L** Habitus. Scale: 1 mm. Habitus not to scale.

but single setae; lateral face longitudinally convex, very finely, superficially and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length, but not very distinct; ventral edge finely serrated, with three robust setae of which the two distal ones are widely separated; medial face smooth, apex moderately distinctly concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with dense, fine punctures; metatarsomeres with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 7A–C. Female unknown.

Diagnosis. The new species differs from all other species of the *N. abnormis* group by the convexly produced anterior margin of pronotum and the lacking scale-like setae on elytra. From *N. trifida* it differs by the smooth ventral posterior margin of metafemur, by the slightly shorter antennal club of male, and of course by shape of parameres being simple and not subdivided into separate lobes.

Etymology. The new species is named according to its occurrence in the Bai Railing Shan.

***Neoserica* (s. l.) *huangi* sp. n.**

http://zoobank.org/9E196146-26B7-45C5-ABA7-24BBABCAC294

Figs 7E–H, 9

Type material examined. Holotype ♂ [China] "Dongqiong, Chayu, Xizang, 16.VII.1973, 1850–2500m, leg. Huang Fusheng" (IZAS).

Description. Body length: 11.8 mm, length of elytra: 8.8 mm, width: 6.8 mm. Body oblong, dark brown, antennal club brown, anterior labroclypeus shiny, dorsal surface dull, densely covered with minute erect setae.

Labroclypeus subtrapezoidal, distinctly wider than long, widest at base, lateral margins moderately convex and convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins moderately reflexed; surface nearly flat and shiny, basis with dull toment, punctation moderately dense and superficial, punctures each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye nearly as wide as long; ocular canthus short (length =1/4 of ocular diameter) and wide, densely and minutely setose. Frons dull, with fine and dense but superficial punctures each bearing a short to minute seta, beside eyes and behind the frontoclypeal suture with a few longer erect setae. Eyes small, ratio diameter/interocular width: 0.46. Antenna with ten antennomeres, club with six antennomeres, straight, as long as remaining antennomeres combined; antennomere 5 two thirds as long as the club, antennomere 4 slightly transverse, anten-

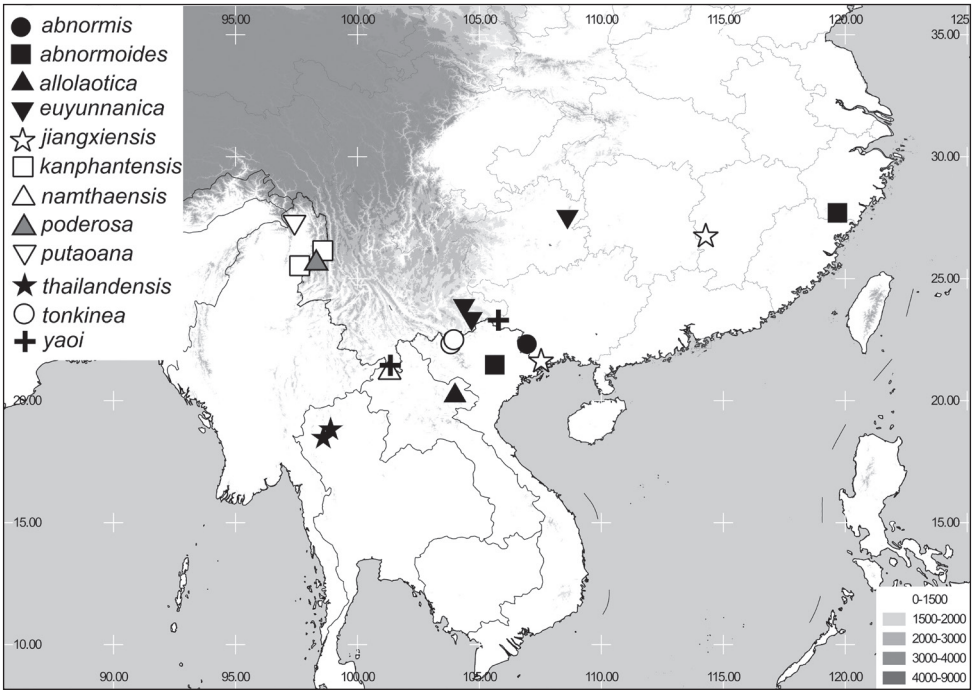

Figure 8. Distribution of the species of the *Neoserica* (s. l.) *abnormis* group: *N. abnormis*, *N. abnormoides*, *N. allolaotica*, *N. euyunnanica*, *N. jiangxiensis*, *N. kanphantensis*, *N. namthaensis*, *N. ponderosa, N. putaoana*, *N. thailandensis*, *N. tonkinea*, *N. yaoi*.

nomere 3 half as long as pedicellus. Mentum elevated and slightly flattened anteriorly. Labrum distinctly produced medially, with a moderate median sinuation.

Pronotum moderately transverse, subtrapezoidal, widest at base, lateral margins evenly convex and strongly convergent anteriorly, anterior angles sharp and distinctly produced, posterior angles blunt, slightly rounded at the tip; anterior margin weakly convex medially, marginal line widely interrupted medially; surface densely and finely punctate, with short to minute erect setae in punctures; setae of anterior and lateral border absent; hypomeron basally distinctly carinate, but carina only weakly produced. Scutellum moderately long, subtriangular, with fine, moderately dense punctures, impunctate on basal midline, with minute erect setae in punctures.

Elytra oblong, widest at posterior third, striae finely impressed, finely and moderately densely punctate, intervals nearly flat, with moderately dense evenly spaced, fine punctures each bearing a short fine erect setae, odd intervals with a few fine longer setae; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura sparsely setose, apical border chitinous, with only a very fine fringe of microtrichomes (visible at 100× magnification).

Ventral surface dull, coarsely and densely punctate, densely covered with short setae ; metacoxa glabrous, with a very few short setae laterally, posterior margin weakly convex; abdominal sternites finely and unevenly densely punctuate, densely and finely

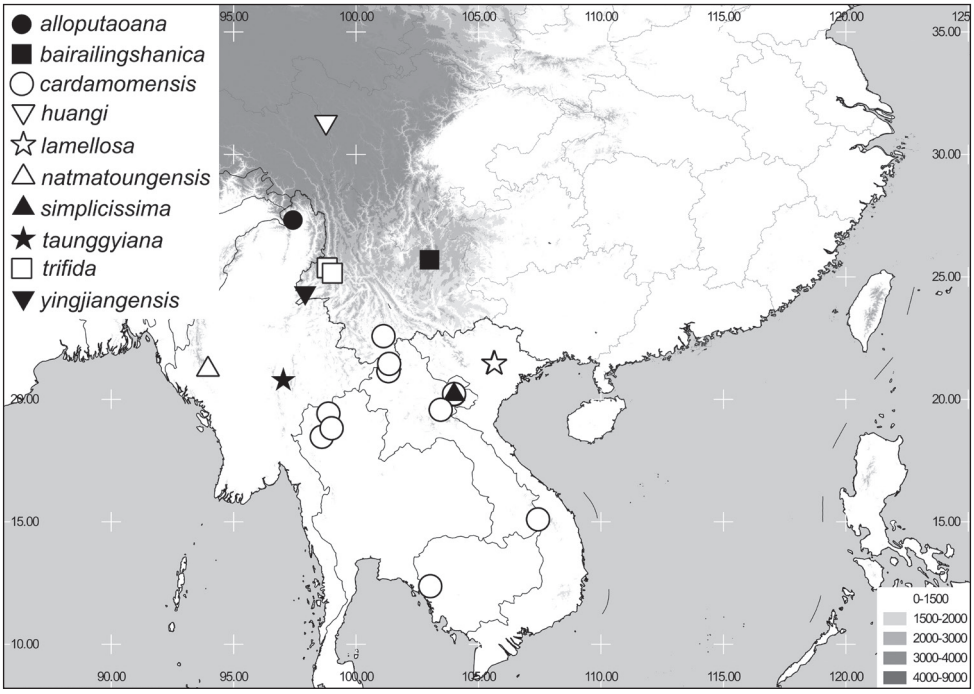

Figure 9. Distribution of the species of the *Neoserica* (s. l.) *abnormis* group: *N. alloputaoana*, *N. bairailingshanica*, *N. cardamomensis*, *N. huangi*, *N. lamellosa*, *N. natmatoungensis*, *N. simplicissima*, *N. taunggyiana*, *N. trifida*, *N. yingjiangensis*.

setose, with a transverse row of coarse punctures, each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.43. Pygidium weakly convex and dull, coarsely and densely punctate, without smooth midline, densely and finely setose, setae on apical half longer.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur dull, anterior margin acute, behind anterior edge without serrated line, anterior longitudinal row complete, posterior margin in apical half ventrally smooth and slightly widened, posterior margin dorsally distinctly serrated, on its basal portion with a few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/3.9, sharply carinate dorsally, with two groups of spines, basal group just before the middle, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, impunctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust equidistant setae; medial face smooth, apex moderately concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few very fine punctures; metatarsomeres ventrally glabrous, with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere slightly longer than following two tar-

someres combined and slightly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 7E–G. Female unknown.

Diagnosis. *Neoserica huangi* differs from all other species of the *N. abnormis* group in the minute to short, dense erect pilosity of the body, as well as the nearly subsymmetrical parameres (basal half).

Etymology. The new species is named after its collector, Huang Fusheng.

***Neoserica* (s. l.) *natmatoungensis* sp. n.**

http://zoobank.org/D790AEAF-BEAA-47FC-903E-F167983D4896

Figs 7I–L, 9

Type material examined. Holotype ♂ "Myanmar (Burma), Province Chin/ Chin Hills Umg. Kanpetlet Natmatoung N.P. (NF), 23.VI.2008 leg. Michael Langer/ E 093°57'N, 21°13' H= ca. 1500m" (ZFMK). Paratypes: 3 ♂♂ "Myanmar (Burma), Province Chin/ Chin Hills Umg. Kanpetlet Natmatoung N.P. (NF), 23.VI.2008 leg. Michael Langer/ E 093°57'N, 21°13' H= ca. 1500m" (ZFMK).

Description. Body length: 11 mm, length of elytra: 7.6 mm, width: 5.2 mm. Body oblong, dark brown, ventral surface and antennal yellowish brown, anterior labroclypeus shiny, dorsal surface moderately shiny, frons dull, with numerous long, yellow, semi-erect setae.

Labroclypeus subtrapezoidal, little wider than long, widest at base, lateral margins weakly convex and convergent anteriorly, anterior angles moderately rounded, anterior margin weakly sinuate medially, margins strongly reflexed; surface flat and shiny, basis without dull toment, finely and densely punctate, with numerous coarser punctures interspersed each bearing a long erect seta; frontoclypeal suture indistinctly incised, flat and distinctly curved medially; smooth area anterior to eye approximately twice as wide as long; ocular canthus long and slender, impunctate and glabrous, with a long terminal seta. Frons dull, finely and densely punctate, with numerous coarser punctures interspersed each bearing a long erect seta. Eyes moderately large, ratio diameter/interocular width: 0.69. Antenna with ten antennomeres, club with five antennomeres, straight, as long as remaining antennomeres combined; antennomere 6 subequal to two thirds of length of club, antennomere 5 transverse. Mentum elevated and slightly flattened anteriorly. Labrum weakly produced medially, with a moderate median sinuation.

Pronotum transverse, subrectangular, widest just before base, lateral margins evenly convex and strongly convergent towards sharp and moderately produced anterior angles, posterior angles blunt, rounded at the tip; anterior margin strongly convexly produced medially, marginal line robust and complete medially; surface densely and finely punctate, with coarse punctures irregularly interspersed each bearing a long semi-erect seta, fine punctures minutely setose; setae of lateral and anterior border dense; hypomeron basally distinctly carinate, but carina not produced. Scutellum

moderately wide and short, with fine, dense punctures, widely smooth on basal midline, with only minute setae.

Elytra oblong, widest at middle, striae weakly impressed, finely and moderately densely punctate, intervals weakly convex with fine and moderately dense punctures concentrated along striae, all intervals with sparse semi-erect long setae, otherwise punctures only with very minute setae; epipleural edge fine, ending at the blunt external apical angle of elytra, epipleura densely setose, apical border chitinous, without fringe of microtrichomes (visible at 100× magnification).

Ventral surface shiny, coarsely densely punctate and finely setose; metacoxa glabrous, with a few short setae laterally, posterior margin straight; abdominal sternites finely and densely punctuate, with minute setae in punctures, each sternite with a transverse row of coarse punctures each bearing a robust short seta. Mesosternum between mesocoxae half as wide as slender mesofemur. Ratio of length of metepisternum/metacoxa: 1/1.47. Pygidium weakly convex and moderately shiny, coarsely and densely punctate, on basal portion also with finer punctures interspersed, without a smooth midline, with dense, long setae.

Legs slender; femora with two longitudinal rows of setae, finely and sparsely punctate between the rows; metafemur shiny, anterior margin acute, behind anterior edge without serrated line, punctures and setae of anterior longitudinal row complete, posterior margin in apical half ventrally smooth and neither widened nor serrate in apical quarter, posterior margin dorsally distinctly serrated, on its basal portion with a very few short setae. Metatibia slender and long, widest at apex, ratio of width/length: 1/4.3, sharply carinate dorsally, with two groups of spines, basal group at one third, apical group at three quarters of metatibial length, basally with a few robust but single setae; lateral face longitudinally convex, finely and sparsely punctate, subdorsal longitudinal carina on lateral face present on about two third of metatibial length; ventral edge finely serrated, with three robust setae of which the two distal ones are widely separated; medial face smooth, apex moderately distinctly concavely sinuate interiorly near tarsal articulation. Tarsomeres ventrally with sparse, short setae, laterally not carinate, protarsomeres smooth, meso- and metatarsomeres with a few fine punctures; metatarsomeres with a strongly serrated ridge ventrally and a sharp subventral carina immediately beside it, first metatarsomere as long as following two tarsomeres combined and distinctly longer than dorsal tibial spur. Protibia long, bidentate; anterior claws symmetrical, basal tooth of inner claw sharply truncate at apex.

Aedeagus: Fig. 7I–K. Female unknown.

Diagnosis. The new species differs from all other species of the *N. abnormis* group in the antennal club composed of five antennomeres, while it is entirely different from *Lepidoserica* by the strongly produced anterior angles of pronotum and the unproduced hypomeron.

Variation. Body length: 9.5–11 mm, length of elytra: 7.0–7.6 mm, width: 5.1–5.2 mm.

Etymology. The new species is named after its type locality, the Natmatoung National Park.

Neoserica (s. l.) *ponderosa* (Arrow, 1946), comb. n.

Fig. 8

Serica ponderosa Arrow, 1946: 11; Ahrens and Sabatinelli 1996: 209, 239; Ahrens 2012: 315.

Type material examined. Syntypes: 1 ♂ "N. E. Burma R. Malaise B. M. 1945-71/ N. E. Burma Kambaiti 7000 ft. 22/4/1934 R. Malaise/ Co-Type/ Serica ponderosa co-type Arrow" (BMNH), 1 ♂ "N. E. Burma R. Malaise B. M. 1945-71/ N. E. Burma Kambaiti 7000 ft. 22/6/1934 R. Malaise/ Co-Type/ Serica ponderosa co-type Arrow" (BMNH), 1 ♂ "N.E. Burma Kambaiti, 2000 m 29/5. 1934 Malaise/ Typus/ Serica ponderosa n.sp. Arrow/ 3136 E91/Naturhistoriska Riksmuseet Stockholm Loan no 559/94" (NHRS), 1 ♂ "N.E. Burma Kambaiti, 7000 ft. 4-8/6. 1934 R. Malaise/ Serica ponderosa co-type Arrow/ ponderosa Arrow/ 3137 E91/Naturhistoriska Riksmuseet Stockholm Loan no 560/94" (NHRS).

Remarks. The aedeagus of a syntype of *N. ponderosa* was illustrated by Ahrens and Sabatinelli (1996) [p. 239]. This species is known so far only from the type locality.

Uncertain taxonomic status

Neoserica (s. l.) *inclinata* Brenske, 1898

Neoserica inclinata Brenske, 1898: 371 [type locality: Cochinchina].

Type material examined. Lectotype: ♀ "56942/ inclinata Type Brsk/ Conchin Morsb./ inclinata Brsk.* Hinter-Ind." (ZMHB).

Remarks. The specimen preserved in the ZHMB is a female and not a male as stated by Brenske (1898). Unfortunately, its genitalia are strongly damaged, and therefore an assignment to *N. abnormis* or any of the other newly recognised species is not possible. This species very likely belongs to the *Neoserica abnormis* group as well.

Discussion

A number of *Neoserica* (s. l.) species that are treated herein resemble *N. abnormis* in external morphology. However, they do not share principal diagnostic features of *N. abnormis* and its closest allies (i.e. elytra with sparse, short, white, scale-like setae and small eyes). These taxa include *Neoserica huangi*, *N. trifida*, *N. yingjiangensis*, *N. bairailingshanica*, and *N. natmatoungensis*. Their systematic position could not be defined here in detail. They would fall in that group of taxa more or less (so far not further defined) widely related with the *Neoserica abnormis* group, but also with *Nepaloserica*, *Chrysoserica*, and *Neoserica barberi* group from India.

The same is valid for *Neoserica* (s. l.) *ponderosa* (Arrow) which quite likely does not belong to the *N. abnormis* group. In the morphology-based phylogenetic analysis (Ahrens 2012), it resulted as the sister taxon of the genus *Nepaloserica*. Since the major diagnostic features of *Nepaloserica* (Frey 1965) are lacking in this species (antennal club composed of six antennomeres rather than seven), it seems reasonable to not assign it now to *Nepaloserica*.

And, last but not least, diagnostic features used in the key above to circumscribe the *N. abnormis* group and to classify the species treated here, are not very suitable to support its monophyly. Given also the huge diversity in genital morphology within these species, it could be that the species belong to separate lineages in respect to *Chrysoserica*, *Nepaloserica*, and *N. abnormis*.

Major efforts are needed to obtain DNA samples of these species in order to reconstruct their phylogeny more robustly and to reveal possibly novel traits that may be helpful for the genus systematics.

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A shore-based preliminary survey of marine ribbon worms (Nemertea) from the Caribbean coast of Colombia

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Abstract

A checklist of benthic ribbon worm species from the Caribbean coast of Colombia is presented, including synonyms, distributions, a photographic record, and the main morphologic characters of each species for a rapid identification. This is the first research focused broadly on nemerteans in Colombia. 54 specimens of nemerteans were hand-collected from the rocky littoral of two different localities, and identified according to personal experience and specialist literature. 13 species were found; of which 11 represent new records for the country. These species belong to eight different traditionally used families: Tubulanidae, Valenciniidae, Lineidae, Amphiporidae, Cratenemertidae, Emplectonematidae, Drepanophoridae and Ototyphlonemertidae. The most common and abundant species was *Dushia atra*. The biodiversity of nemerteans in Colombia seems to overlap with the nemertean fauna from Florida and Brazil, explained by the convergence of the North Brazil Current, Guiana Current, Caribbean Currents and the Panama-Colombia Contracurrent in the sampled region. The results of this work suggest that the Caribbean coast of Colombia is a region with a high diversity of nemerteans, and provide important taxonomic data for environmental assessments and future biological research.

