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Editorial Announcement:
New format and reduction of subscription prices for 2015

The "Revue suisse de Zoology" (RSZ) has a tradition in the field of scientific zoology going back 121 years. Historically, articles relating to almost all aspects of zoology have been published, principally by researchers associated with Swiss universities or museums. During the last 20 years, the RSZ focused its interest on systematic zoology, and the majority of recent articles deal with alpha-taxonomy, viz. the description of new species, and studies on the systematics and taxonomy of all groups of animals. For the future, we wish to continue to provide the scientific community with high quality, peer-reviewed articles on animal systematics and diversity, with a strong preference for collection-based research.

Like many other scientific journals, the RSZ has had to cope with soaring production costs and competition from new, entirely digital media. This is even more acute now that a printed article is no longer required for the valid introduction of a new taxon name.

It has thus become necessary to make some changes in the production of the RSZ. However, as many authors consider a printed publication as a mark of excellence, a printed version will be maintained in addition to an electronic version, which will be made available on the RSZ website 1).

Instead of the previous four issues per year there will only be two issues, printed in a larger format without changing the total number of articles. As a very positive effect of printing two instead of four issues per year, the subscription prices will be lowered considerably to 130 Swiss francs (for domestic subscribers) or 150 Swiss francs (for international subscribers).

The new format will be in A4 size, with two text columns, and colour illustrations if needed. As before, all manuscripts will be peer-reviewed and the journal remains indexed by the SCI Journal Citation Reports.

The new guidelines for the submission of manuscripts are given on the inside of the back cover of this issue and on the website of the RSZ 1).

The editorial team is convinced that the new format, the high print quality, the scientific content, and the reduced subscription rate will maintain the attractiveness of the "Revue suisse de Zoology" and appeal to you as an author, reader, or librarian.

1) http://www.ville-ge.ch/mhng/publication03_english.php. Note that almost all previous issues of the RSZ are now available through the Biodiversity Heritage Library, http://www.biodiversitylibrary.org/bibliography/8981#summary
An unexpected occurrence - a case study on an intergeneric hybrid in giant snakes

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An unexpected occurrence - a case study on an intergeneric hybrid in giant snakes. - In recent years an increasing number of studies have identified cases of interspecific hybrids in reptiles, but intergeneric hybridisation, especially in snakes, is still only rarely known. In the current study we used several methods, SEM recordings, morphometrics, and both mitochondrial and nuclear gene analyses, to identify and analyse an intergeneric hybrid as a representative case study for the challenges related to this phenomenon. We here present evidence of intergeneric hybridisation between species of two well-studied boid genera: Eunectes (E. notaeus) and Boa (B. constrictor). For the intergeneric hybrid specimen the nuclear gene analyses result in its intermediate and separate phylogenetic position whereas morphological analyses clearly show that only some characteristics are intermediate, while other characters can be clearly assigned to either one of the parental species. The indistinct morphological character states and the conflicting phylogenetic position based on the genetic data show that such a hybrid can be extremely difficult to identify in situ and furthermore, those results can lead to false assumptions about the real identity and recognition of hybrids, e.g. when modern barcoding methods are used for fast and easy taxon-identification. Therefore, better recognition, identification and long term observations of both interspecific and intergeneric hybrids are needed to properly assess and preserve the current biodiversity.

Un événement inattendu - étude d’un cas d’hybridation intergénérique de serpents géants. - Récemment, un nombre croissant d’études ont permis d’identifier des hybridations interspécifiques chez les reptiles, mais les cas d’hybridation intergénériques demeurent rares, tout particulièrement chez

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les serpents. Dans notre étude, nous utilisons plusieurs méthodes modernes: microscopie SEM, morphométrie et analyses génétiques des gènes mito-chondriaux et nucléaires, afin d’identifier et d’analyser un hybride inter-générique qui permettra de soulever les problématiques scientifiques liées à ce type d’hybridation. Nous présentons ici des arguments en faveur d’un cas d’hybridation intergénérique entre deux genres néotropicaux bien connus: Eunectes (E. notaeus) et Boa (B. constrictor). Les résultats de l’analyse des gènes nucléaires placent ce spécimen hybride intergénérique dans une position intermédiaire entre ses parents mais distincte phylogénétiquement alors que l’analyse morphologique montre clairement que seuls certains caractères sont intermédiaires, alors que d’autres peuvent être clairement assignés à l’une ou l’autre des deux espèces parentales. Les caractères morphologiques non diagnostics d’un taxon connu et la position phylo-génétique conflictuelle obtenue par les données génétiques montre que ce type d’hybride intergénérique peut se révéler extrêmement difficile à identifier in situ. Une identification erronée est alors fortement probable plutôt que la détection de la nature hybride du spécimen, surtout lorsque les méthodes modernes de barcoding seront utilisées pour des identifications faciles et rapides. De ce fait, une meilleure connaissance et un suivi à long terme de tous les hybrides à la fois interspécifiques et intergénériques sera nécessaire afin d’identifier correctement la biodiversité actuelle pour appréhender sa conservation avec plus d’efficacité.

**Keywords:** Barcoding - BDNF - Boa constrictor - Eunectes notaeus - hybridisation - mtDNA - phylogeny - RAG1 - SEM - speciation.

**INTRODUCTION**

Interspecific hybrids are well known in amphibians and reptiles, but have until recently been considered as uncommon (Mertens, 1950, 1956, 1964, 1968, 1972; Murphy & Crabtree, 1988; Leaché & Cole, 2007; Mebert, 2008; Kearney et al., 2009). Such interspecific hybridisation arises not only in captivity like in zoos, but also in situ where under certain circumstances hybrid zones between two distinct species occur. Especially in recent years quite a few reptile examples have been observed, e.g. in turtles [Cuora mouhotii x C. galbinifrons (Shi et al., 2005), Mauremys reevesii x M. si-nensis (Fong & Chen, 2010)], in different lizard families [Anolis polylepis x A. osa (Köhler et al., 2010), Aspidoscelis dixoni x A. tigris (Cole et al., 2007), Podarcis sicu-lus x P. waglerianus (Capula, 1993)], in colubrids [Pantherophis bairdi x P. obsoletus lindheimeri (Vandewege et al., 2012)], in vipers [Bitis gabonica x B. arietans (Broadley & Parker, 1976; Broadley, 2006)], in boids [Eunectes murinus x E. notaeus (Dirksen & Böhme, 1998)], and in pythonids [Python natalensis x P. bivittatus (Branch & Erasmus, 1984)].

While interspecific hybrids now seem not too uncommon, intergeneric hybrids, as are known between snake genera like Liasis mackloti x Morelia spilota (Banks & Schwaner, 1984) and Crotalus horridus x Sistrurus catenatus (Bailey, 1942) are apparently still very rare occurrences. One of the most recently reported occurrences of intergeneric hybridisation are two hybrid specimens of Pituophis catenifer sayi and Pantherophis vulpinus (LeClere et al., 2012) which are of particular interest since these
are true naturally occurring intergeneric hybrid snakes. In the pet trade intergeneric snake hybrids are well known and some reptile breeders attempt to hybridise specific snake genera, e.g. Pantherophis x Pitophis, Pantherophis x Lampropeltis, or Acrantophis x Boa (LeClere et al., 2012; Branson’s Wild World, 2014; Hybrid Herps, 2014). Although several fora exist where breeders exchange their experiences, unfortunately no substantial studies exist which summarise the number of successful hybridisations in captivity and compare them to the number of known natural hybrids. Thus, one can only state that interspecific and intergeneric snakes are far better known and much more common in captivity than in nature.

Here we report on a new case of an intergeneric hybrid snake which was born in captivity and is kept in the ‘Ménagerie du Jardin des Plantes’, at the Paris Natural History Museum (MNHN). This living specimen is a boid hybrid between a female Boa constrictor and a male Eunectes notaeus. With the idea to shorten the phrase “intergeneric hybrid specimen” and to reflect the identity of this hybrid we name it “BOACONDA” – a joined name between the names Boa (Boa) and Anaconda (Eunectes).