Keywords

Nemertini, Rhynchocoela, Caribbean biodiversity, benthic species

Introduction

Nemerteans, phylum Nemertea, also known as Nemertini, Rhynchocoela, or ribbon worms, comprise a group of bilateral, coelomate and non-segmented worms (Turbeville 2002; Thollesson and Norenburg 2003). The main synapomorphy supporting monophyly of the phylum is the presence of an eversible proboscis housed in a fluid-filled cavity, the rhynchocoel, which is considered to be a true coelom anatomically (*ibid.*). The proboscis, though structurally independent of the digestive system, is the primary means of prey capture by nemerteans. About 1275 species of nemerteans are considered validly named, most of which are found in marine environments (Kajihara et al. 2008). Marine nemerteans occur worldwide and inhabit almost all marine ecosystems from shallow water to the deep sea. Benthic species typically are slender and may be somewhat dorsoventrally flattened, and have the ability to stretch and contract their bodies extensively. They often are cryptic in habit and not frequently observed by non-specialists. Nevertheless, several species are known to have important effects as active predators, especially on mollusks, crustaceans and annelids (Roe 1976; Thiel and Kruse 2001; Caplins and Turbeville 2011). Nemerteans also have caught the attention of different biological fields such as regeneration (Coe 1934, 1943), developmental biology (Martindale and Henry 1995; Maslakova et al. 2004), genetics (Andrade et al. 2012; Chen et al. 2012), and pharmacology (Kem et al. 2006).

About 36 species have been recorded for the Caribbean Sea (Corrêa 1961, 1963; Kirsteuer 1973, 1974, 1977; Schwartz and Norenburg 2005). Three were recorded for Colombian coasts: *Ototyphlonemertes erneba* and *Ototyphlonemertes lactea* (Kirsteuer 1977) were reported from La Guajira, in the northeastern part of the country, whereas *Baseodiscus mexicanus* was recorded from the Pacific Coast (Coe 1940). However, in almost every study carried out on benthic ecosystems of Colombia, nemerteans have been mentioned to be an abundant component of the macrofauna communities (López 1981; Dueñas 1998; Vides 1999; Trujillo et al. 2009). They are recorded only as nemerteans in these studies, with no further taxonomic evaluation, due to the use of collection and fixation methods unsuitable for ribbon worms. Accurate identification of nemerteans is best done in the context of a regional synoptic survey based as much as possible on living specimens (Norenburg 2009). Color, eye-pattern, proboscis armature and, among small specimens, even some internal anatomical features are most reliably available from living specimens. Here, we start that process for Colombian nemerteans.

Detailed taxonomic understanding of animals also may require them to be properly fixed for histological examination and, increasingly, for genetic studies. There are few species-level identification keys to nemerteans, and those that do exist cannot be applied reliably beyond their region of origin. This reflects the paucity of experts available to make regional keys and also the low level of explicit morphological variation available in nemerteans, which results in extensive superficial similarity among species. Taxonomy, and therefore phylogeny, within the phylum also is poorly resolved, because many (perhaps most) nemertean species descriptions are inadequate and diagnoses for genera and families often are conflicting or insufficiently diagnostic (Gibson 1985; Schwartz and Norenburg 2001; Maslakova and Norenburg 2008).

A recent higher-level phylogeny of the nemerteans was proposed on the basis of DNA sequence data (Thollesson and Norenburg 2003) and resolved some deep and long-standing questions but some high-level relationships remain cloudy, whereas others are hostage to the analytical paradigms used (Andrade et al. 2012). The longest-standing traditional taxonomy divides the phylum into the two classes Enopla and Anopla. The class Enopla is characterized by the synapomorphy of central proboscis armature, as well placement of the mouth, which opens anteriorly either subterminally or joined with the rhynchodeum. In Anopla the mouth characteristically is ventral and post-cerebral and the proboscis lacks discrete central armature. Neither class is supported as monophyletic by recent molecular phylogenies. Within these classes, four orders – Hoplonemertea, Heteronemertea, Palaeonemertea and Bdellonemertea – were recognized for most of the last 100 years, based on disposition of body-wall musculature, nerve cords, blood vessels, and nature of proboscis armature (Hyman 1951; Gibson 1972). There is strong molecular evidence supporting monophyly of Hoplonemertea and Heteronemertea respectively, whereas Palaeonemertea consistently is found to be non-monophyletic, with at least some lineages basal within the phylum (Thollesson and Norenburg 2003; Andrade et al. 2012). Bdellonemertea has had a controversial history but now consistently falls within Hoplonemertea Monostilifera Distromatorhynchocoela (Thollesson and Norenburg 2003; Andrade et al. 2012). Thollesson and Norenburg (2003) proposed a new phylogeny of Nemertea, dividing the phylum into two clades Palaeonemertea (but with unknown exact membership) and Neonemertea, with the latter comprising the Hoplonemertea and the new clade Pilidiophora (= Heteronemertea + Hubrechtellidae) based respectively on absence or presence of a pilidium larva. This proposal was only partially supported by a more recent study (Andrade et al. 2012). For taxonomic purposes it remains most practical to refer to three main groupings: Palaeonemertea (though not monophyletic), Pilidiophora, and Hoplonemertea (Santos and Norenburg 2011).

Recent phylogenetic studies also re-enforce views by a number of nemertean systematists that several of the most species-rich genera (especially *Cerebratulus*, *Lineus*, *Micrura*, *Amphiporus*, and *Tetrastemma*) are non-monophyletic (Schwartz and Norenburg 2001; Strand and Sundberg 2005; Puerta et al. 2010; Andrade et al. 2012). That, in turn, results in a number of common families not being monophyletic, whereas monophyly of other families generally has not been tested. Some family designations are used here as accepted in recent literature or as best approximations in the case of taxa we could not identify to species. The latter can reflect either inability to match a worm to an existing description or the species may be undescribed. We use only family names for which there is phylogenetic evidence that they distinguish, for our purpose here, unique clades relative to each other.

Although in the last decades research in biodiversity of Colombia has increased, the phylum Nemertea remains one of its most neglected taxa (Díaz and Acero 2003). We present here the first study to target the phylum Nemertea in the country, though focused primarily on the region of Santa Marta, Colombia. We report here the occurrence of 12 named and six unidentified species of nemerteans, in addition to two named species previously recorded for the northeastern Caribbean coast of Colombia (Kirsteuer 1977).

Collection sites and methods

The material was collected from two different localities in the Santa Marta region on the Caribbean coast of Colombia: Inca-Inca and Taganga (Fig. 1).

The sites are in the bays formed by the extensions into the sea of the foothills of the Sierra Nevada de Santa Marta (SNSM), which is considered the highest coastal mountain range in the world. The common characteristic of these sites is the presence of a rocky littoral zone formed by metamorphic rocks interspersed with sandy beaches. There are two main climatic seasons – dry from December to April and rainy from May to November – influenced mainly by the Alisios winds (Dueñas 1998; Quiroga et al. 2004). During the dry season the region is affected by upwelling phenomena, producing changes in the temperature of the water and high biological productivity; in the rainy season there is a strong influence of fresh water from rivers draining the SNSM. The tidal range is 0.48 m (Garcia et al. 2011). Though the two sites are physically similar, they differ in anthropogenic impact. Inca Inca (74°14'W, 11°11'N) is located in one of the most important touristic centers in the Santa Marta region. Taganga (74°12'W, 14°15'N) is a traditional fishing bay where touristic activity has increased in the last decade and SCUBA activities have become economically important.

Specimens were collected from the rocky littoral zone. Three methods were used to look for the worms: inspecting the surface of rocks, breaking apart rocks when they had crevices, and leaving a portion of coarse substrate in a bowl of sea water so that worms were obligated to go up to the surface as the seawater de-oxygenated. Each specimen was relaxed in 7.5% magnesium chloride, measured and photographed *in vivo*, fixed in 10% buffered formalin and finally transferred to 70% ethanol after at least 24 hours of fixation. When necessary, histological sections were done at the level of the head and in the middle region of the body. For this, cross sections of paraplast embedded tissue were made and stained with hematoxylin and eosin. Taxonomic identification was based on Coe (1940, 1943, 1951), Corrêa (1954, 1961), Kirsteuer (1973, 1977), Riser (1991), Collin et al. (2005), Schwartz and Norenburg (2005), and Norenburg (2009). All the specimens were deposited at the CBUM.

Results and discussion

A total of 54 specimens was collected, of which 46 were identified to 13 species, and 2 only to family; 4 individuals could not be identified and they are recorded as 4-eyed monostiliferans (Table 1). Two specimens self-destructed; one was a heteronemertean and the other a hoplonemertean (their tissues were preserved in absolute alcohol for future molecular study). All the named species found in this work have been recorded from other localities, including continental and insular Caribbean, Brazil, and Gulf of Mexico (Coe 1940, 1951; Corrêa 1954, 1961, 1963; Kirsteuer 1973, 1977; Collin et al. 2005; Schwartz and Norenburg 2005; Norenburg 2009), with the caveat that unknown levels of confidence accompany nemertean identifications based on morphology and often less

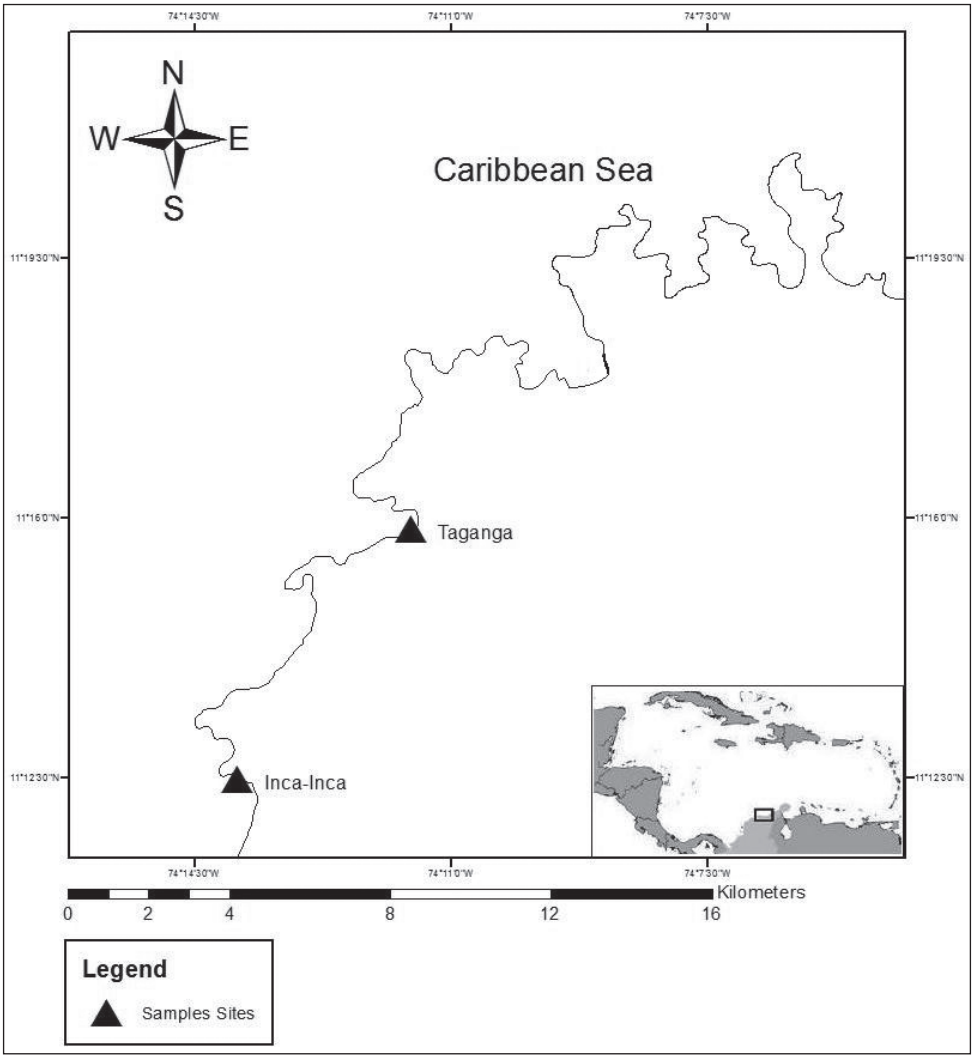

Figure 1. Map of the region of Santa Marta, Colombia, South America. The triangles show the sampled sites.

than ideal original descriptions. Nevertheless, the species reported here seem to reflect minimal endemism and some species seem to have biogeographically complex distributions. The influence and combined effects of the North Brazil Current, Guiana Current, Caribbean Current and the Panama-Colombia Contracurrent could favor relatively wide dispersion of planktonic nemertean larvae and juveniles (Andrade et al. 2003; Okolodkov 2010). Potential hosts for *Carcinonemertes* and *Malacobdella*, both of which have worldwide distributions, were not sampled in this study. *Ototyphlonemertes erneba* and *Ototyphlonemertes lactea* were previously recorded in Colombia from the more northeastern Guajira region on the Caribbean coast (Kirsteuer 1977) but only *O. lactea* was found in the present survey, perhaps due to differences in habitats sampled and collecting methods.

Table 1. Nemerteans from Caribbean Coast of Colombia. The systematics is based on Thollesson and Norenburg (2003) and Chernyshev (2003). The specimens were deposited in the "Centro de Colecciones Biológicas de la Universidad del Magdalena". Localities: (II) Inca-Inca, (TA) Taganga, (GU) Guajira. Habitats: (1) under rocks on muddy substrate, (2) under clean rocks, (3) interstitial, (4) rock crevices, (5) rocks with sponges.

Taxon	Locality	Habitat	Voucher	Synonyms
PALAEONEMERTEA : TUBULANIDAE				
Tubulanus rhabdotus Corrêa, 1954	II	1	CBUMAG:NEM00042	
HETERONEMERTEA : VALENCINIIDAE				
Baseodiscus delineatus (Delle Chiaje, 1825)	II, TA	2	CBUMAG:NEM:00002, CBUMAG:NEM:00008, CBUMAG:NEM:00012, CBUMAG:NEM00046, CBUMAG:NEM00051, CBUMAG:NEM00052	(a)
HETERONEMERTEA : LINEIDAE (*sensu lato*)				
Dushia atra (Girard, 1851)	II, TA	2, 3	CBUMAG:NEM:0003, CBUMAG:NEM:00006, CBUMAG:NEM00020, CBUMAG:NEM00027, CBUMAG:NEM00028, CBUMAG:NEM00029, CBUMAG:NEM00030, CBUMAG:NEM00031, CBUMAG:NEM00032, CBUMAG:NEM00033, CBUMAG:NEM00034, CBUMAG:NEM00035, CBUMAG:NEM00036, CBUMAG:NEM00037, CBUMAG:NEM00038	(b)
Lineus stigmatus Coe, 1951	TA	2	CBUMAG:NEM00050	
Micrura ignea Schwartz & Norenburg, 2005	II	1, 2	CBUMAG:NEM00001, CBUMAG:NEM00041	
HOPLONEMERTEA : MONOSTILIFERA				
Amphiporus cruentatus Verrill, 1879	II	2, 4	CBUMAG:NEM:00015, CBUMAG:NEM:00016	
Amphiporus cf. *ochraceus* (Verrill, 1873)	II	2, 4	CBUMAG:NEM:0011, CBUMAG:NEM00025, CBUMAG:NEM00026, CBUMAG:NEM00048	(c)
Amphiporus texanus Coe, 1951	II, TA	2, 4	CBUMAG:NEM00004 CBUMAG:NEM00017 CBUMAG:NEM00018 CBUMAG:NEM00019	
Nemertopsis bivittata (Delle Chiaje, 1841)	II	4	CBUMAG:NEM00048	(d)
Ototyphlonemertes erneba (Corrêa, 1950)	GA			
Ototyphlonemertes lactea (Corrêa, 1954)	TA, GA	3	CBUMAG:NEM00054, CBUMAG:NEM00055	(e)
Zygonemertes fragariae Corrêa, 1954	II	2	CBUMAG:NEM00040	

Taxon	Locality	Habitat	Voucher	Synonyms
Zygonemertes virescens (Verrill, 1879)	II	2,4	CBUMAG:NEM:00007, CBUMAG:NEM:00009, CBUMAG:NEM:00014, CBUMAG:NEM:00021 CBUMAG:NEM:00022, CBUMAG:NEM:00023	(f)
4-eyed monostiliferan sp.1	TA	2	CBUMAG:NEM:00010, CBUMAG:NEM00024	
4-eyed monostiliferan sp.2	II	2	CBUMAG:NEM:0005	
4-eyed monostiliferan sp.3	TA	2	CBUMAG:NEM00044	
Cratenemertidae sp.	TA	2, 5	CBUMAG:NEM00043, CBUMAG:NEM00049	
HOPLONEMERTEA: POLYSTILIFERA: REPTANTIA				
Punnettia cf. *natans* (Kirsteuer, 1973)	TA	5	CBUMAG:NEM00045	(g)

The following taxonomic key (see below) and the descriptions of the main characteristics, together with photographs of the different species, provide a tool for rapid visual identification of the nemerteans found in this survey of the Santa Marta region of Colombia. That for *Ototyphlonemertes erneba* is based on published descriptions.

Key to shoreline live Nemertea of Caribbean Colombia

1a Mouth ventral and posterior to brain; proboscis without modified middle region bearing armature..... **"Class" Anopla 2**

1b Mouth antero-terminal or subterminal and usually sharing a common opening with the rhynchopore but rarely the two open separately; proboscis with modified middle region bearing armature of one or more stylets..... ..... **"Class" Enopla 6**

2a Cephalic lobe (head) demarcated posteriorly with pair lateral vertical furrows (may be indistinct)..... **3**

2b Cephalic lobe lateral margins each a distinct longitudinal furrow.... **Lineidae 4**

3a Ground color pale ochre; numerous irregularly spaced blackish-brown rings encircle body – most anterior interrupted by mouth, fourth bears pale, often indistinct, oval lateral sense organ..... ***Tubulanus rhabdotus***

3b Ground color pale, milky tan; numerous reddish brown short but irregular length longitudinal lines cover dorsal surface and may extend ventrally; cephalic furrows with orthogonal secondary furrows... ***Baseodiscus delineatus***

4a Caudal cirrus present in adults but may be very small..... **5**

4b Caudal cirrus lacking in adults; blackish-brown ground color with numerous pairs of white markings dorsally along length of body; anterior 2/3 of cephalic lobe white with symmetrical brown patterning..... ***Lineus stigmatus***

5a Body uniformly blackish except for white anterior margin of cephalic lobe and white caudal cirrus; mouth longer than relaxed width of worm.... ***Dushia atra***

5b Body uniform bright orange anteriorly, grading to yellowish posteriorly..... ..... ***Micrura ignea***

6a Proboscis armature a plate with numerous tiny tack-like stylets; also numerous sacs of accessory stylets; long and wide oblique cephalic furrows with orthogonal secondary furrows; numerous conspicuous ocelli set in approximately 4 rows ..... ***Punnettia* cf. *natans***

6b Proboscis armature a distinct single stylet resting on a basis, usually with a pair of sacs containing accessory stylets **7**

7a Ocelli present (not always evident) **9**

7b Ocelli absent; statocyst present ..... ***Ototyphlonemertes* 8**

8a Statocyst with usually 3 statolith granules; stylet smooth; papillae at anterior of anterior proboscis chamber each with rod-shaped inclusion..... ***O. erneba***

8b Statocyst with about 12 statolith granules; proboscis extremely short (about length of head); stylet helically sculpted; cerebral organs and cephalic cirri absent ..... ***O. lactea***

9a Four ocelli set as rectangle.....Unidentified monostiliferan spp 1–3 (see text)

9b More than four ocelli (not always evident) **10**

10a Blood vessels conspicuously filled with red corpuscles ... ***Amphiporus cruentatus***

10b Blood vessels "colorless" **11**

11a Body uniformly dark brown and opaque, cephalic lobe rimmed by white "halo"; about 6 ocelli along each antero-lateral margin visible only in specimens squeezed under coverslip..... ***Amphiporus texanus***

11b Ocelli visible without squeezing specimen **12**

12a Ocelli extend laterally next to and posterior to cerebral ganglia; armature basis concave or flat posterior margin; epidermis contains small, intracellular, crescent-shaped hooks (requires squeezing specimen under coverslip and compound microscopy at 200–400×) ..... ***Zygonemertes* 13**

12b Ocelli all precerebral; armature basis convex posterior margin **14**

13a Body pale to dark green as adult, may be grayish-white as juvenile ... ***Z. virescens***

13b Body uniformly rosy pink ..... ***Z. fragariae***

14a Ocelli small, 6-10 in a pair of rows parallel to and near lateral margins of head; body uniformly translucent milky gray to yellowish, and cerebral ganglia with orange hue..... ***Amphiporus* cf. *ochraceus***

14b Ocelli large, about 26 set in four groups but may appear to form one large group along each lateral margin of the head; body relatively opaque rosy red; armature basis very rounded and short relative to stylet; good swimmer when irritated..... **Cratenemertidae sp. 1**

The mouth is ventral and posterior to the cerebral ganglia in Palaeonemertea and Heteronemertea (e.g., Fig. 2 D, K). In all the Hoplonemertea Monostilifera encountered here the mouth and proboscis share a common pore, the rhynchopore, located at or subterminal to the tip of the head (NB: they open separately in most polystiliferans and in

a few monostiliferans, but both openings are at the tip of the head). In lineid Heteronemertea (generally and in all specimens encountered here) a more or less deep furrow extends longitudinally along each side of the head and often is referred to as a cephalic slit, groove or furrow; the cerebral organ pore opens at its posterior. Cephalic furrows (when present) of tubulanid palaeonemerteans, baseodiscid heteronemerteans and hoplonemerteans are shallow and vertical or oblique, at the sides of the head near the cerebral ganglia, and they may be inconspicuous; the cerebral organ pore opens into the middle of each furrow. These furrows might best be referred to as cerebral organ furrows to distinguish them from a circumferential cephalic groove; a shallow epidermal groove that encircles the body and demarcates the "head" from the foregut region and found in most benthic Hoplonemertea and a very few Palaeonemertea and Pilidiophora. It commonly is postcerebral and in Hoplonemertea usually takes the form of a dorsal posteriorly directed "V" and a ventral anteriorly directed "V". The hoplonemertean proboscis when everted reveals a characteristic cylindrically uniform coating of more or less conspicuous epidermal papillae, whereas the anoplan proboscis generally lacks conspicuous papillae and often is bilaterally differentiated. The mid-region of the monostiliferan hoplonemertean proboscis is conspicuously differentiated into a bulb-like structure posteriorly and an anterior diaphragm bearing a basis with stylet and two or more sacs containing accessory stylets (e.g., Fig. 3G, M, P; 4C, G, J, M; 5H, K), whereas the mid-proboscis of polystiliferan Hoplonemertea is inconspicuously differentiated and bears an ovoid basis with multiple tiny stylets that may be very difficult to observe even with the 40× objective of a compound microscope. Measurements given below are from animals collected in this study.

Synonyms

(a) *Baseodiscus delineatus* (Delle Chiaje, 1825): *Baseodiscus curtus*, *Baseodiscus delineatus* var. *curta*, *Baseodiscus delineatus* var. *curtus*, *Baseodiscus insignis*, *Borlasia carmelina*, *Eupolia amboinensis*, *Eupolia ascophora*, *Eupolia curta*, *Nemertes delineatus*, *Nemertes delineatus*, *Polia delineata* Delle Chiaje, 1825 (Gibson 1995, 2014a).
(b) *Dushia atra* (Girard, 1851): *Cerebratulus ater*, *Lineus ater*, *Meckelia atra* Girard, 1851 (Norenburg 2009).
(c) *Amphiporus* cf. *ochraceus* (Verrill, 1873): *Cosmocephala ochracea* Verrill, 1873 (Gibson 1995).
(d) *Nemertopsis bivittata* (Delle Chiaje, 1841): *Eunemertes peronea*, *Nemerteopsis peronea*, *Nemertes peronea*, *Nemertopsis peronea*, *Omatoplea peronea*, *Ommatoplea peronea*, *Polia bivittata* Delle Chiaje, 1841; *Prosorhochmus bistriatus*, *Prosorochmus bistriatus* (Gibson 1995).
(e) *Ototyphlonemertes lactea* Corrêa, 1954: *Norenburgia lactea* Chernyshev, 1993 (Gibson 1995).
(f) *Zygonemertes virescens* (Verrill, 1879): *Amphiporus agilis*, *Amphiporus virescens* Verrill,1879; *Nemertes verrilli*, *Ophionemertes agilis* (Gibson 1995).
(g) *Curranemertes natans* Kirsteuer, 1973.

Palaeonemertea: Tubulanidae

***Tubulanus rhabdotus* Corrêa, 1954**
Fig. 2A, B

Description. One specimen up to about 30 mm long and 1 mm wide; dorsoventrally flattened, cephalic lobe broadly rounded anteriorly; caudal terminus blunt. Ochre with numerous small dark dots arranged in longitudinal lines, dark brown rings of differing thickness spaced irregularly along body, first four rings thickest. Prominent but short, vertical cerebral organ furrows demarcate head from rest of body. Eyespots lacking. Mouth ventral, just posterior to cephalic grooves. Proboscis pore subterminal. Lateral sensory organ present in fourth ring. Worm secretes and lives in soft tube of honey color.

Distribution. Curaçao (Corrêa 1963); Florida and Virgin Islands, USA (Corrêa 1961); São Paulo, Brazil (Corrêa 1954); Santa Marta, Colombia.

Heteronemertea: Valenciniidae

***Baseodiscus delineatus* (Delle Chiaje, 1825)**
Fig. 2C–E

Description. Six specimens up to about 50 mm long, 2 mm wide; dorsoventrally flattened; cephalic lobe broadly rounded. Milky ground color; dorsally with abundant short interrupted reddish to brown longitudinal lines, paler or completely absent on ventral surface. Shallow, cerebral organ furrows post-cerebral, vertical and slightly oblique, with inconspicuous, orthogonally oriented secondary furrows. Numerous ocelli arranged irregularly along antero-lateral margin of head. Mouth ventral, posterior to cerebral organ furrows. Proboscis pore at anterior of head; proboscis short and thin.

Distribution. This species seems to be circumglobal in tropical and subtropical seas (Norenburg 2009).

Heteronemertea: Lineidae (*sensu lato*)

***Dushia atra* (Girard, 1851)**
Fig. 2F–I

Description. Fifteen specimens up to about 160 mm long, 2.5 mm wide; dorsoventrally flattened; head elongate, can be pointy; short, slender caudal cirrus present. Black body, lips of cephalic furrows, tip of head and tail grayish or milky white. Deep cephalic furrows form lateral margins of head. Ocelli lacking. Mouth ventral, a large longitudinal slit posterior to cephalic furrows. Proboscis long, yellow, with smooth surface when everted.

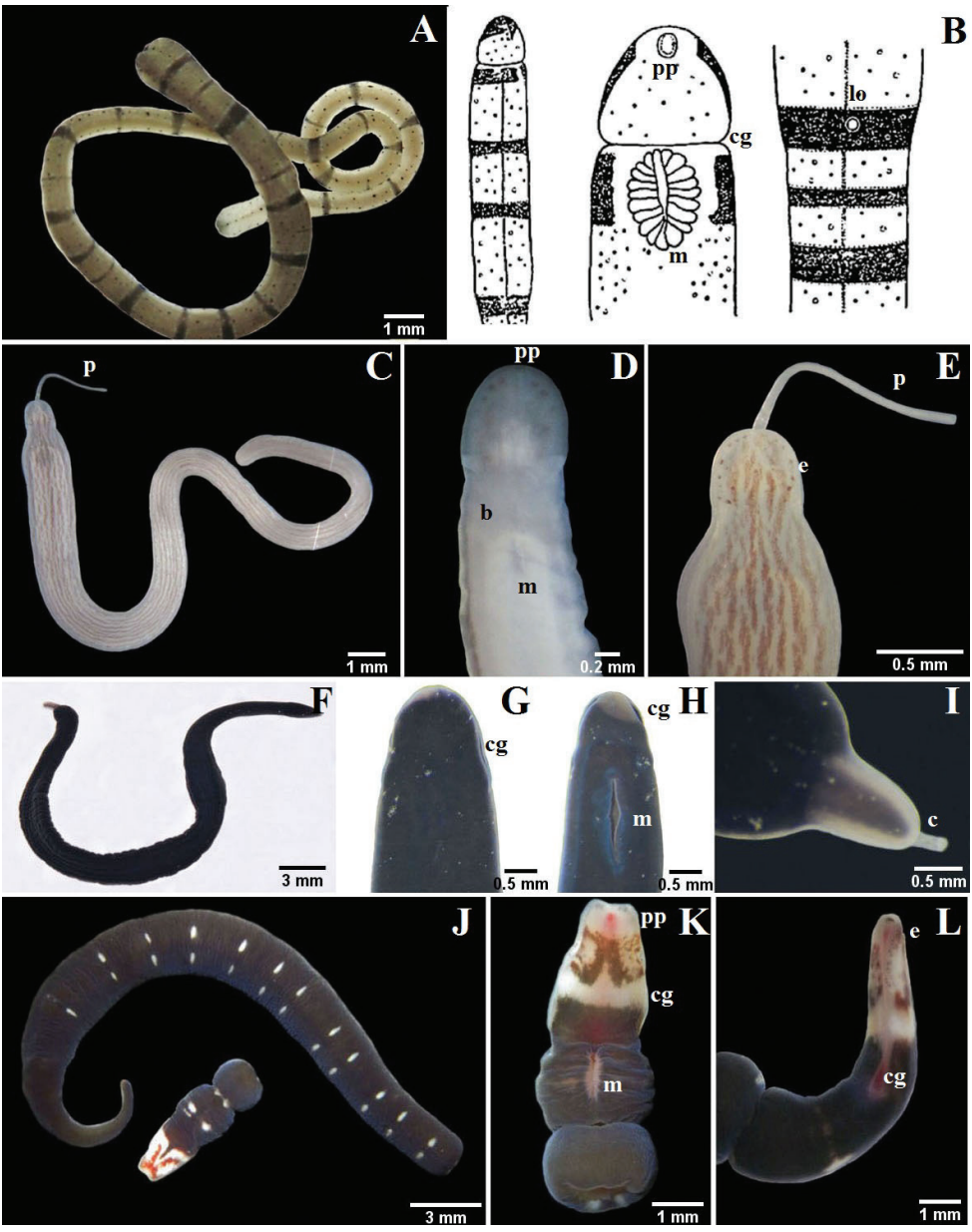

Figure 2. A–B *Tubulanus rhabdotus*: **B** detail of the head, mouth and lateral organ (modified from Corrêa 1954) **C–E** *Baseodiscus delineatus*: **C** entire specimen, the worm has expulsed the proboscis **D** ventral detail of the head **E** dorsal detail of the head **F–I** *Dushia atra*: **G** dorsal detail of the head **H** ventral detail of the head **I** detail of the tail showing the caudal cirrus **J–L** *Lineus stigmatus*: **J** entire specimen, the worm autotomized **K** ventral detail of the head **L** lateral detail of the head. *b* brain, *c* cirrus, *cg* cephalic grooves, *e* eyes, *lo* lateral organ, *m* mouth, *p* proboscis, *pp* proboscis pore.

Distribution. Curaçao (Corrêa 1963), Gulf of Mexico (Norenburg 2009); Santa Marta.

Comments. This was the most frequently found species, though not necessarily the most abundant; we did not do quantitative sampling in this study. Given the wide regional distributions of other nemerteans in this and other recent studies (e.g., Corrêa 1961, 1963; Norenburg 2009) one expects such a common species to be identifiable as a regionally known species. Many of the early descriptions, however, are based on highly contracted and, often, fragmented specimens and lack observations from life (e.g., Verrill 1900; Coe 1901; Stiasny-Wijnhoff 1920). Presence or absence of a caudal cirrus is unreliably known for several named species from the region that are more or less blackish. The genera *Cerebratulus* and *Micrura*, both considered to have a caudal cirrus as a matter of diagnosis, are known among nemertean specialists to be fraught with taxonomic inconsistencies (see, e.g., Schwartz and Norenburg 2001, 2005). The presence or absence of a caudal cirrus seems, based on DNA data, to be an unreliable diagnostic for those genera (Schwartz 2009). Possible Caribbean options for our species include *Cerebratulus leucopsis* (Coe 1901), reported to have a caudal cirrus, and *Corsoua kristenseni* Corrêa, 1963, reported to lack a caudal cirrus. We believe that the former may be synonymous with *Dushia atra sensu* Corrêa (1963) from Curaçao. *Corsoua kristenseni* has a small mouth and occurs in mangrove habitat, whereas *D. atra sensu* Corrêa (1963) has a large mouth and occurs at the high-water line in clean sand under rubble, as do our specimens, though Corrêa (1963) does not mention a caudal cirrus. Our material consistently has a small caudal cirrus but it could easily be missed in preserved specimens. Pending anatomical studies, we assign our specimens to *D. atra sensu* Corrêa (1963). A potential taxonomic problem remains in that Girard (1893) describes his specimens as having been dredged from deep water off Cape Florida, which is at strong variance with the very narrowly constrained habitat of our specimens and those found on other Caribbean islands (JLN, pers obs).

Lineus stigmatus Coe, 1951

Fig. 2J–L

Description. One specimen up to about 30 mm long, 2 mm wide; dorsoventrally flattened, anterior margin somewhat squared, posterior end tapered, caudal cirrus absent. Body dark violet or dark olive green; paired, widely spaced, transversely elongate white markings dorsally, each pair part of barely perceptible thin white ring encircling body; anterior two-thirds of head white with prominent brown pigment patterning, including a V-shaped marking dorsally and ventrally, each pointed anteriorly. Deep cephalic furrows form lateral margins of head. About 20 to 30 small ocelli disposed in a single irregular line on each side of head along anterior third of cephalic furrow. Mouth ventral, a large longitudinal slit posterior to cephalic furrows. Cephalic ganglion visible through body wall as a pink mass.

Distribution. Florida (Coe 1951), Belize (JLN, pers obs); Santa Marta, Colombia.

Comment. Coe (1951) named *Lineus stigmatus* from the shore of Biscayne Bay, Florida. He illustrates and describes in useful detail only the posterior portion, and this agrees strongly with the pattern of paired white markings seen in our specimen, which is not known from any other nemerteans in the region. We believe that it is reasonable to assign our specimens to Coe's species; we base this on the distinctive color pattern and the strong regional distribution overlaps for many of the other regional nemertean species. Though Coe (1951) noted a potential similarity with *Lineus albocinctus* Verrill, 1900, we judge the color patterns to be very different. Coe (1951) also comments "…color pattern in this species has a superficial resemblance to that of some individuals of *L. geniculatus* (D. Chiaje) in which the white rings are interrupted in the mid dorsal line but in the latter species the rings continue laterally and ventrally". Riser (1991) resurrected *Notospermus* (Huschke, 1830) and transferred to it *Lineus geniculatus* (*sensu* Delle Chiaje, 1828) of several authors. We agree that the pigment pattern resembles that of *N. geniculatus* as well as that of a variety of similar worm images available via the internet and attributed to *N. geniculatus* (JLN, pers obs). We anticipate that *L. stigmatus* is congeneric with *N. geniculatus*, but this needs to be corroborated with internal anatomy and/or molecular data.

***Micrura ignea* Schwartz & Norenburg, 2005**
Fig. 3A–D

Description. Two specimens up to about 100 mm long, 3 mm wide; dorsoventrally flattened; head "triangular", pointed anteriorly and widening posteriorly; posterior end blunt with short and slender caudal cirrus. Orange grading posteriorly to yellowish. Deep cephalic furrows form lateral margins of head. Mouth slit-shaped, posterior to cephalic grooves. Eyespots lacking. Proboscis long, thick and pink; when everted it possesses ruffles.

Distribution. Belize (Schwartz and Norenburg 2005); Caribbean coast of Panama (Collin et al. 2005); Santa Marta, Colombia.

Hoplonemertea: Monostilifera

***Amphiporus cruentatus* Verrill, 1879**
Fig. 3E–G

Description. Two specimens up to about 20 mm long, < 1 mm wide; dorsoventrally flattened, bluntly rounded at both ends. Pale yellow, with three thin, longitudinal blood vessels made bright red by corpuscles that can be observed flowing through the vessels. Cerebral organ furrows, vertical, not prominent, precerebral. About 6–10 conspicuous, blackish, precerebral ocelli, in single row along each. Rhynchopore subterminal at tip of head; rhynchocoel extends to about middle of body length; proboscis long and thick; armature approximately at center of proboscis; stylet slender (length:

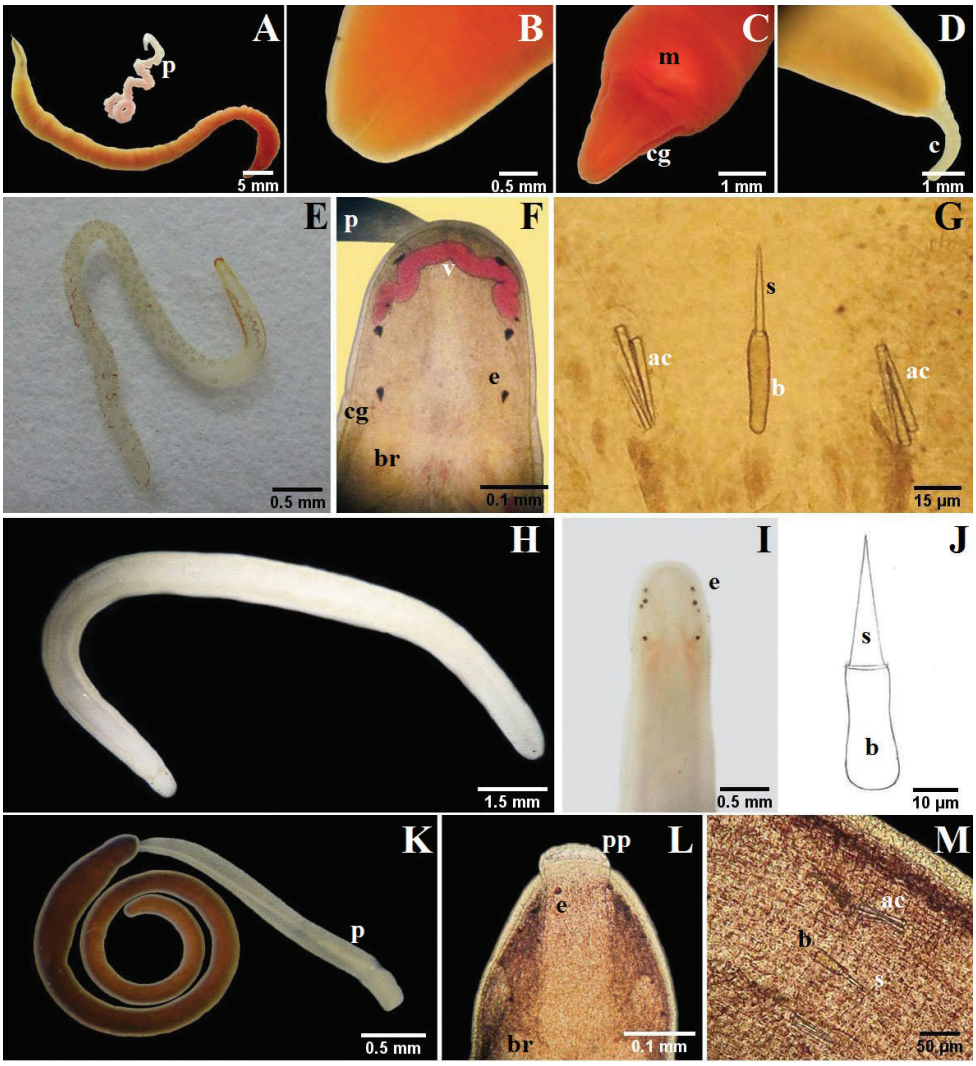

Figure 3. A–D *Micrura ignea*: **A** entire specimen, the worm has expulsed the proboscis **B** dorsal detail of the head **C** ventral detail of the head **D** detail of the tail **E–G** *Amphiporus cruentatus*: **F** dorsal detail of the head **G** detail of the stylets **H–J** *Amphiporus* cf. *ochraceus*: **I** dorsal detail of the head **J** drawing of the stylet **K–M** *Amphiporus texanus*: **K** entire worm **L** dorsal detail of the head **M** detail of the stylets. *ac* accessory stylet, *b* base of the stylet, *br* brain, *c* cirrus, *cg* cephalic grooves, *e* eyes, *m* mouth, *p* proboscis, *pp* proboscis pore, *s* sylet, *v* blood vessel.