Both boid genera Eunectes and Boa have been well studied (e.g. Dirksen & Böhme, 1998; Dirksen, 2002; Bertona & Chiaraviglio, 2003; Burbrink, 2005; Aller et al., 2006; Bonny, 2007; Reed & Rodda, 2009) and the phylogenetic position of both genera among boid snakes has been clearly resolved in recent multigene (mitochondrial and nuclear genes) phylogenetic studies (e.g. Vences et al., 2001; Burbrink, 2005; Noonan & Chippindale, 2006; Reynolds et al., 2014).

The genus Eunectes consists of five acknowledged species and the genus Boa is currently believed to harbour a single species with nine subspecies. The main habitat of Eunectes notaeus is alongside the Rio Paraguay and its tributaries, which are part of the Pantanal. These rivers cross Bolivia, Brazil, Paraguay, Argentina and partly Uruguay (Stimson, 1969; Petzold, 1982; Henderson et al., 1995; Dirksen & Böhme, 1998; Dirksen, 2002) (Fig. 1, distribution range of Eunectes notaeus marked with transverse lines). E. notaeus inhabits mainly swamps and seasonal flooded areas but it can also be found in forested or deforested as well as agricultural areas (Strüssmann & Sazima, 1993; Dirksen & Henderson, 2002; Reed & Rodda, 2009).

Boa constrictor is distributed in Central America and north and central regions of South America, from Mexico to Argentina and southern Brazil (Bonny, 2007; Reed & Rodda, 2009) (Fig. 1, distribution range of Boa constrictor marked with vertical lines). The species inhabits a wide range of biotopes where it is common in forests, grasslands and agricultural areas (Bonny, 2007; Reed & Rodda, 2009).

Both species Eunectes notaeus and Boa constrictor are syntopic in the northern part of the Pantanal (western Brazil) and along the upper river section of the Rio Guaporé in Bolivia (Strüssmann & Sazima, 1993; Junk et al., 2006; Souza et al., 2010). They prefer dense vegetation near water (Chiaraviglio, 2006; Reed & Rodda, 2009).

The hybrid BOACONDA was born on 29th May, 2009 in the “Ménagerie” of the MNHN in Paris. This snake is the only surviving individual of a clutch comprising two individuals without the skeleton, one congenital malformation and about 20 unfertilised eggs. It was sexed twice with a testing probe and identified as a male on 14th April, 2010 and 3rd December, 2011 respectively. Because of the young age of the hybrid individual sexual activity could not yet be observed, therefore, the question
Distribution map: vertical lines – distribution of *Boa constrictor* spp.; transverse lines – distribution of *Eunectes notaeus*; crossed markings – overlapping distribution range of both species [modified from figures 7.2 and 8.2 of *Reed & Rodda* (2009)].

about fertility or sterility cannot be satisfyingly answered. The **BOACONDA** (Figs 2 E-H), its mother (Figs 2 A-B) and both potential fathers (Figs 2 C-D) are still alive and therefore electronically tagged and their respective tag numbers are:
250228500004090, 250228700001763, 2502296000049768, and 00-01FO-7C39. The female *B. c. constrictor* arrived at the Ménagerie on 28th September, 2005 and she was previously never in contact with any male snake (I. Ineich, pers. comm.). Since the arrival day the female *B. c. constrictor* is kept in the same terrarium as the two male *E. notaeus*. Copulation was observed several times by snake keepers at the Ménagerie in 2007 and 2008.