30 µm), supported on cylindrical basis (33 × 8 µm); 2 pouches with 3 accessory stylets each. Mature females with dark or bright gray eggs visible through body wall.

Distribution. Gulf of Mexico, New England (USA) and Washington (Norenburg 2009); California (Coe 1940); Santa Marta, Colombia.

***Amphiporus* cf. *ochraceus* (Verrill, 1873)**
Fig. 3H–J

Description. Four specimens up to about 10 mm long, 0.5 mm wide; dorsoventrally flattened, bluntly rounded at both ends. Variable color, yellowish to milky gray, sometimes with light orange pigmentation in cephalic region corresponding to cerebral ganglia. Cerebral organ furrows vertical, precerebral. About 6-10 conspicuous, blackish, precerebral ocelli, arranged in single regular row, along each lateral margin of head. Rhynchopore subterminal; rhynchocoel about three quarters of body length; proboscis long; medially constricted basis same length as slender stylet (length: 29 μm); 2 pouches with 2 accessory stylets each.

Distribution. Gulf of Mexico and New England (USA) (Norenburg 2009); Santa Marta, Colombia.

***Amphiporus texanus* Coe, 1951**
Fig. 3K–M

Description. Four specimens up to about 15 mm long, 0.5 mm wide; dorsoventrally flattened, bluntly rounded at both ends; cephalic lobe narrower than foregut region. Dark brown body; with magnification, thick unpigmented margin (i.e., epidermis) appears white. Cerebral organ furrows vertical, precerebral. Row of about 6 ocelli present along each lateral margin of head; visible in squeeze preparation. Rhynchopore subterminal; proboscis large and thick, conspicuous papillae; central stylet slender (length: 42 μm), supported on wide cylindrical basis (34 × 10 μm) at middle of proboscis; two pouches with 2-4 accessory stylets each.

Distribution. Gulf of Mexico and Southern Florida (Norenburg 2009); Curaçao (Schwartz and Norenburg 2005); Santa Marta, Colombia.

***Nemertopsis bivittata* (Delle Chiaje, 1841)**
Fig. 4A–C

Description. One specimen up to about 20 mm long; 1 mm wide; rounded at both ends. Yellow milky base color, dorsally with 2 brown to reddish longitudinal lines joined at anterior and posterior ends. Cerebral organ furrows precerebral, difficult to see. Head almost undifferentiated from body. Cephalic grooves not visible. Two pre-cerebral eyes on each lateral margin of head. Rhynchopore subterminal; proboscis small, slender provided with papillae; short central stylet (length: 11 μm), supported on a massive base (27 × 7 μm). Two pouches containing three accessory stylet each.

Distribution. USA East Coast – Florida (Thollesson and Norenburg 2003), South Carolina (Caplins et al. 2012); Atlantic Galician Island (Junoy and Herrera-Bachiller

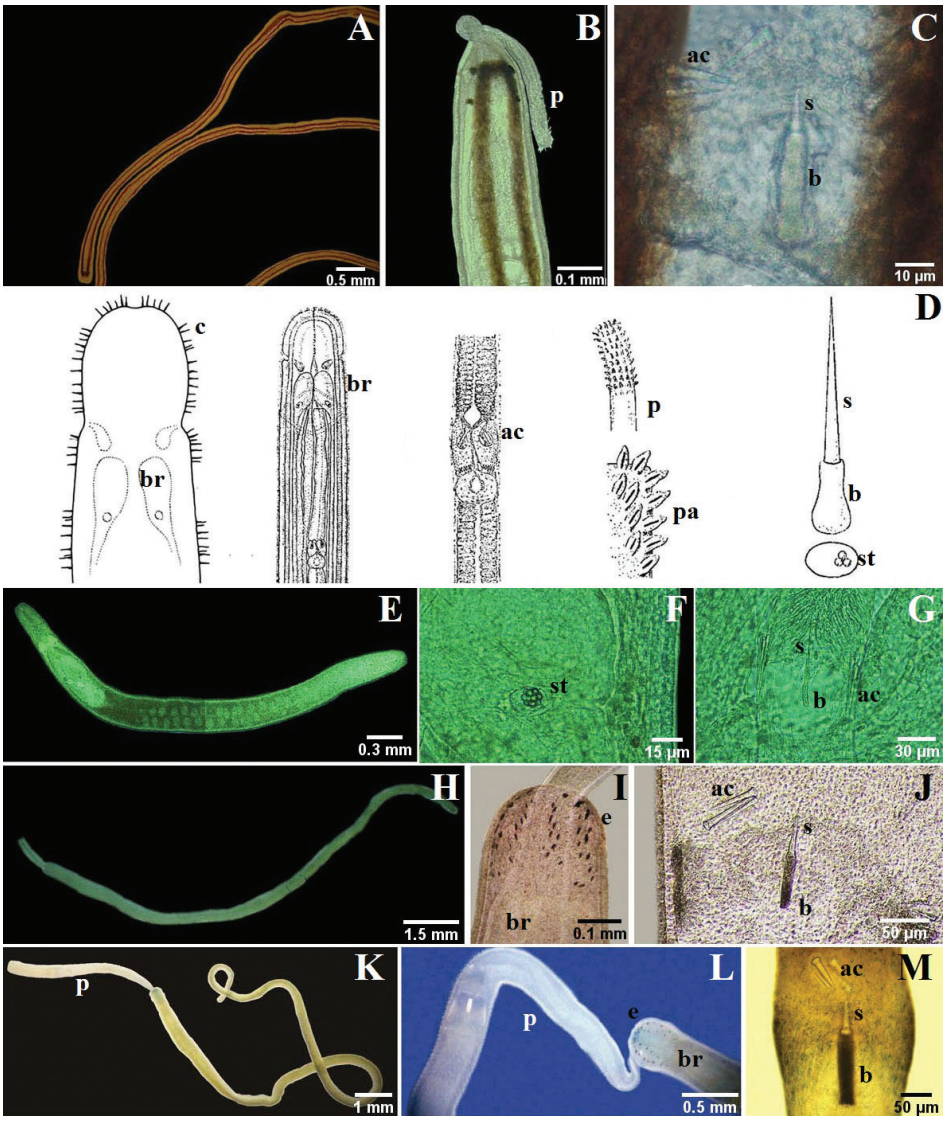

Figure 4. A–C *Nemertopsis bivittata*: **B** dorsal detail of the head and proboscis, **C** detail of the stylets **D** *Ototyphlonemertes erneba* (modified from Corrêa 1950 and Kirsteuer 1977) **E–G** *Ototyphlonemertes lactea*: **E** entire worm **F** detail of the statocysts **G** detail of the stylets **H–J** *Zygonemertes fragariae*: **H** entire worm **I** detail of the head **J** detail of the stylets **K–M** *Zygonemertes virescens*: **K** entire worm **L** detail of the head **M** detail of the stylets. *ac* accessory stylet, *b* base of the stylet, *br* brain, *c* sensorial cirrus, *e* eyes, *p* proboscis, *pa* proboscis papilla, *s* sylet, *st* statocysts.

2010); European waters, Portuguese and Spanish Exclusive Economic Zone, Red Sea (Gibson 2014b); Santa Marta, Colombia.

Comment. Caplins et al. (2012) found support suggesting that the two color morphs of *N. bivittata* commonly found sympatrically – one with dorsal stripes that meet anteriorly and the other with lines that do not meet – are genetically isolated. Sup-

port includes statistical difference in size of stylets and in DNA sequence differences for mitochondrial cytochrome-oxidase-1 gene – minimum and an a maximum pair-wise difference of 13.6% and 19.9% – (Caplins et al. 2012). Though awaiting explicit molecular data, Norenburg (2013) commented that *N. bivittata* and *Nemertopsis gracilis* Coe, 1904, probably are synonyms and, therefore, following Sun and Dong (1998), the morph with lines meeting would be *Nemertopsis bullocki* Coe, 1940 and the one with stripes not meeting would be, by priority, *Nemertopsis bivittata* (Delle Chiaje, 1841). For now, we do not formally distinguish the two here and assign our specimen at *Nemertopsis bivittata*.

***Ototyphlonemertes erneba* (Corrêa, 1950)**
Fig. 4D

Description. Up to about 12 mm long; < 1 mm wide; according to (Corrêa 1954), small meiofaunal worm dorsoventrally flattened, tapered at posterior end. Cream color. Cerebral organs and furrows present, precerebral. Eyes absent. Long sensory cirri along anterior and lateral margins of head. Pair statocysts; statolith an aggregation of 3 spherical granules. Rhynchocoel approximately half of body length; proboscis long, stout, with long papillae; anterior papillae (closest to proboscis insertion) each with rod-shaped inclusion; posterior proboscis opaque in transmitted light (white with incident light); stylet slender, >2× length of pyriform basis; 2 pouches with 6 accessory stylets each.

Distribution. Brazil (Corrêa 1950); Guajira, Colombia (Kirsteuer 1977).

***Ototyphlonemertes lactea* (Corrêa, 1954)**
Fig. 4E–G

Description. Two specimens up to about 3.5 mm long; < 0.3 mm wide; truncated at both ends. Milky white color. Cerebral organs and associated furrows absent. Without ocelli. Two ovoid statocysts present, statolith formed by more than 10 spherical granules. Rhynchocoel short, about one-third of body length; proboscis very short; posterior proboscis vesicular (translucent) with transmitted light; armature at middle of proboscis; stylet slender, helically sculpted (length: 15 μm); basis thin, cylindrical (14 × 2 μm); 2 pouches with 3 accessory stylets each.

Distribution. Brazil (Corrêa 1950); Guajira, Colombia (Kirsteuer 1977); Santa Marta, Colombia.

***Zygonemertes fragariae* Corrêa, 1955**
Fig. 4H–J

Description. One specimen up to about 12 mm long, 1 mm wide; dorsoventrally flattened, bluntly rounded at both ends. Body vivid pinkish strawberry-red. Cerebral organ furrows shallow, precerebral. Pair irregular rows of 8-13 ocelli each on each side

of head; row of about 10 ocelli between brain and each lateral margin of body and reaching post-cerebrally into foregut region. Rhynchopore subterminal; rhynchocoel to about middle of body length; proboscis long and thick with thin papillae; central stylet thin (length: 45 μm); basis smooth, cylindrical (54 × 14 μm); 2 pouches with 2 or 3 accessory stylets each. Epidermis with minute crescent-shaped intracellular spicules.

Distribution. São Sebastião (Brazil) (Corrêa 1954); Santa Marta, Colombia.

***Zygonemertes virescens* (Verrill, 1879)**
Fig. 4K–M

Description. Six specimens up to about 30 mm long, < 2 mm wide; dorsoventrally flattened, bluntly rounded at both ends. Variable color, from white to yellow or greenish. Cerebral organ furrows shallow, precerebral. Numerous pre-cerebral small ocelli arranged in two pair irregular rows of about 15–20 ocelli each; row of post-cerebral ocelli each side between brain and lateral margin of body, extending far posterior to brain along lateral nerve cord. Rhynchopore subterminal; rhynchocoel wide and almost full body length; proboscis long with small papillae; stylet slender (length: 60 μm) supported on massive and medially constricted basis (112 × 28 μm); two pouches, each bearing 3 accessory stylets. Epidermis with minute crescent-sphaped intracellular spicules.

Distribution. Gulf of Mexico and New England (Norenburg 2009); California and Oregon (Corrêa 1964); Southern Florida and Virgin Islands (Corrêa 1961); Gulf of Maine (Gibson 2014c); North Atlantic (Azores) (Strand 2002); Santa Marta, Colombia.

4-eyed monostiliferan sp. 1
Fig. 5A–C

Description. Two specimens about 12 mm long, 1 mm wide; dorsoventrally flattened. White to yellow-brownish color. Cerebral organ furrows shallow, precerebral. Four precerebral ocelli set as corners of a wide rectangle. Rhynchocoel voluminous, extending almost full body length. Rhynchopore subterminal. Proboscis stout; armature far posterior; Stylet (length 45 μm) supported on massive medially constricted basis (110 × 50 μm); two pouches with 2 accessory stylets each.

Distribution. Santa Marta, Colombia.

4-eyed monostiliferan sp. 2
Fig. 5D–E

Description. One specimen about 10 mm long, < 1 mm wide; dorsoventrally flattened; head arrow-shaped, tail tapered. Milky white color. Brain appears as a pink

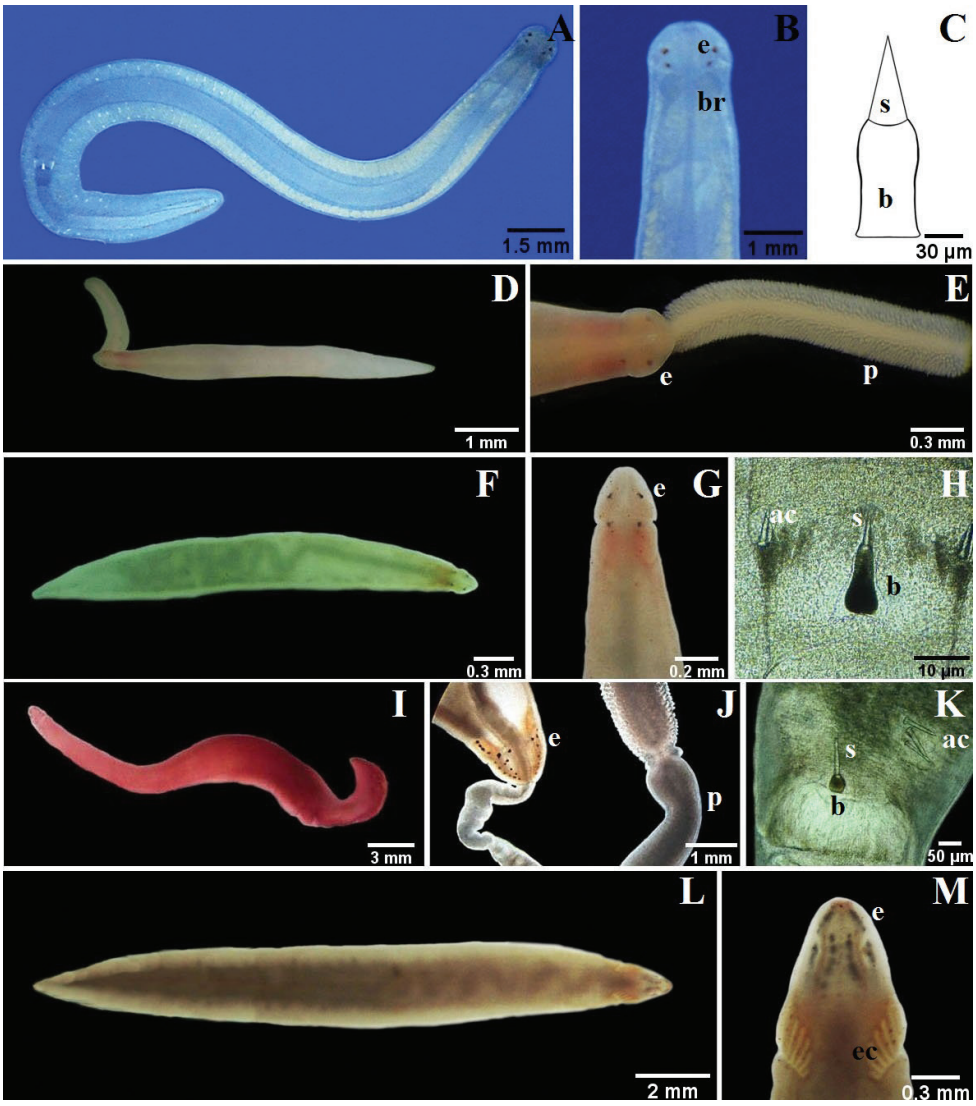

Figure 5. A–C 4-eyed monostiliferan sp. 1: **B** dorsal detail of the head **C** drawing of the stylet **D–E** 4-eyed monostiliferan sp. 2: **E** dorsal detail of the head and proboscis **F–H** 4-eyed monostiliferan sp. 3: **G** dorsal detail of the head **H** detail of the stylets **I–K** Cratenemertidae sp.: **J** dorsal detail of the head and proboscis **K** detail of the stylets **L–M** *Punnettia* cf. *natans*: **M** dorsal detail of the head. *ac* accessory stylet, *b* base of the stylet, *br* brain, *e* eyes, *ec* epithelial crests, *p* proboscis, *s* sylet.

orange spot in head. Cerebral organ furrows shallow, precerebral. Postcerebral groove inconspicuous, forms dorsal "V". Two pair ocelli, anterior and posterior separated by cerebral organ furrow. Rhynchopore subterminal. Proboscis stout, densely papillated.

Distribution. Santa Marta, Colombia.

4-eyed monostiliferan sp. 3
Fig. 5F–H

Description. One specimen about 6 mm long, < 1 mm wide; dorsoventrally flattened; head arrow-shaped; tail tapered. Cream to greenish color. Brain region pink. Cerebral organ furrows precerebral, deep. Postcerebral groove forms a "V" dorsally. Two pair ocelli, set as square, anterior and posterior separated by cerebral organ furrows. Rhynchopore subterminal; rhynchocoel extends three fourths of body length. Stylet (length: 70 μm) supported on massive pear-shaped basis (130 × 60 μm).

Distribution. Santa Marta, Colombia.

Cratenemertidae sp.
Fig. 5I–K

Description. Two specimens up to about 22 mm long, 2 mm wide; tapered at both ends. Uniform bright red color. Conspicuous mid-dorsal cephalic crest. Cerebral organ furrows precerebral, inconspicuous, with few faint ridges orthoganol to furrow axis. About 26 ocelli scattered in four elongate, irregular groups, anterior and posterior separated by cerebral organ furrows. Rhynchopore subterminal. Proboscis long and stout, with dense, large papillae; stylet (length: 120 μm) on short, wide and rounded basis (50 × 48 μm); two pouches containing three accessory stylets each. Worms capable of swimming with strong undulating movements.

Distribution. Santa Marta, Colombia.

Hoplonemertea: Polystilifera

***Punnettia* cf. *natans* (Kirsteuer, 1973)**
Fig. 5L–M

Description. One specimen about 17 mm long, < 1 mm wide; dorsoventrally flattened, tapered at both ends. Gray to brown color, darker on head and along mid-dorsal line of body; ventral surface milky gray. Head narrow with respect to body. Cerebral organ furrows wide, postcerebral, subdivided by about 5 longitudinal epithelial ridges (secondary furrows) orthoganol to furrow axis. Numerous large ocelli, precerebral, arranged in four irregular longitudinal rows, outer rows possibly divided into anterior and posterior clusters. Armature normally several stylets supported on a single basis, but not documented by us. Individuals capable of swimming by undulatory movements, leaving mucus behind it.

Distribution. Bahía Mochima (Venezuela) (Kirsteuer 1973); Santa Marta, Colombia.

Comment. Two named polystiliferan species are known from the region. *Polyschista curacaoensis* Stiasny-Wijnhoff, 1925 is known only from three pieces – two

heads and a tail – already preserved and strongly contracted when first examined by Stiasny-Wijnhoff; therefore, of dubious value for anatomical study. The heads are described as having a "a well defined brown longitudinal marking on their back" while "the margins are a milky, transparent white and two to three times as broad as the thick [brown] middle part". The tail is described as being transparent and white. This does not fit well the present species. *Curranemertes natans* Kirsteuer, 1973 is known only from Venezuela and described as "orange to brownish" dorsally, with the thicker median region of the head being a "darker brownish shade". Though Kirsteuer (1973) concludes that the two species differ in internal anatomy, he cites only character states that he presumes "probably" differ in *Polyschista*. We are not sanguine that our specimen is either species, though it resembles specimens previously collected by JLN off Belize and Bocas del Toro, Panama and identified as *Curranemertes* cf. *natans*.

Härlin (1998), with support from a morphological phylogenetic analysis re-assigned *Curranemertes natans* to the phylo-clade *Punnettia*. Härlin and Härlin (2000) found *Punnettia* to be paraphyletic but without placing the type species, *Punnettia hubrechti*. They concluded by discarding *Punnettia*, in a Phylocode act, with the argument that it is "a messy name" and assigning its species to two phylo-clades but without placing *P. hubrechti*. Thus, with respect to a Linnean classification, we cannot know which *Punnettia* species would remain so, because they form a clade with *P. hubrechti*. Hence, it seems more appropriate at this time to retain *Curranemertes natans*, pending resolution of *Punnettia* phylogeny.

Comments

Direct observations of the nemerteans "in vivo" facilitates collection of information about nemertean species that is more reliable than possible with preserved specimens, and permits photographic records useful for their identification (Norenburg 2009). Taxonomy of four-eyed monostiliferans is difficult because many of the species described were, historically, mis-allocated and many of the descriptions lack useful characterization of external features, and even characterization of internal anatomy often is of dubious quality and misleading (JLN pers obs). Recognition and allocation of species that lack highly distinctive diagnostic features, such as those in this study, is especially difficult. While internal anatomy could point to recently formulated generic diagnoses, the work involved is better suited to individual monographic studies.

Although, the purpose of this research was taxonomical, it is worth mentioning that the most frequent species was *Dushia atra*, representing 30% of the total of collected specimens. It was followed by *Baseodiscus delineatus* and *Zygonemertes virescens* at 12% each. The major diversity, in terms of number of species, was observed at Inca-Inca, with 7 species. However, the sampling effort was not the same in all collection sites, so it is not possible to make a reliable comparison of the biodiversity among the

stations. Most studies of nemerteans in the Caribbean, and elsewhere, have focused on taxonomy (Coe 1901; Corrêa 1961, 1963; Kirsteuer 1973, 1974, 1977; Schwartz and Norenburg 2005; Collin et al. 2005), and there are no other records of relative abundances or dominance of species.

Frequently, aggregations of 3–5 con-specific specimens of *Amphiporus cruentatus*, *Amphiporus texanus*, *Dushia atra* and *Zygonemertes virescens*, were found under rocks or in rock crevices. This behavior has been observed before in several species of nemerteans and in some cases may be related with reproduction events (Thiel and Junoy 2006) but often it seems the worms are gregarious, though that may be a by-product of worms focusing on particularly suitable microhabitats (JLN, pers obs).

This study represents the first taxonomic work focused on nemerteans of Colombia, and specifically the Caribbean coast. Except for *Ototyphlonemertes lactea*, all species are new records for Colombia. Among the 36 species reported from the Caribbean region (Corrêa 1961, 1963; Kirsteuer 1974, 1977; Schwartz and Norenburg 2005) at least 12 are present in the rocky shores of two beaches in the small region of Santa Marta. This suggests that more intensive investigation, across more habitats, will yield significantly greater nemertean diversity. This study also begins to open up study of nemerteans in Colombia to different fields of biology.

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New records of fish parasitic isopods of the gill-attaching genus *Mothocya* Costa, in Hope, 1851 from the Virgin Islands, Caribbean, with description of a new species

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Abstract

Two species of *Mothocya* Costa, in Hope, 1851 are reported from the Virgin Islands. *Mothocya xenobranchia* Bruce, 1986 was collected from St. John Island from the gills of the Atlantic needlefish, *Strongylura marina*, which is a new locality record and also confirms a previously uncertain host identity. *Mothocya bertlucy* **sp. n.** is described from St. Thomas, St John and Guana Islands, from the gills of the redlip blenny, *Ophioblennius macclurei*, the first record of a blenny as host for any *Mothocya*. The distinguishing characters of *Mothocya bertlucy* **sp. n.** include its small size (< 9 mm) and eyes, the slender pleotelson with a narrowly rounded caudomedial point, extended uropod peduncle and uropods which do not extend past the pleotelson posterior margin, and the narrow pleon which is only slightly overlapped by pereonite 7.

Keywords

Cymothoidae, *Mothocya*, gill chamber, fish parasite, Caribbean Sea, St. Thomas, St. John, Guana Island

Introduction

Cymothoid isopods are one of the most recognisable groups of isopods to fisherman and anglers (Smit et al. 2014). These large (> 6 mm) aquatic parasites are commonly found on the external surface, inside the buccal cavity, or in the branchial cavity of their fish host. Cymothoids removed from the gills are often asymmetrical in body shape, twisted slightly due to the shape of the gill arches and operculum in the branchial cavity (Kensley and Schotte 1989).

In some cases, these parasites cause gill and branchial filament damage (Kroger and Guthrie 1972, Colorni et al. 1997). Williams and Williams (1978) commented on the discolouration and considerable erosion of the gill filaments and opercular flap in some fish they studied. Rokicki (1982) noted atrophy of the gill filaments which automatically affects the fish's development; and Colorni et al. (1997) reported on deformed and calcified gill rakers as well as gill filaments which were dystrophic and fused together with total obliteration of both primary and secondary lamellae.

One of these gill-attaching cymothoid genera is *Mothocya* Costa, in Hope, 1851. Historically the systematics and biology of this genus had not been considered problematic, but Bruce (1986) showed that *Irona* Schioedte & Meinert, 1884 and *Mothocya* were synonymous and that many of the species were misidentified, which had led to the misrepresentation of their hosts and distributions. Bruce (1986) comprehensively reviewed *Mothocya* and corrected many of these errors, revising seven species and describing 18 new species. Since then, another four species have been described (WoRMS 2014), making a total of 29 valid *Mothocya* species in the world (Smit et al. 2014).

There are six known species of *Mothocya* in the Caribbean Sea. These are *M. argenosa* Bruce, 1986 (Bermuda; Florida and Georgia, USA; Cuba; and the British Virgin Islands); *M. bermudensis* Bruce, 1986 (Bermuda; Haiti; Saint Barthélemy, Leeward Islands); *M. bohlkeorum* Williams & Williams, 1982 (Florida, USA; Bahamas; Saint Eustatius, Leeward Islands; and Puerto Rico); *M. nana* (Schioedte & Meinert, 1884) (Florida, Georgia and Maryland USA; Saint Barthélemy, Leeward Islands; and Panama), *M. omidaptria* Bruce, 1986 (Brazil and West Indies), and *M. xenobranchia* Bruce, 1986 (Florida, USA; and Venezuela). To date there are no known species recorded from the US Virgin Islands and only one species known from the British Virgin Islands (*M. argenosa*). The new species described here increases the number of species known from the Caribbean to seven.

Methods

Collections were made from the Virgin Islands, specifically St. John, and St. Thomas, US Virgin Islands, and Guana Island, British Virgin Islands, in the Caribbean Sea during 2013 as part of a study on blood parasites of Caribbean reef fishes. Atlantic needlefish (*Strongylura marina*) were collected near the surface at night by snorkelers using hand nets, while redlip blennies (*Ophioblennius macclurei*) were collected by hand nets during

the day from reef habitat in shallow bays by snorkelers or divers. Isopods were removed from the gills of their infected hosts using forceps, preserved in 70% ethanol, and processed according to techniques described in Hadfield et al. (2010, 2011). Species descriptions were prepared in DELTA (Descriptive Language for Taxonomy, see Coleman et al. 2010) using a general Cymothoidae character set (as in Hadfield et al. 2013, 2014). Ratios and measurements were rounded off to one decimal place and were made using maximum values of the specific measured article. Classification follows Brandt and Poore (2003). Host nomenclature and distribution are from FishBase (Froese and Pauly 2014).

Abbreviations. AMNH – American Museum of Natural History, New York, NY, USA; TL – total length; USNM – National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; W – width.

Taxonomy

Family Cymothoidae Leach, 1814

Genus *Mothocya* Costa, in Hope, 1851

Mothocya Costa, in Hope, 1851: 48. – Trilles 1968: 168. – Monod 1971: 174. – Bruce 1986: 1092–1095. – Trilles 1994: 197.

Irona Schioedte & Meinert, 1884: 381. – Stebbing 1905: 27. – Richardson 1905: 265. – Hale 1926: 218. – Monod 1971: 174. – Kussakin 1979: 307. – Trilles 1994: 166.

Diagnosis. Body not vaulted, widest at pereonite 5, usually twisted to one side. Cephalon with rostrum folded back, anterior margin rounded. Antennae widely separated, antennula longer and more stout than antenna. Eyes distinct. Maxilliped article 3 with 3–5 recurved robust setae; without oostegite lobe. Maxilla mesial lobe partly fused to lateral lobe. Maxillula simple. Pereonite 1 anterolateral angles slightly extended around cephalon. Pleon subequal to pereon. Pleonite 1 partly concealed by pereonite 7. Coxae 5–7 dorsally visible, projecting posteriorly past respective somite; large, and rounded, reniform. Brood pouch formed from coxae 2–4 and 6. Pereopods without carina, never enlarged or with protrusions. Pleopods simple, without setae. Pleopods 3–5 with lamellar proximomedial lobe, frequently with peduncle lobe. Uropod peduncle without retinaculae, exopod longer than endopod.

Type species. *Mothocya epimerica* Costa, in Hope, 1851; by subsequent designation (Bruce 1986). Costa, in Hope (1851) described three species, *M. contracta* Costa, in Hope, 1851, *M. detecta* Costa, in Hope, 1851 and *M. epimerica* of which only *M. epimerica* is recognised as a valid species.

Remarks. Female *Mothocya* are often twisted to one side due to the confines of the gill chamber. *Mothocya* can be identified by the asymmetrical body shape, antennula longer than the antenna, a maxilliped with an oostegite lobe and the brood pouch from coxae 2–4 and 6. Males are smaller and not twisted, with appendix masculina on pleopod 2.

A detailed diagnosis of *Mothocya* was given by Bruce (1986), including female and male characters as well as additional characters for the genus. The current diagnosis is a shortened and updated version with more information on the main defining characters such as the body, pleopod and uropod morphology. These important characteristics are very useful in species identifications, as is the host species with some *Mothocya* species being host species or host genus specific.

Bruce (1986) synonymised *Irona* with *Mothocya*, with many of the *Irona* species actually being junior synonyms for *Mothocya* species. The validity of the genus *Irona* was considered uncertain for many years (Monod 1923, 1971, Trilles 1968) after Schioedte and Meinert (1884) described it as well as redescribing *Mothocya* in the same paper. Bruce (1986) described 18 new species of *Mothocya* in his review, nine of which had synonymies from earlier misidentifications. Many species appear very similar in general appearance, with the antennulae, antennae, mouthparts and pereopods uniform across species and thus not very informative at species level (Bruce 1986).

When looking at individual characters, *Mothocya* can be distinguished from other gill-inhabiting genera. *Elthusa* Schioedte & Meinert, 1884 is similar to *Mothocya* and can be distinguished by the antennula being shorter than the antenna (longer in *Mothocya*), maxilliped article 3 is slender with setae (robust and without setae in *Mothocya*), and the pereopod dactyli are relatively short whereas they are long and robust in *Mothocya* (Bruce 1990). *Ichthyoxenus* Herklots, 1870, differs from *Mothocya* with the antennula being shorter than the antenna, having a strongly ovate and vaulted body, as well as a narrow pleon and short and rounded coxae.

Mothocya occurs in all oceans and is predominantly tropical and subtropical in its distribution. Currently 29 species names are valid (*Mothocya contracta* Costa, in Hope, 1851 designated as *nomen dubium*), with four species described since Bruce's (1986) monograph.

Mothocya xenobranchia Bruce, 1986

Figs 1–2

Mothocya xenobranchia Bruce, 1986: 1116–1119, figs. 13–14. – Trilles 1994: 203. – Bunkley-Williams et al. 1998: 29. – Bunkley-Williams et al. 2006: 178. – Schotte et al. 2009: 983.

Material examined. ♀ (15.0 mm TL; 10.0 mm W), ♂ (9.0 mm TL; 4.0 mm W) collected from Lameshur Bay, 18°18'59"N, 64°43'25"W, St. John Island, US Virgin Islands, from the gills of the Atlantic needlefish (34 mm TL), *Strongylura marina*, 18 May 2013, coll. Nico J. Smit (AMNH_IZC 00197448).

Ovigerous female. Body moderately twisted, 1.4 times as long as greatest width, strongly arched longitudinally, widest at pereonite 3, most narrow at pereonite 1, lateral margins slightly convex. Cephalon 0.7 times longer than wide, visible from dorsal view,

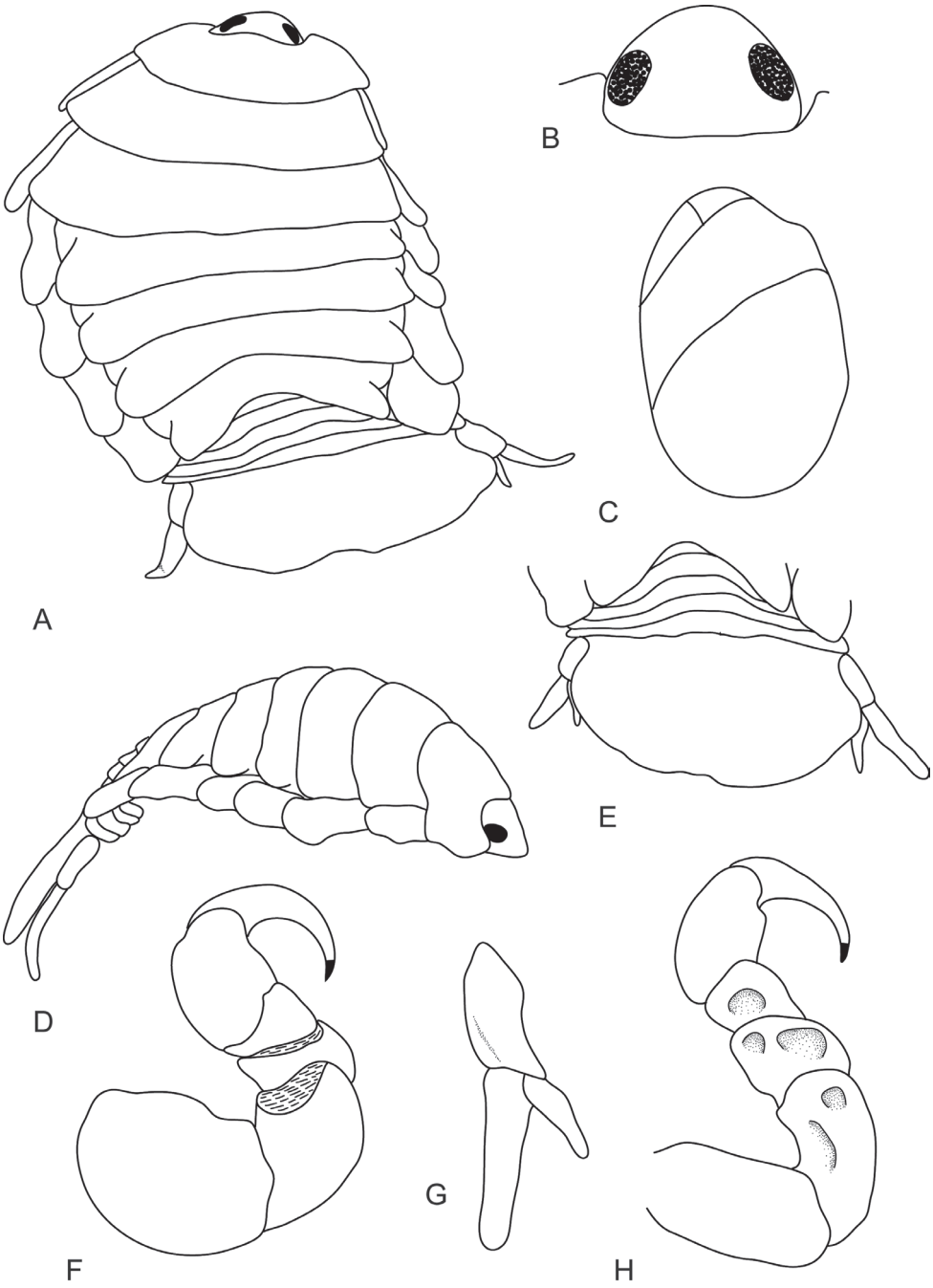

Figure 1. *Mothocya xenobranchia* Bruce, 1986 (15 mm) (AMNH_IZC 00197448): **A** dorsal view **B** dorsal view of cephalon **C** oostegites **D** lateral view **E** dorsal view of pleotelson **F** pereopod 1 **G** uropod **H** pereopod 7 showing indentations.

subtriangular. Eyes oval with distinct margins, 0.2 times width of cephalon, 0.4 times length of cephalon. Coxae 2–3 narrow; 4–7 large, rounded and produced, slightly produced past pereonite margin. Pereonites 1–4 increasing in length and width; 5–7 decreasing in length and width; becoming more progressively rounded posteriorly. Pleon with pleonite 1 largely concealed by pereonite 7; pleonites posterior margin smooth, mostly concave; pleonites 2–5 partially overlapped by pereonite 7; pleonite 5 posterior margin straight. Pleotelson 0.6 times as long as anterior width, dorsal surface smooth, anterolateral margin recessed, lateral margins widen slightly then curve inwards, posterior margin broadly truncate, without median point.