MATERIAL AND METHODS

GENETIC ANALYSES

To determine the respective position of the hybrid in phylogenies calculated on the basis of different commonly used gene sequences (both mitochondrial and nuclear genes), we used tissue samples (obtained through biopsies) from the hybrid as well as its biological mother (*B. c. constrictor*) and both of the potential paternal individuals (*E. notaeus*). DNA was extracted from each tissue sample usingpeqGold Tissue DNA Mini Kit (PEQLAB). A fragment of the mitochondrial 16S rRNA gene was amplified with the primers 16sar-L (5'-CGCCTGTTTATCAAAAACAK3') and 16sbr-H (5'-CCGGTCTGAACTCAGCTGCATKCCAATRTCA-3') (Palumbi *et al.*, 2002). Furthermore, two nuclear genes were amplified: a part of the RAG1 gene using the primers RAG1MartFL1 (5'-AGCTGCAGYCYTAYCAYAARATGTA-3') and RAG1AM-PR1 (5'-AACTCAGCTGCATTKCCAATRTCA-3') of Chiari *et al.* (2004) and a fragment of the BDNF gene using the primers BDNF-F (5'-GACCATCCTTCTCTKACTATGTTATTCTCATCTT-3') and BDNF-R (5'-CATCTTCCCTTTTAATGGTCAGTGTAACAC-3') of Noonan & Chippindale (2006). We used the amplification protocols described in Chiari *et al.* (2004), Schmitz *et al.* (2005a), and Crottini *et al.* (2009) for 16S, RAG1 and BDNF, respectively. The PCR products were purified using the High Pure PCR Product Purification Kit (Roche Diagnostics GmbH) in accordance with the manufacturer’s instructions. For quality assurance both directions of the amplified PCR product were sequenced by an external vendor (Macrogen). New sequences were generated for five *Boa constrictor*, one *Calabaria reinhardtii*, two *Eunectes notaeus* and the hybrid (*Boaconda*). Accession numbers for the newly generated sequences are shown in the Appendix I.

Complementary sequence data for the completion of our datasets for the respective phylogenetic analyses were obtained from GenBank (see Appendix I).

The obtained sequences were initially automatically aligned using ClustalW (Thompson *et al.*, 1994) and manually checked using the original chromatograph data in the program BioEdit (Hall, 1999).

We used neighbour-joining (NJ), maximum likelihood (ML) and Bayesian inference methods to calculate the phylogenetic trees for the respective genes. NJ analyses was performed using PAUP* 4.0b10 (Swofford, 2002). For the ML tree we used the PhyML 3.0 computer cluster of the Montpellier bioinformatics platform (http://www.atgc-montpellier.fr/phyml/) (Guindon *et al.*, 2010). Bootstrap analysis (20000 [for NJ] and 2000 [for ML] pseudo-replicates) was used to estimate node support. Bayesian reconstructions were performed with MrBayes, version 3.12 (Huelsenbeck & Ronquist, 2001). Estimation of the correct parameters for the both the
Fig. 2

(A, B) *Boa c. constrictor* (250228700001763). (C, D) *Eunectes notaeus* (2502296000049768), the specimen 0001FO7C39 is similar in colouration as the other *E. notaeus*. (E-H) *BOACONDA* (250228500004090), with (H) shortly after birth.
Bayesian and the ML analyses were done using jModelTest (Guindon & Gascuel, 2003; Posada, 2008). The exact parameters used for the Bayesian analyses followed those described in detail by Reeder (2003) and Schmitz et al. (2005b). Node support of bootstraps ≥70 % (Hillis & Bull, 1993) and Bayesian posterior probabilities ≥0.95 were considered to be highly significantly supported.

Scale Microstructure

For the SEM (Scanning Electron Microscope) recordings, dried exuviae from both parent species (3 potential species: 2 paternal Eunectes notaeus and 1 maternal Boa c. constrictor) and the hybrid were used. The microstructure of snake scales is unique among different species and shows almost no variation between individuals of one species and furthermore, it is independent of the individual age (N. Ernst unpubl. data; Schmidt & Gorb, 2012). Therefore, only one of the Eunectes notaeus individuals (00-01FO-7C39) will be described in detail. The samples from each body side (dorsal and ventral) were attached to a standard pin stub mount with a double sided carbon adhesive tape. The samples were powdered with a layer of 50 nm gold-palladium composite using a Hummer VII sputtering system (Anatech LTD, Alexandria, VA) with a 120 m Torr vacuum.

The observations were done with a HITACHI S-2460N Natural Scanning Electron Microscope (Hitachi, Tokyo, Japan) at an accelerating voltage of 25 kV and pictures were electronically displayed with the Digital Image Scanning System 5 (Version 5.4.14.2, copyright 2004) and exported to the Digital Image Processing System 2.6 (Version 2.6.14.1, copyright 1997-2005) by which the pictures were saved as JPEG and TIFF files. Microstructures of the anterior, middle and posterior regions of both dorsal and ventral scales were examined. Images of the hinge region (part of skin between scales) were also taken. These were taken at a magnification of 2.000x and 6.000x. The primary microstructure can be seen in the middle region of a scale.