Antennula comprised of 7 articles; articles 1 and 2 distinct and articulated; article 2 0.8 times as long as article 1; article 3 as long as wide, 0.5 times as long as combined lengths of articles 1 and 2; last article terminating in 4–7 short simple setae. Antenna comprised of 7 articles; article 3 1.2 times as long as article 2, 2.1 times as long as wide; article 4 2.3 times as long as wide, 0.9 times as long as article 3; article 5 0.7 times as long as article 4, 1.7 times as long as wide; last article terminating in 6–7 short simple setae.

Molar process present, mandible palp without setae. Maxillula with 4 terminal robust setae. Maxilla lateral lobe with 2 recurved robust setae; mesial lobe with 2 large recurved robust setae. Maxilliped weakly segmented, palp article 2 with no simple setae, article 3 with 4 recurved robust setae and no simple setae.

Pereopod 1 basis 1.2 times as long as greatest width; ischium 0.9 times as long as basis; merus proximal margin with slight bulbous protrusion; carpus with straight proximal margin; propodus 1.3 times as long as wide; dactylus slender, 1.1 times as long as propodus, 2.3 times as long as basal width. Pereopod 7 basis 1.9 times as long as greatest width; ischium 0.9 as long as basis, without protrusions; merus proximal margin without bulbous protrusion, 0.5 as long as ischium, 0.9 times as long as wide; carpus 0.9 as long as ischium, without bulbous protrusion, 1.1 times as long as wide; propodus 0.8 as long as ischium, 1.7 times as long as wide; dactylus slender, 0.9 as long as propodus, 2.4 times as long as basal width. Pereopod 7 with small indentations on the inner side of the ischium, merus and carpus.

Pleopod 1 exopod as long as wide, lateral margin strongly convex, distally broadly rounded, mesial margin strongly convex; endopod 1.2 times as long as wide, lateral margin weakly convex, distally narrowly rounded, mesial margin straight, peduncle 0.7 times as wide as long. Pleopods 2–5 similar in structure to pleopod 1. Large medial lobes present and increasing in size from pleopods 1 to 5. Peduncle lobes increasing in size from pleopods 2 to 5.

Uropod longer than pleotelson; peduncle 0.7 times longer than exopod, lateral margin without setae; rami extending beyond pleotelson, marginal setae absent, apices broadly rounded. Endopod apically slightly pointed, 3.6 times as long as greatest width, lateral margin weakly convex, mesial margin weakly convex, terminating without setae. Exopod extending beyond endopod, 1.9 times longer than endopod, 3.8 times as long as greatest width, apically rounded, lateral margin straight, mesial margin straight, terminating without setae.

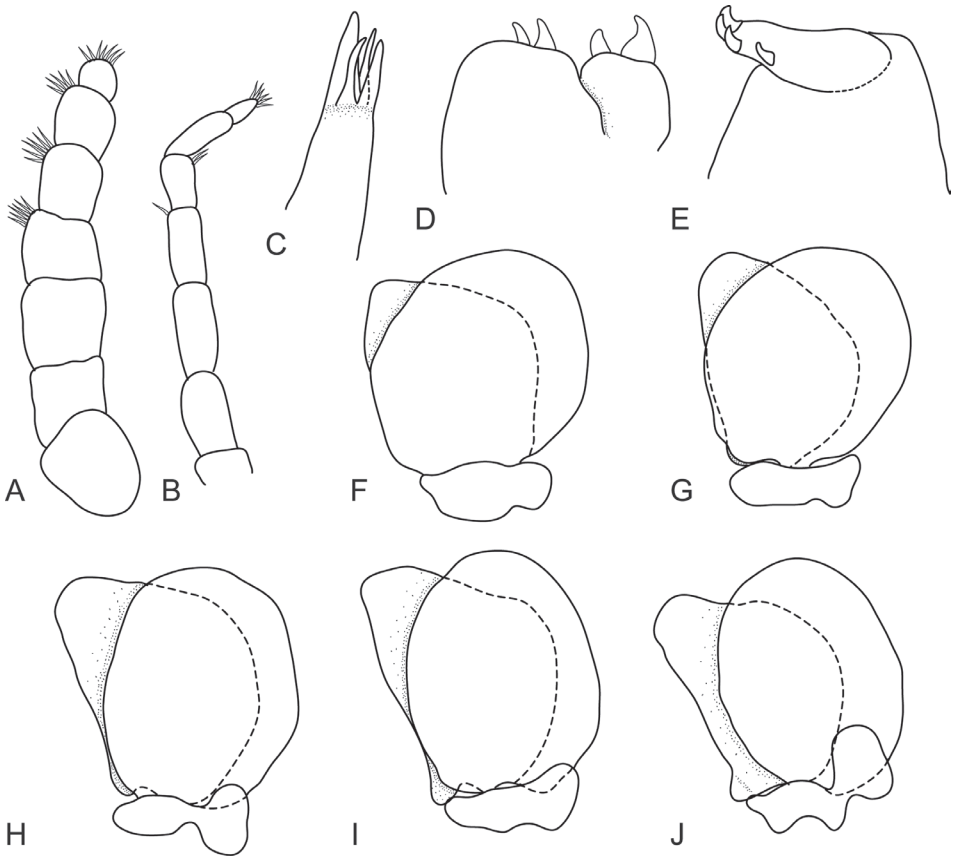

Figure 2. *Mothocya xenobranchia* Bruce, 1986 (15 mm) (AMNH_IZC 00197448): **A** antennula **B** antenna **C** tip of maxillula **D** tip of maxilla **E** tip of maxilliped article 3 **F** pleopod 1 **G** pleopod 2 **H** pleopod 3 **I** pleopod 4 **J** pleopod 5.

Type material. Holotype (16.2 mm TL) from the gill cavity of *Tylosurus crocodilis crocodilis* from Bahia Mochima, Venezuela (USNM 216274); Paratypes (USNM 216275–216278) (Bruce 1986; not examined).

Distribution. Off the coast of Florida, Florida Keys (USA); Cumaná, Venezuela (Bruce 1986, Bunkley-Williams et al. 1998, Schotte et al. 2009); and St. John Island, US Virgin Islands (present study).

Hosts. Known from the hound needlefish, *Tylosurus crocodilis crocodilis* (Péron & Lesueur, 1821) (Bruce 1986, Bunkley-Williams et al. 1998, Schotte et al. 2009) and *Strongylura marina* (Walbaum, 1792) (previously unconfirmed but verified in the present study). There is also another unconfirmed record from *S. notata notata* (Poey, 1860) in Florida (Bruce 1986).

Remarks. *Mothocya xenobranchia* is known from Belonidae fish hosts and distinguished by the broad body which is arched in lateral view, the invaginations on the inner portion of pereopod 7, antenna with seven articles, and the shape of the pleotelson which is tapered anteriorly, then widens before bluntly rounding off.

When comparing *M. xenobranchia* from the present study to the description given by Bruce (1986) there are a few minor differences but these are within the normal range of species variation. Variations include a different length to width ratio of the body and size of the eyes on the cephalon, more pronounced rostrum in the holotype, different number of setae on maxilla, but these characteristics given by Bruce (1986) are averages based on many specimens and can be variable depending on the specimen. In his remarks on the species, Bruce (1986) states the antenna can have seven or eight articles too and thus even this difference can be accounted for.

The other Caribbean species differ from *M. xenobranchia* in that *M. bermudensis* is smaller overall, with smaller eyes and less produced coxae; *Mothocya argenosa* has larger eyes, a larger and rounder pleotelson and smaller coxae; and *M. nana* has a narrower body shape and is not arched longitudinally. *Mothocya bohlkeorum* has a narrow strongly produced rostrum; antennula and antenna bases closer together; larger and rounder coxae; and less developed proximomedial and peduncle lobes on the pleopods. Lastly, *M. omidaptria* has much longer uropods, is not arched in lateral view, acute coxae on pereonite 7, and a narrowly produced rostrum. Furthermore, these species all have different hosts to *M. xenobranchia* and thus there is no overlap of this isopod species on its host species in the Caribbean.

This record of *M. xenobranchia* in the US Virgin Islands is a new locality record and also confirms the previously uncertain host record of *Strongylura marina* (Bruce 1986). The locality record conforms to the distribution of this species within the western Atlantic. Likewise, the host record is also from a Belonidae species and thus conforms to the host preference of this species.

Mothocya bertlucy sp. n.

http://zoobank.org/DC08E45E-5DDF-40D5-9310-B3AEA5C68265
Figs 3–7

Material examined. All material from the gills of the redlip blenny, *Ophioblennius macclurei*.

Holotype. Ovigerous ♀ (8.0 mm TL; 4.5 mm W), collected from Lameshur Bay, 18°18'59"N, 64°43'25"W, St. John Island, US Virgin Islands, July 2013, coll. L. Renoux & J. Sellers (AMNH_IZC 00197449).

Paratypes. ♀ dissected (7.0 mm TL; 3.5 mm W), three immature ♂♂, one dissected (5.5–6.0 mm TL; 2.0–2.5 mm W), collected from Brewers Bay, 18°20'24"N, 64°58'44"W, St. Thomas Island, Caribbean Sea), 19 May 2013, coll. J. A. Barry & A. McCammon (AMNH_IZC 00197450). Ovigerous ♀ (9.0 mm TL; 5.0 mm W), collected from Lameshur Bay, 18°18'59"N, 64°43'25"W, St. John Island, US Virgin Islands, July 2013, coll, L. Renoux & J. Sellers (AMNH_IZC 00197451). Ovigerous ♀ (7.5 mm TL; 4.0 mm W), mature ♂ (6.0 mm TL; 4.0 mm W), collected from Guana Island, 18°28'0"N, 64°33'59"W, British Virgin Islands, 07 July 2013, coll: R. Ditter & J. Barry (AMNH_IZC 00197452).

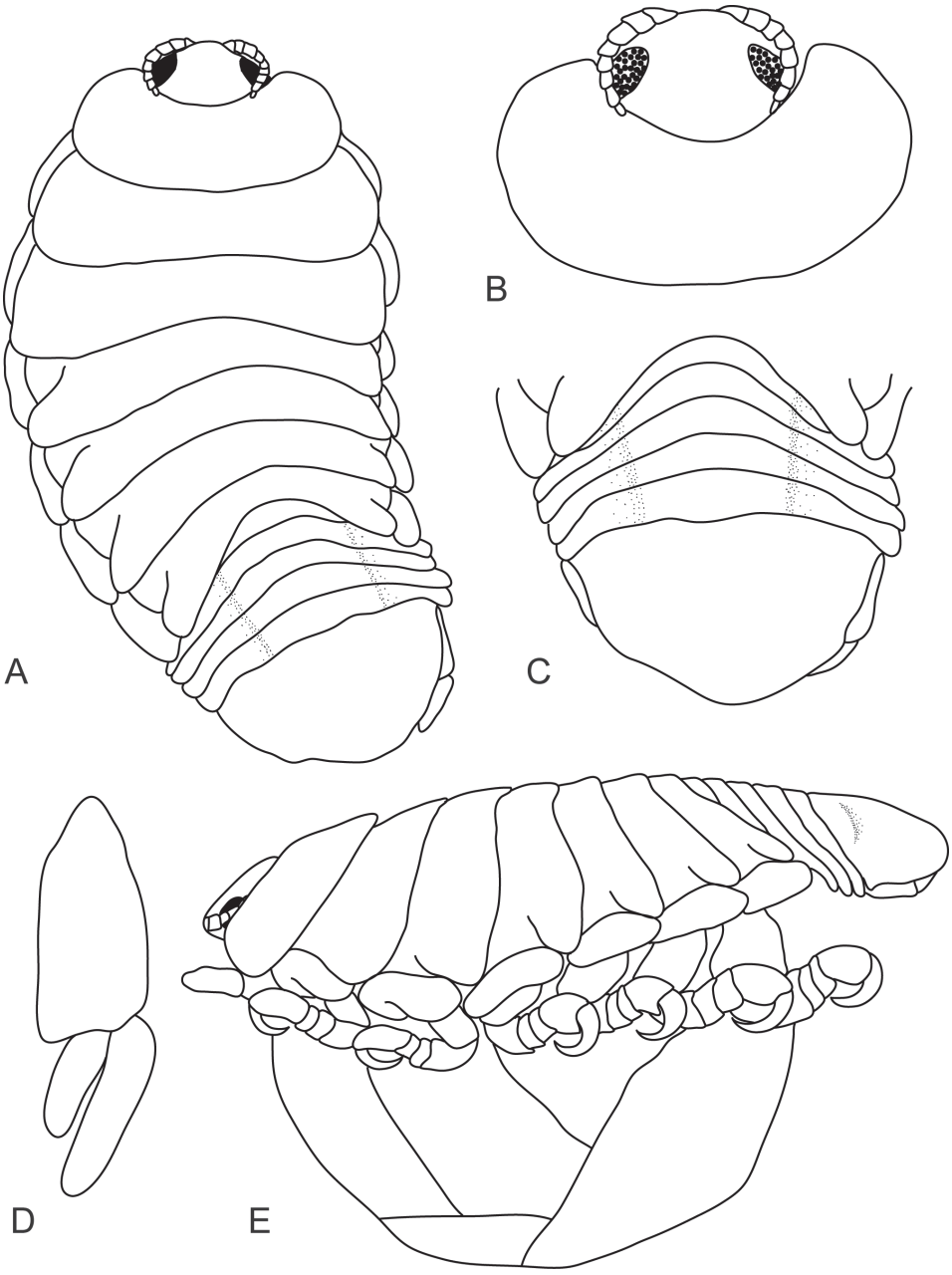

Figure 3. *Mothocya bertlucy* sp. n. ovigerous female holotype (7 mm) (AMNH_IZC 00197449): **A** dorsal view **B** anterodorsal view of pereonite 1 and cephalon **C** dorsal view of pleotelson **D** uropod **E** lateral view.

Ovigerous female holotype. Body oval and moderately twisted, 1.9 times as long as greatest width, widest at pereonite 3, most narrow at pereonite 1, lateral margins slightly convex. Cephalon 0.7 times longer than wide, visible from dorsal view. Eyes

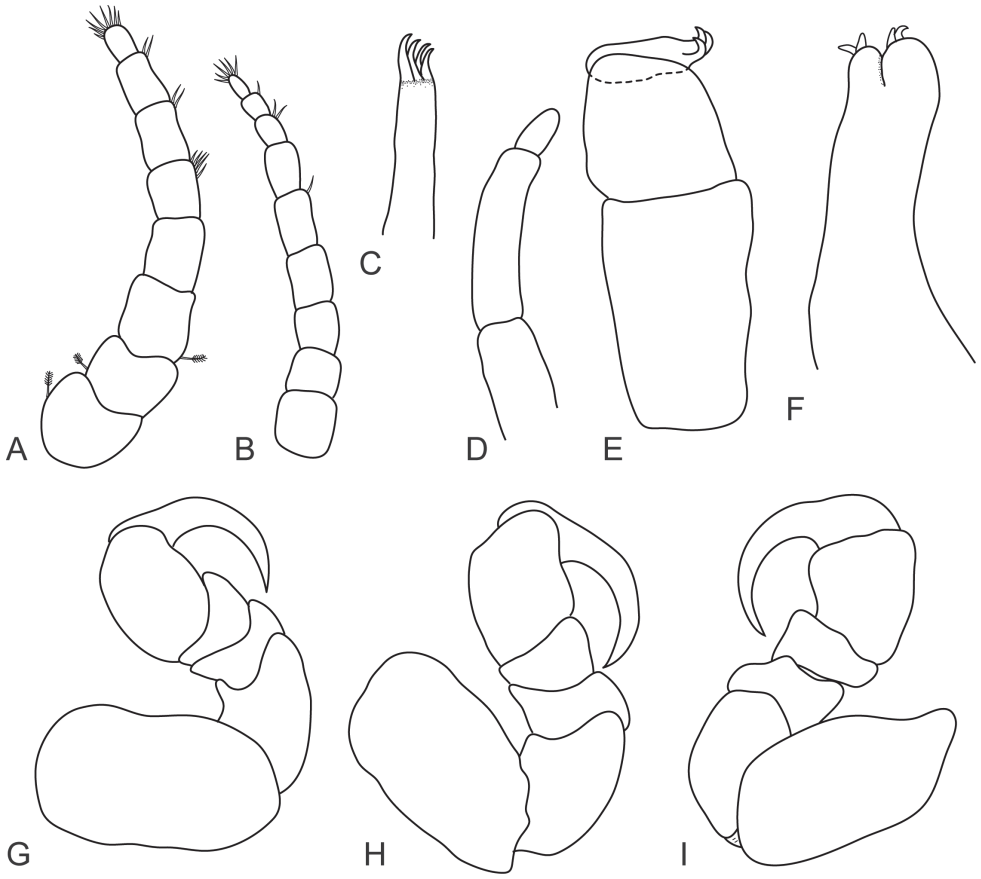

Figure 4. *Mothocya bertlucy* sp. n. female paratype (7 mm) (AMNH_IZC 00197450): **A** antennula **B** antenna **C** maxillula **D** molar process **E** maxilliped **F** maxilla **G** pereopod 1 **H** pereopod 2 **I** pereopod 7.

oval with distinct margins, 0.2 times width of cephalon, 0.4 times length of cephalon. Pereonite 1 smooth, anterolateral angle rounded. Posterior margins of pereonites smooth and slightly curved laterally. Coxae narrow with rounded point, shorter or same length as pereonite. Pereonites 1–3 increasing in length and width; 4–7 decreasing in length and width, becoming progressively rounded posteriorly. Pleon with pleonite 1 largely concealed by pereonite 7, visible in dorsal view; pleonites posterior margin smooth, mostly concave; pleonite 2 partially overlapped by pereonite 7; pleonite 5 posterior margin slightly concave. Pleotelson 0.6 times as long as anterior width, dorsal surface smooth, lateral margins weakly concave, posterior margin converging to blunt caudomedial point.

Antennula comprised of 8 articles; articles 1 and 2 distinct and articulated with plumose setae; article 2 0.9 times as long as article 1; article 3 1.2 times as long as wide, 0.5 times as long as combined lengths of articles 1 and 2 with plumose seta; short simple

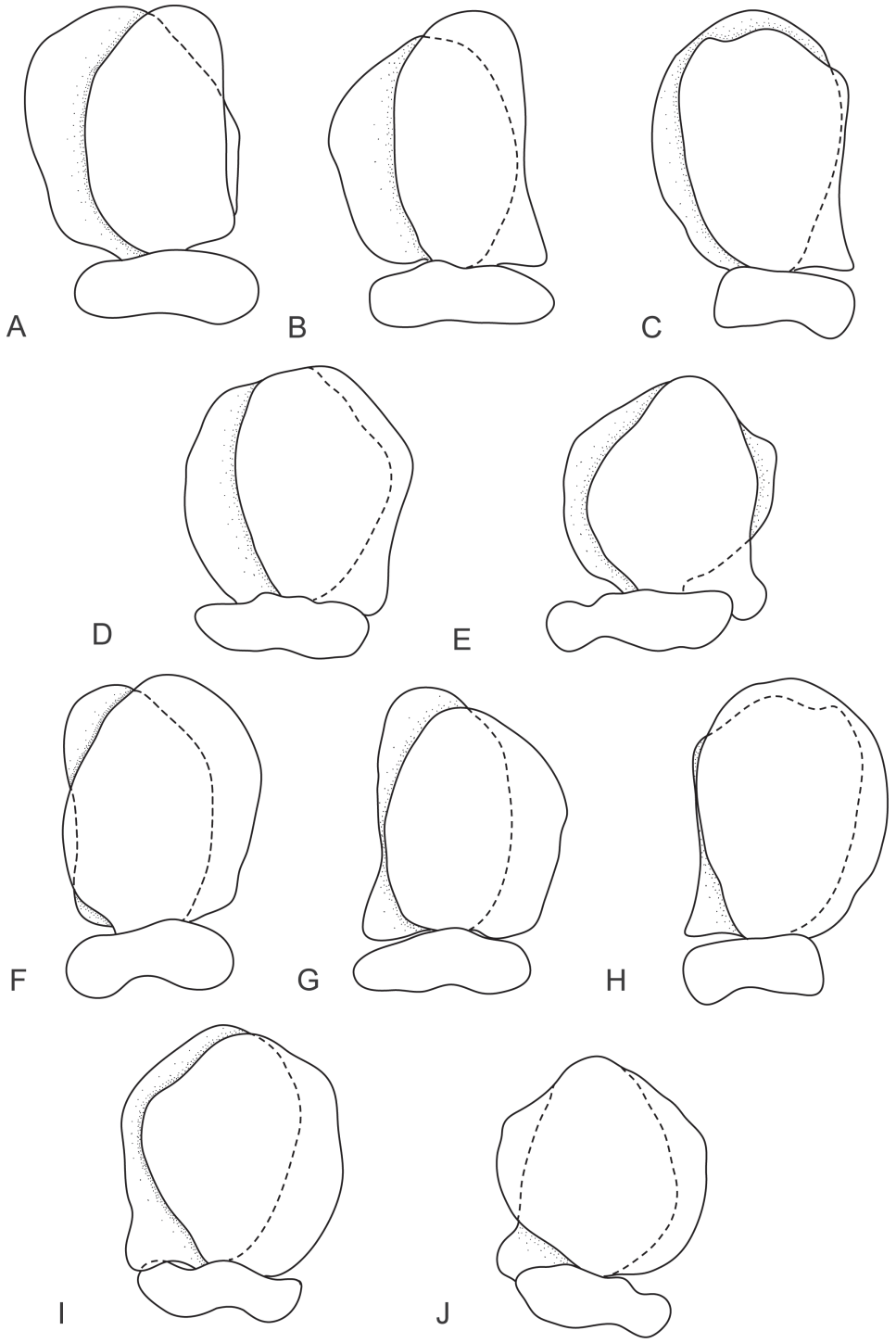

Figure 5. *Mothocya bertlucy* sp. n. female paratype (7 mm) (AMNH_IZC 00197450): **A–E** dorsal pleopod 1–5 respectively **F–J** ventral pleopod 1–5 respectively.

setae present on last four articles, last article terminating in 4–8 short simple setae. Antenna comprised of 9 articles; article 3 1.3 times as long as article 2, 1.3 times as long as wide; article 4 1.4 times as long as wide, 1.1 times as long as article 3; article 5 as long as article 4, 1.4 times as long as wide; short simple setae on last three articles, last article terminating in 6–7 short simple setae.

Molar process present, mandible palp without setae. Maxillula with 4 terminal robust setae. Mxilla lateral lobe with 2 recurved robust setae; mesial lobe with 2 large recurved robust setae. Maxilliped comprised of 3 articles, palp article 2 without simple setae, article 3 with 3 recurved robust setae, and no simple setae.

Pereopods without robust or simple setae. Pereopod 1 basis 1.8 times as long as greatest width; ischium 0.6 times as long as basis; merus proximal margin without bulbous protrusion; carpus with straight proximal margin; propodus 1.4 times as long as wide; dactylus slender, 1.3 times as long as propodus, 2.6 times as long as basal width. Pereopod 2 propodus 1.3 as long as wide; dactylus 1.3 as long as propodus. Pereopod 7 basis 1.7 times as long as greatest width; ischium 0.7 as long as basis, without protrusions; merus proximal margin with slight bulbous protrusion, 0.4 as long as ischium, 0.6 times as long as wide; carpus 0.9 as long as ischium, without bulbous protrusion, 0.6 times as long as wide; propodus 0.9 as long as ischium, 1.3 times as long as wide; dactylus slender, 1.7 as long as propodus, 2.7 times as long as basal width.

Pleopod 1 exopod 1.3 times as long as wide, lateral margin weakly convex, distally narrowly rounded, medial margin weakly oblique, mesial margin strongly convex; endopod 1.8 times as long as wide, lateral margin weakly convex, distally narrowly rounded, mesial margin straight, peduncle 0.4 times as wide as long. Pleopods 2–5 similar to pleopod 1. Proximomedial lobes present and increasing in size from pleopod 1 to 5. Peduncle lobes absent.

Uropod more than half the length of pleotelson, peduncle 1.2 times longer than rami, peduncle lateral margin without setae; rami not extending beyond pleotelson, marginal setae absent, apices broadly rounded. Endopod apically rounded, 2.8 times as long as greatest width, lateral margin straight, mesial margin straight, terminating without setae. Exopod extending beyond endopod, 1.7 times longer than endopod, 4.2 times as long as greatest width, apically rounded, lateral margin straight, mesial margin straight, terminating without setae.

Male. Males similar to females but smaller. Body more oval and not twisted, 2.1 times as long as wide. Maxilliped article three with three recurved robust setae. Maxilla with one recurved robust seta on the medial lobe and two on the lateral lobe. Penis set close together, medially united. Pleopod 2 appendix masculina basally swollen, 0.8 times as long as endopod, distally bluntly rounded. Pleotelson triangular converging to a sharp caudal point. Uropods extend past posterior margin of pleotelson and endopod is longer, exopod 1.5 times as long as endopod.

Size. Ovigerous females (7.0–9.0 mm TL; 3.5–5.0 mm W), non-ovigerous females (7.0 mm TL; 3.0 mm W); mature male (6.0 mm TL; 4.0 mm W), immature males (5.5–6.0 mm TL; 2.0–2.5 mm W).

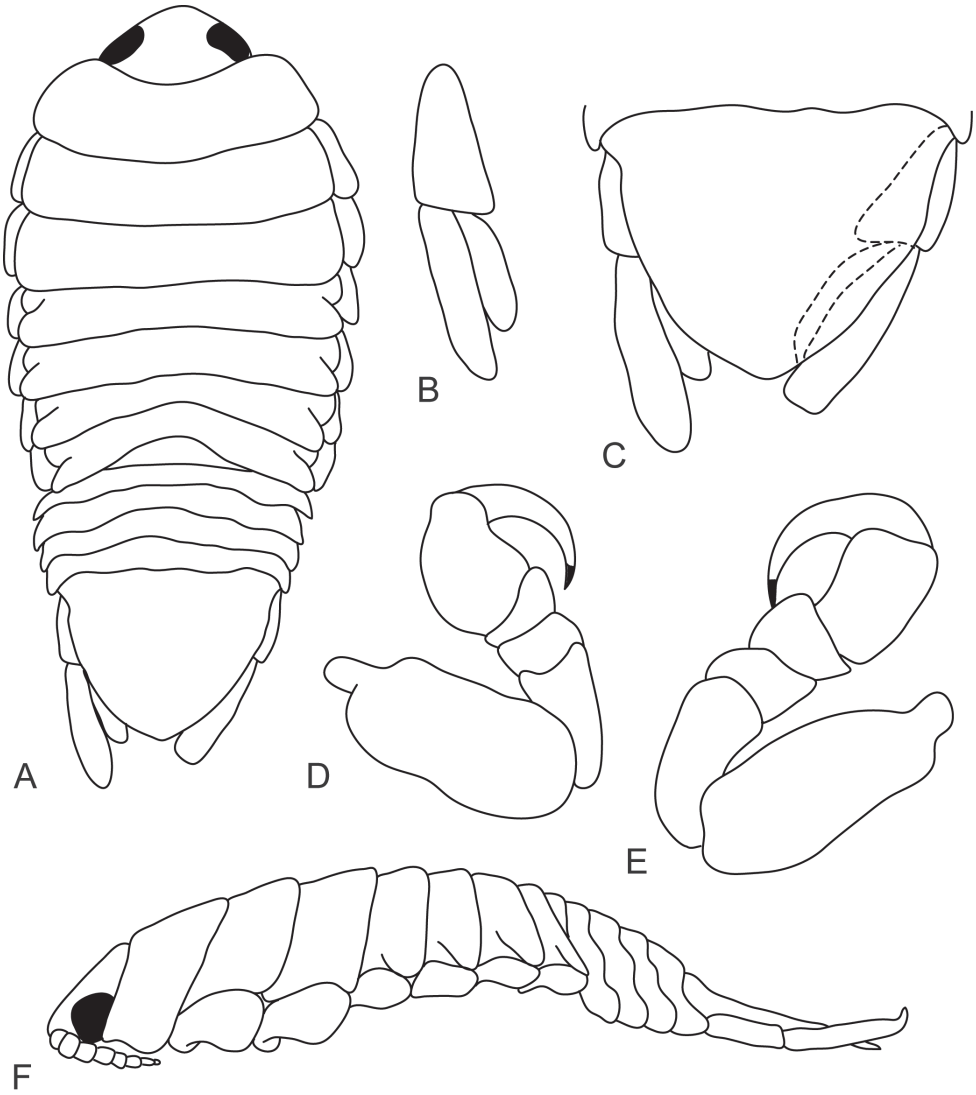

Figure 6. *Mothocya bertlucy* sp. n. male paratype (5.5 mm) (AMNH_IZC 00197450): **A** dorsal view **B** uropod **C** dorsal view of pleotelson **D** pereopod 1 **E** pereopod 7 **F** lateral view.

Etymology. This species is named in honour of Ernest H. ("Bert") Williams Jr. and Lucy Bunkley-Williams on the occasion of their retirement and in recognition of their contribution to Caribbean marine parasitology; noun in apposition.

Distribution. Known from St. John, St. Thomas, and Guana Islands, Caribbean Sea.

Hosts. Only known from the redlip blenny, *Ophioblennius macclurei* (Silvester, 1915).

Remarks. *Mothocya bertlucy* sp. n. can be identified by its unique host (redlip blenny), small size (like those reported from atherinids), relatively small eyes, the small

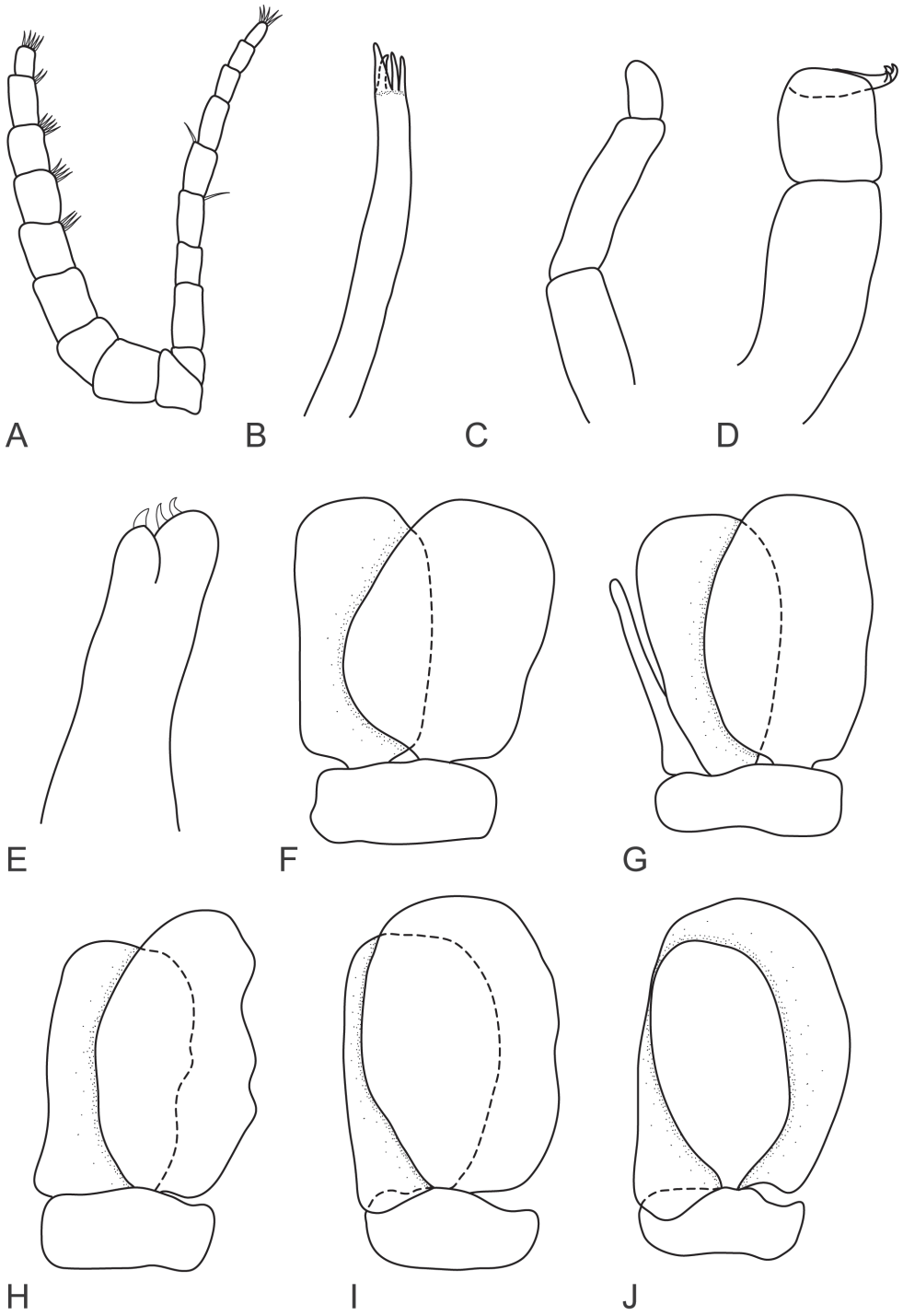

Figure 7. *Mothocya bertlucy* sp. n. male paratype (5.5 mm) (AMNH_IZC 00197450): **A** antennula and antenna **B** maxillula **C** molar process **D** maxilliped **E** maxilla **F–J** pleopod 1–5 respectively.

pleotelson with a narrowly rounded caudomedial point, large uropod peduncle with short rami, uropods which do not extend past the pleotelson posterior margin, and the narrow pleon which is only slightly overlapped by pereonite 7.

The species most similar to *Mothocya bertlucy* sp. n. is *M. rosea* Bruce, 1986 found on the Mexican and Californian coasts. In comparison to *M. bertlucy*, *M. rosea* has more produced proximomedial lobes on pleopods 3–5, larger eyes, broad truncate pleotelson, and four setae on the maxilliped article 3.

The three small *Mothocya* species from atherinids (*M. argenosa*; *M. epimerica*; and *M. waminda* Bruce, 1986) were all compared to the current species. *Mothocya argenosa* from the western Atlantic measures 5.6–9.8 mm, but has larger eyes, longer uropods, the pleotelson is more rounded and the posterolateral margins of pereonite 7 are acute. *Mothocya epimerica* from the Mediterranean has a more pointed rostrum, rounded pleotelson, larger eyes and four setae on the maxilliped. *Mothocya waminda* from the Indo-Pacific has an appendix masculina on pereopod 2 in the female and longer uropods.

Mothocya bertlucy sp. n. differs from all the other known Caribbean species in that *M. bohlkeorum* has much larger and more produced coxae and a larger truncate pleotelson; *M. nana* has a wider pleotelson, truncate rostrum and larger coxae; *M. bermudensis* has an antennula with only seven articles, large eyes and an arched body; and *M. omidaptria* has longer uropods extending past the pleotelson, a strongly produced rostrum and acute coxae as well as posterolateral angles of pereonite 7.

This is the first account of a *Mothocya* species from the US Virgin Islands and is also the first record on a blenny, which helps establish its status as a new species as Bruce (1986) commented that "host identity may be useful in making a *Mothocya* identification."

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RESEARCH ARTICLE

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A new species of *Ptilomymar* (Hymenoptera, Mymaridae) and a key to the described species

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Abstract

Ptilomymar dianensis **sp. n.** (Hymenoptera, Mymaridae) from southwest China is described and illustrated. A key to the six described species is given. The type specimens are deposited in the insect collections of Northeast Forestry University, China.

Keywords

Chalcidoidea, Mymaridae, *Ptilomymar dianensis*, taxonomy, new species, China

Introduction

Ptilomymar was established by Annecke and Doutt (1961). Currently, this genus contains five described species, *Ptilomymar rete* Annecke & Doutt from Mexico, *P. orientalis* Taguchi from the Philippines (Taguchi, 1972), *P. besucheti* Viggiani from Sri Lanka (Viggiani, 1974), *P. magnificum* Yoshimoto from Canada (Yoshimoto 1990), and *P. dictyon* Hayat & Anis from India (Hayat and Anis 1999). Here we describe a new species of *Ptilomymar* from southwest China. A tentative key to species is provided based on their original descriptions. No types other than that of the new species were examined.

Materials and methods

Specimens were collected from Yunnan Province (southwest China) using yellow pan traps. Specimens were dissected and mounted dorsally or laterally in Canada balsam on slides following the method described by Noyes (1982) and modified for the Mymaridae by Huber (1988). Photographs were taken with a digital CCD camera attached to an Olympus BX51 compound microscope, and most measurements were made from slide-mounted specimens using an eye-piece reticle. Total body length excluding ovipositor was measured with an eye-piece reticle from alcohol-preserved specimens before being dissected. All measurements are given in micrometers (μm). Specimens studied are deposited in the following institution:

NEFU Northeast Forestry University, Harbin, China.

Morphological terminology and abbreviations are those of Gibson (1997) and Huber (2012), as follows (with some additions):

OD Mid ocellar diameter
OOL Ocular-ocellar length
LOL Least ocellar length
POL Postocellar length
Fl_n Flagellar segment
Gt_n Gastral tergum

Results

Key to species of *Ptilomymar* of the world (based on features from the original descriptions and illustrations).