Pholidosis and Morphometrics

We selected three body and two head scale counts, four body and seven head measurements for the morphological analysis. Additionally, the gender and the eye-colour (EYC) (only of the four living specimens) were recorded (Table 3). Ventral (VEN) and subcaudal (SUC) scale numbers were counted according to standard techniques, as were the dorsal scale rows at midbody (DOR) (Dowling, 1951). The numbers of the supralabial (SUL) and of the infralabial scales (IFL) were counted. Following head measurements were taken with an digital calliper (Brüder Mannesmann Werkzeuge, Remscheid, Germany): the head length, which was measured from the posterior end of the lower jaw bone to the snout end (HEL); the head width, which was measured as the distance between the mandibular joints (HWI); the distance between the eyes, measured dorsally (DSE); maximal eye diameter (EYD); the distance between the nares, measured dorsally (DNA); maximum dorso-ventral diameter (DIH); maximum lateral diameter (DIW). Additionally, the snout-vent length (SVL) and the tail length (TAL) were taken with an inextensible strap and measured with a folding meter stick. The total length (TOL) was calculated by adding up the snout-vent length (SVL) and the tail length (TAL). For the analysis we calcu-
lated some ratios (TAL/TOL; HEW/HEL; HEL/SVL; HEL/TOL; DSE/HEW; DSE/HEL; EYD/HEL; DNA/HEW; DNA/HEL; DIW/DIH). All measurements were taken on the right side of the snakes. We measured the BOACONDA, the mother (Boa c. constrictor), the two potential fathers (Eunectes notaeus, 2502296000049768 and 00-01FO-7C39), and seven museum specimens of E. notaeus and eight museum specimens of B. c. constrictor from the Natural History Museum of Geneva, Switzerland (MHNG) (see Appendix II). Additionally the weight (WEI) was recorded, the coloration described and the eye colour (EYC) of the four living specimens were determined. The eye colour was described with the colour catalogue for field biologists by Köhler (2012). The statistical analyses [Univariate Analysis, Principal Component Analysis (PCA), with variances and covariances of groups, and between-group calculations] were conducted using PAST version 2.16 (Hammer et al., 2001).

RESULTS

GENETIC ANALYSES

Of the three computed phylogenetic gene trees (Figs 3 A-C), the mitochondrial tree shows as expected a complete sequence identity of the BOACONDA with its maternal lineage (Boa c. constrictor) and thus both the confirmed mother and the hybrid offspring are placed in the same well supported clade. In contrast to the mitochondrial tree, the hybrid is placed in an approximately intermediate position between its parental species Eunectes notaeus (2502296000049768, 00-01FO-7C39) and Boa c. constrictor in both computed trees for the nuclear genes, even though contrarily to ML the MrBayes package treats heterozygous (ambiguous) sites as missing data (Potts et al., 2014). The nuclear genes used do not allow us to determine which one of the male E. notaeus individuals is the actual father, but since there were absolutely no differences in both nuclear genes between the two E. notaeus specimens, we treat both specimens equally.

The two parental genera are situated on highly significantly supported distinct clades and are well separated from each other. Both the BDNF- and RAG1-tree (Figs 3 B-C) show that the integration of hybrids does not significantly alter the node support for the parental taxa. The intermediate position can be explained due to heterozygosity at most or all of the 12 variable sites in the BDNF gene fragment and 19 variable sites in the RAG1 gene fragment. 11 of the variable sites (12) in the BNDF gene fragment between B. c. constrictor mother and E. notaeus potential fathers are identified as fixed synapomorphies (Table 1) and all 19 variable sites in the RAG1 gene fragment are synapomorphies in B. c. constrictor and E. notaeus (respectively 2502296000049768 and 00-01FO-7C39) (Table 2). The hybrid shows heterozygosity at 83 % of variable sites in the BDNF-gene fragment and 100 % of variable sites in the RAG1-gene fragment.

SCALE MICROSTRUCTURE

The microstructure of the dorsal scale (Fig. 4 A) of Boa c. constrictor shows cells which are irregularly shaped and mostly longer than they are wide. The cell borders are primarily smooth and form anterior a few elongated, broad peaks. The pores of the cells are elongated, almost regularly aligned, touch the cell borders, and
Phylogenetic tree based on the mitochondrial gene fragment 16S with calculated node support for ML analysis above the branches (only node supports over 70% are listed), and Bayesian analysis (only node supports over 0.70 are listed) and calculated NJ node support under the branches (only node supports over 60 % are listed).
Phylogenetic tree based on the nuclear gene fragment BDNF with calculated node support for ML analysis above the branches (only node supports over 70% are listed), and Bayesian analysis (only node supports over 0.70 are listed) and calculated NJ node support under the branches (only node supports over 60% are listed).
Phylogenetic tree based on the nuclear gene fragment RAG1 with calculated node support for ML analysis above the branches (only node supports over 70% are listed), and Bayesian analysis (only node supports over 0.70 are listed) and calculated NJ node support under the branches (only node supports over 60% are listed).
### Table 1: Variable sites from the BDNF data. Sites representing species specific synapomorphies are indicated with an asterisk (*).

<table>
<thead>
<tr>
<th>Sample</th>
<th>123*</th>
<th>209*</th>
<th>251*</th>
<th>263*</th>
<th>267*</th>
<th>356*</th>
<th>392*</th>
<th>470*</th>
<th>497*</th>
<th>647*</th>
<th>659*</th>
<th>710*</th>
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</thead>
<tbody>
<tr>
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<td>A</td>
<td>A</td>
<td>T</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>G</td>
<td>G</td>
<td>C</td>
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<td>A</td>
</tr>
<tr>
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<td>T</td>
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<tr>
<td><em>Boa c. constrictor</em> (250228700001763)</td>
<td>G</td>
<td>G</td>
<td>C</td>
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<td>G</td>
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<td>A</td>
<td>C</td>
<td>C</td>
<td>A</td>
<td>T</td>
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<tr>
<td><em>Boa c. constrictor</em> (NE4.5)</td>
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<td>G</td>
<td>C</td>
<td>G</td>
<td>T</td>
<td>G</td>
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<td>A</td>
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<tr>
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<td>C</td>
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<td>C</td>
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</tr>
<tr>
<td>BOACONDA (250228500004090)</td>
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<td>A/G</td>
<td>C/T</td>
<td>A/G</td>
<td>C/T</td>
<td>A/G</td>
<td>A/G</td>
<td>A/G</td>
<td>C/G</td>
<td>C</td>
<td>A/T</td>
<td>A</td>
</tr>
</tbody>
</table>

### Table 2: Variable sites from the RAG1 data. Sites representing species specific synapomorphies are indicated with an asterisk (*).

| Sample                        | 122* | 125* | 161* | 167* | 171* | 232* | 291* | 309* | 317* | 320* | 347* | 462* | 551* | 713* | 774* | 776* | 857* | 860* | 871* |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| *Eunectes notaeus* (0001FO7C39) | A    | T    | G    | A    | A    | C    | C    | T    | A    | C    | T    | A    | C    | A    | A    | A    | A    | T    | G    |
| *Eunectes notaeus* (2502296000049768) | A    | T    | G    | A    | A    | C    | C    | T    | A    | C    | T    | A    | C    | A    | A    | A    | T    | G    | T    |
| *Boa c. constrictor* (250228700001763) | G    | C    | A    | G    | G    | T    | A    | G    | G    | T    | C    | G    | G    | C    | A    | C    | T    | T    | G    |
| *Boa c. imperator* (175.1) | G    | C    | A    | G    | G    | T    | A    | G    | G    | T    | C    | G    | G    | C    | A    | C    | T    | T    | G    |
the distance between the pores has the same width as that of the pores. The cells of the ventral scales (Fig. 4 B) of *B. c. constrictor* are irregularly shaped and mostly longer than they are wide with only few short, pointed anterior peaks which are irregularly arranged. The lateral cell borders are mostly smooth. The hinge region shows hemispheric rises with big round pores lying closely together.

The dorsal scales (Fig. 4 C) of *Eunectes notaeus* (00-01FO-7C39) have a microstructure of irregular shape, mostly broad and not longer than they are wide. The cell borders are smooth and the anterior border is shaped in few rounded peaks. The pores of the cells are elongated, asymmetrically aligned, do not touch the cell borders, and the distances between the pores are wider than the width of the pores themselves. The ventral scale (Fig. 4 D) microstructure shows short but very wide cells with serrated anterior cell borders. The peaks of the cell borders are irregularly arranged, very short and rounded. The cells have small, shallow and round pores which are irregularly aligned. The hinge region consists of hemispheric rises with small and shallow pores which are situated at greater distances from each other.