(Note: females are not known for *orientalis*; males are not known for *dictyon* and *rete*)

1 ♀: flagellum clavate, funicle 8-segmented and clava 1-segmented..... **2**
– ♂: flagellum filiform, 11-segmented **6**
2 Scape distinctly enlarged ventrally in apical half (Fig. 1) **3**
– Scape not distinctly enlarged ventrally in apical half **4**
3 Pedicel about 1.6× as long as fl_1; fl_1 distinctly longer than wide (Fig. 1); fore wing about 3.6× as long as wide, with a triangular dark brown marking behind marginal vein (Fig. 4); metanotum about 0.25× as long as scutellum.... ..... ***P. dianensis* sp. n.**
– Pedicel about 5.0× as long as fl_1; fl_1 as long as or at most slightly longer than wide; fore wing about 5.4× as long as wide, without a broad dark band behind marginal vein; metanotum slightly less than 0.5× as long as scutellum.. ..... ***P. magnificum***

4 Propodeum with strong reticulations lateral to the translucent carinae; petiole not much longer than wide; gt_1 with small translucent carinae..... ***P. rete***

– Propodeum almost smooth lateral to the translucent carinae; petiole at least 2× as long as wide; gt_1 with large translucent carinae **5**

5 Fl_7 and fl_8 each distinctly shorter than $fl_{3–6}$ individually; gt_1 with a pair of scale-like setae on each side; ovipositor not exserted ..... ***P. dictyon***

– $Fl_{3–8}$ almost subequal in length; gt_1 without scale-like setae; ovipositor distinctly exserted..... ***P. besucheti***

6 Propodeum with unbranched spiracular setae ..... ***P. orientalis***

– Propodeum with branched spiracular setae **7**

7 Scape distinctly enlarged ventrally in apical half (Fig. 10) **8**

– Scape not distinctly enlarged ventrally in apical half ..... ***P. besucheti***

8 Pedicel about 1.3× as long as fl_1; fl_1 distinctly longer than wide; fore wing with a triangular dark brown marking behind marginal vein (Fig. 11); metanotum 0.25× as long as scutellum ..... ***P. dianensis* sp. n.**

– Pedicel about 3.0× as long as fl_1; fl_1 as long as or at most slightly longer than wide; fore wing without a broad dark band behind marginal vein; metanotum slightly less than 0.5× as long as scutellum..... ***P. magnificum***

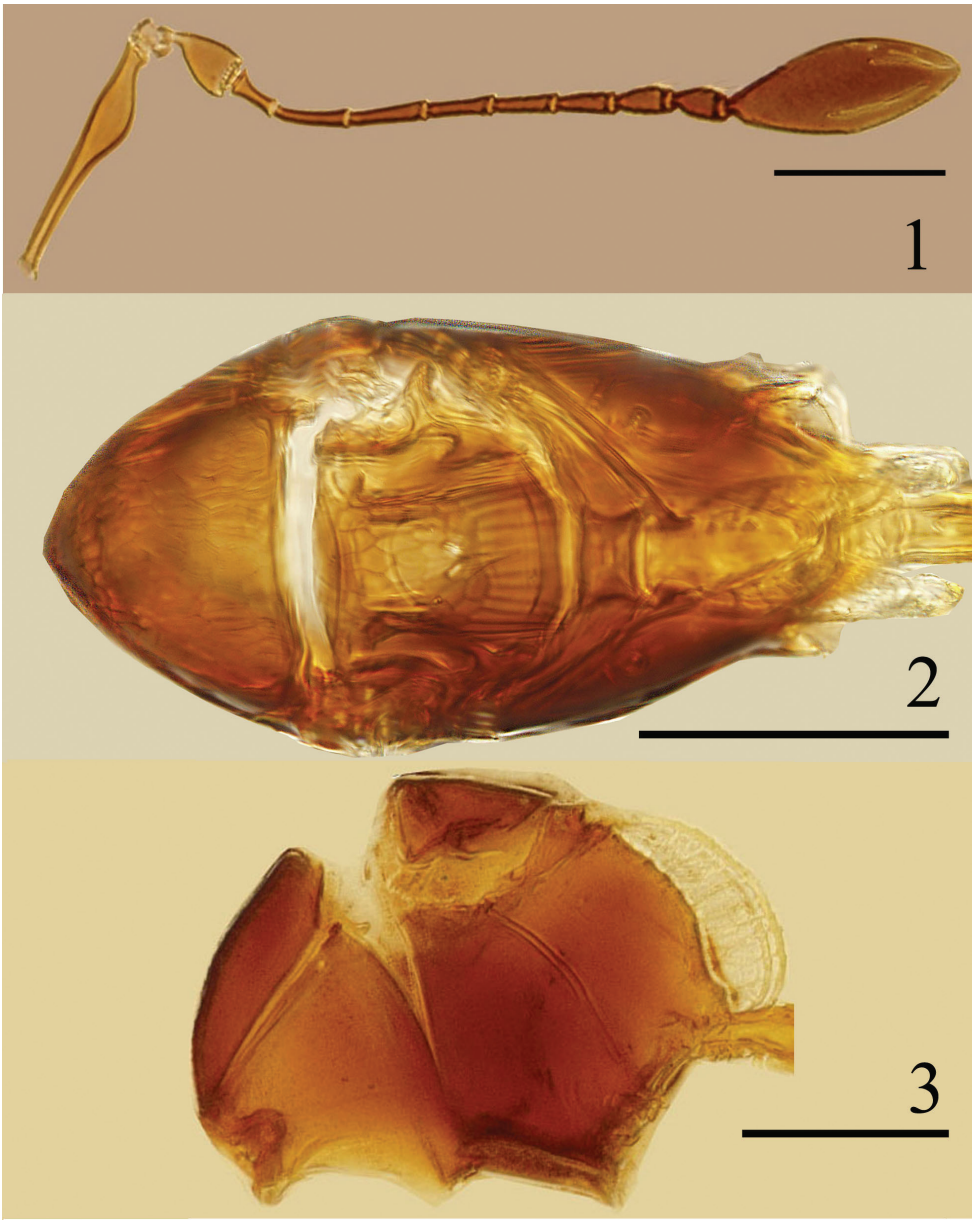
***Ptilomymar dianensis* Jin & Li, sp. n.**
http://zoobank.org/457CE7F5-F306-410B-BE28-E46C5D092CCB
Figs 1–12

Holotype ♀ (NEFU), China, Yunnan Province, Mengla County, Menglun Town, Mannanxing, 11–13.I. 2013, Hui-Lin Han, Ye Chen.

Paratypes. Two males. CHINA. Yunnan. Same data as holotype (1♂, NEFU); Jinghong City, Yexianggu, 17–18.I. 2013, Hui-Lin Han, Ye Chen (1♂, NEFU).

Diagnosis. Scape distinctly enlarged ventrally in apical half; pedicel about 1.6× as long as fl_1; fl_1 distinctly longer than wide; fore wing 3.62× as long as wide, with a triangular dark brown marking behind marginal vein, and a narrow brown strip just beyond venation; gt_1 with large translucent carinae; ovipositor distinctly exserted.

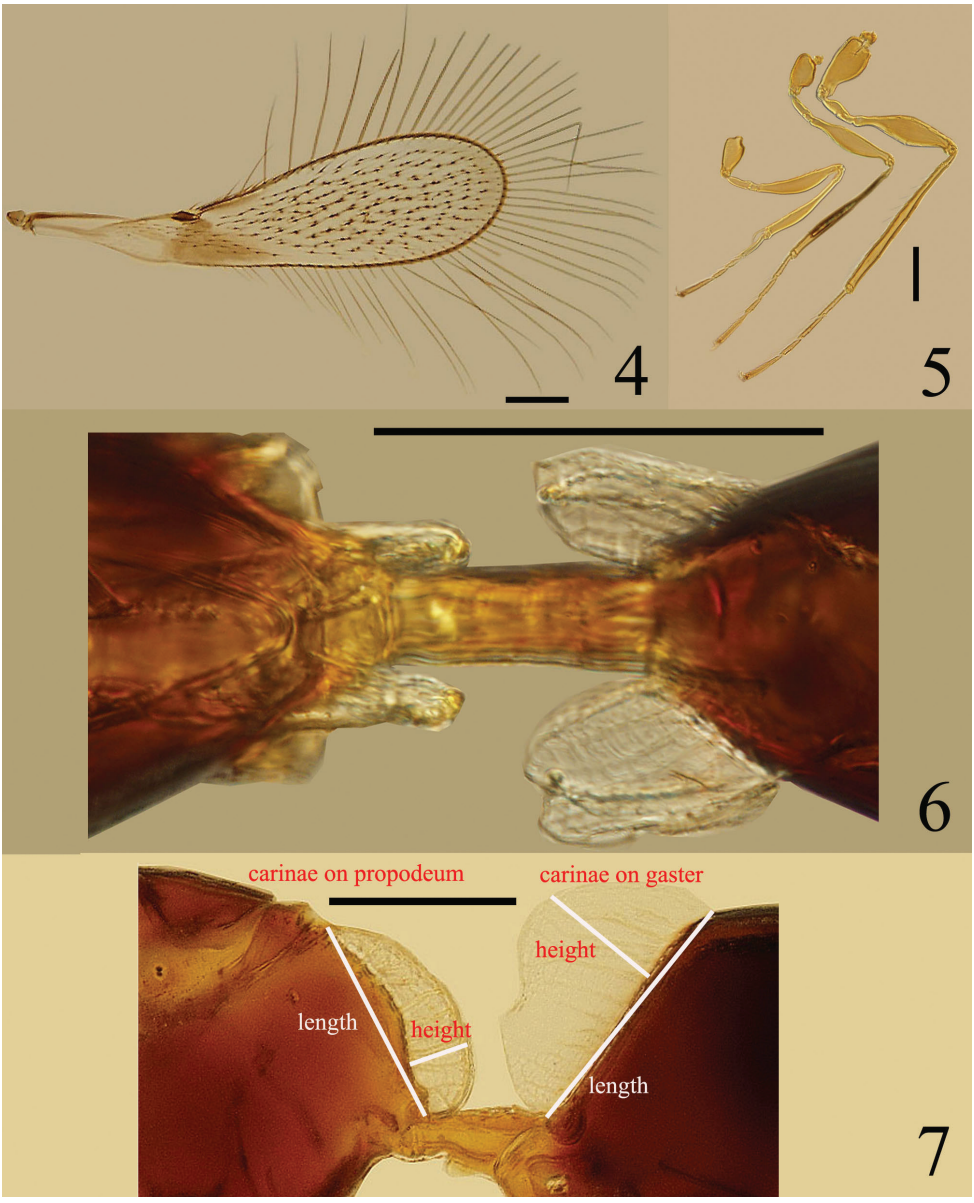
Ptilomymar dianensis is distinguished from most other species except *P. magnificum* by the shape of the scape that is distinctly enlarged ventrally in apical half (the scape not distinctly enlarged ventrally in apical half in the remaining species), *P. dianensis* differs from *P. magnificum* by its longer fl_1 (shorter in *P. magnificum*), wider fore wing (narrower in *P. magnificum*), and shorter metanotum, 0.25× as long as scutellum (longer metanotum, slightly less than 0.5× as long as scutellum in *P. magnificum*). *P. dianensis* differs from *P. rete* by its larger translucent carinae (smaller in *P. rete*) and distinctly exserted ovipositor (not distinctly exserted in *P. rete*). *P. dianensis* differs from *P. orientalis* by its branched spiracular setae on propodeum (unbranched spiracular setae in *P. orientalis*), wider fore wing (narrower in *P. orientalis*), and larger facets (smaller in *P. orientalis*). *P. dianensis* differs from *P. besucheti* and *P. dictyon* by its longer fl_1 (shorter in the latter two), wider fore



Figures 1–3. *Ptilomymar dianensis* sp. n., holotype female: **1** antenna **2** mesosoma, dorsal **3** mesosoma, lateral. Scale bars=100 μm.

wing (narrower in the latter two), distinctly exserted ovipositor (not exserted in *P. dictyon*), $fl_{3–8}$ almost subequal in length (fl_7 and fl_8 each distinctly shorter than $fl_{3–6}$ individually in *P. dictyon*).

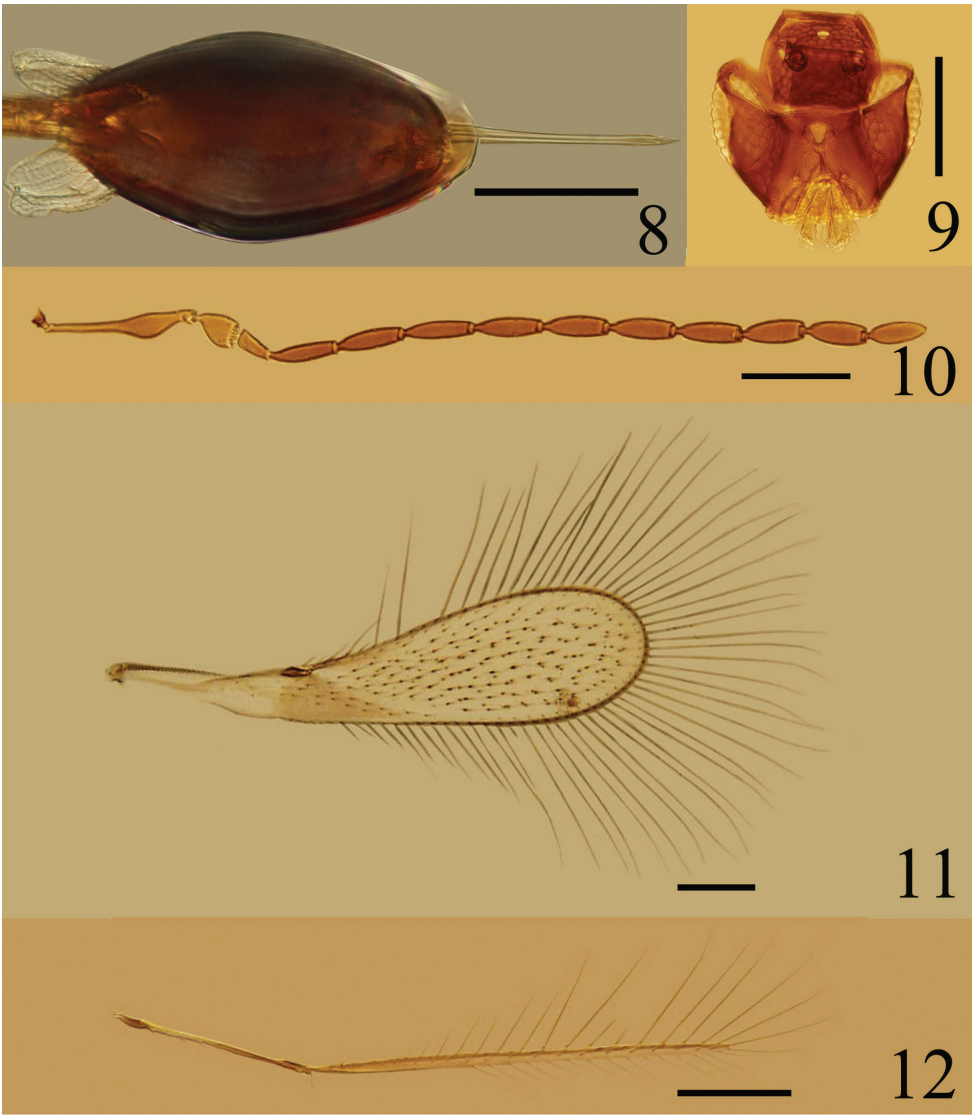
Description. Female. Head dark brown with ocelli black. Antenna brown with fl_1 slightly lighter, scape and pedicel yellowish-brown. Mesosoma dark brown with



Figures 4–7. *Ptilomymar dianensis* sp. n., holotype female: **4** fore wing **5** legs **6** carinae on mesosoma and metasoma, dorsal **7** carinae on mesosoma and metasoma, lateral. Scale bars=100 μm.

pronotum and petiole brown. Fore wing hyaline, with a triangular dark brown marking behind marginal vein, and a narrow brown strip just beyond venation. Venation brown with stigmal vein dark brown. Legs yellowish-brown with last tarsal segments brown. Metasoma dark brown with ovipositor brown.

Head. Eye about 1.5× as long as wide; facets large, each nearly the size of an ocellus. Vertex 0.82× as long as wide, with strong reticulate sculpture; POL about 6.5× as long



Figures 8–12. *Ptilomymar dianensis* sp. n., holotype female: **8** gaster. Paratype male: **9** head, dorsal **10** antenna **11** fore wing **12** hind wing. Scale bars=100 μm.

as OOL. Antenna (Fig. 1). Scape 5.45× as long as wide, longitudinally striate, distinctly enlarged ventrally in apical half; pedicel almost smooth, 1.31× as long as wide, and 1.55× as long as fl_1; fl_1 distinctly longer than wide; fl_2 slightly longer than pedicel, 1.64× as long as fl_1; clava 2.48× as long as wide.

Mesosoma (Fig. 2) 1.95× as long as wide. Mesoscutum 0.58× as long as wide, with strong reticulation. Scutellum with strong reticulation on anterior scutellum and longitudinal striate on posterior scutellum; with a pair of campaniform sensilla nearer posterior margin than anterior margin. Metanotum 0.25× as long as scutellum. Mid panel

of metanotum subrectangle, with longitudinal striate. Propodeum slightly shorter than mesoscutum, without reticulate sculpture, with 2 large subparallel translucent carinae (Figs 2, 3, 6, 7) and 2 branched setae, each on lateral to spiracle.

Fore wing (Fig. 4) 3.62× as long as wide, longest marginal setae 1.38× as long as greatest wing width. Stigmal vein with 4 campaniform sensilla apically.

Legs (Fig. 5) with femora, especially metafemur, swollen medially. Mesocoxa without teeth-like structures on the posterior surface.

Metasoma. Petiole (Fig. 6) about 2.8× as long as wide. Gaster (Fig. 8) oblong, Gt_1 (Fig. 7) with 2 large translucent carinae and 1 smaller carinae and a pair of scale-like setae on each side; ovipositor distinctly exserted, about 0.7× as long as mesotibia.

Measurements (length/width, μm): Body length: 500. OD 9.6, OOL 9.6, LOL 33.6, POL 62.4. Antenna: scape 144.0/ 26.4, pedicel 40.8/ 31.2, fl_1 26.4, fl_2 43.2, fl_3 45.6, fl_4 38.4, fl_5 36.0, fl_6 33.6, fl_7 33.6, fl_8 31.2, clava 136.8/ 55.2. Fore wing 752.4/ 207.9, longest marginal setae 287.1. Propodeum with carinae length 115.2, height 33.6 (measured in lateral view – Fig. 3); gaster with dorsolateral carina length 144, height 67.2 (measured in lateral view – Fig. 7), and ventromedian carina length 120, height 33.6. Ovipositor 201.6.

Male. Similar to female except as follows. Antenna (Fig. 10) with all the flagellar segments longer than wide. Fore wing (Fig. 11) 3.89–4.06× as long as wide. Hind wing (Fig. 12) 0.76–0.78× as long as fore wing, disc with only one row of setae.

Measurements (length/width, μm): Body length 550–580. Antenna: scape 139.2–144.0/ 21.6–26.4, pedicel 43.2/ 28.8–31.2, fl_1 33.6, fl_2 64.8, fl_3 67.2, fl_4 38.4, fl_5 64.8, fl_6 62.4, fl_7 62.4, fl_8 62.4, fl_9 60.0, fl_{10} 60.0, fl_{11} 57.6. Fore wing 643.5–693.0/ 158.4–178.2, hind wing 504.9–524.7.

Host. Unknown.

Etymology. Chinese: dian=Yunnan Province, and refers to the distribution of the species in the Yunnan Province of China.

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