There are only comparatively slight differences in the microstructure of the dorsal and ventral scales (so-called reticulated structure sensu Price, 1982) between *Boa c. constrictor* and *Eunectes notaeus* (Figs 4 E-F). The microstructure of the hybrid shares more similarities with *B. c. constrictor* than with *E. notaeus*. The only noticeable similarity the BOACONDA shares with *E. notaeus* (00-01FO-7C39) is that the cells of the dorsal scales are broader than they are long (Fig. 4 E). It seems that the microstructure of the hybrid is intermediate to both *B. c. constrictor* and *E. notaeus*, a classic situation for hybrids, but with distinct tendencies towards *B. c. constrictor*; which likely leads to the observed pattern in the hybrid since even as the patterns of *E. notaeus* and *B. c. constrictor* are rather similar, the scale microstructure of *B. c. constrictor* is clearly more pronounced. The microstructure of the BOACONDA looks regular and distinctly sculptured.

In detail one can see a close resemblance between the hybrid and *B. c. constrictor* in the anterior and posterior regions of the dorsal scales (Fig. 4 E). Also the hinge region of the hybrid with its large round pores and the cell borders, which span over the elevations, looks more like the hinge region of *B. c. constrictor*. The hybrid shows serrated cell borders. These serrations are blunt and elongated which appear to be an intermediate form between *E. notaeus* (with almost smooth borders) and *B. c. constrictor* (with narrow and elongated serrations).

A similar intermediate pattern can be found in the ventral scales of the BOACONDA (Fig. 4 F) comparing it to those of the parents, *B. c. constrictor* and *E. notaeus*. In general, the ventral scales show a similar but more elementary pattern than the pattern of the dorsal scales. A remarkable similarity in the microstructure can be found between *B. c. constrictor* and the hybrid with elongated ridges and punctate pores in-between, whereas *E. notaeus* has bigger rounded pores (Fig. 4 F). The primary microstructure of the BOACONDA’s cell borders shows an intermediate pattern to *B. c. constrictor* and *E. notaeus* respectively. The cell borders of the hybrid are shaped in long and broad serrations, while the borders of *B. c. constrictor* are almost smooth and *E. notaeus* has cell borders which show short and narrow serrations.
SEM recordings. (A) Dorsal scale of *Boa c. constrictor* (250228700001763). (B) Ventral scale of *Boa c. constrictor* (250228700001763). (C) Dorsal scale of *Eunectes notaeus* (0001FO7C39). (D) Ventral scale of *Eunectes notaeus* (0001FO7C39). (E) Dorsal scale of *Boacondas* (250228500004090). (F) Ventral scale of Boacondas (250228500004090).

**Pholidosis and Morphometrics**

The pholidosis and morphometrics show an interesting pattern. The numbers of ventral scales (VEN), the ratio of tail length to the total length (TAL/TOL), the ratio of the distance between the eyes towards the head length (DSE/HEL), and the ratio of the
distance between the nares towards the head length (DNA/HEL) of Boaconda are in the range of the values of Boa c. constrictor (Table 3, Figs 5 A-B). In contrast to this, the ratio of the head length towards the total length (HEL/TOL), and the ratio of the eye diameter towards the head length (EYD/HEL) lie in the ranges of the values of Eunectes notaeus (Table 3, Figs 5 C-D). The numbers of the supralabial (SUL) and of the infralabial (IFL) scales are intermediary between B. c. constrictor and E. notaeus (Table 3, Fig. 5 F) as well as the count of the dorsal scale rows (DOR) (Table 3, Fig. 5 E).

**COLOURATION**

The colouration of the Boaconda (Figs. 2 E-H) shows also intermediate characteristics and only few distinct characters are shared with one of the parental species. The ground-colouration is a light yellow similar to the potential fathers. Dorsally are two brown blotches many of them are fused to stripes. The female Boa c. constrictor (Figs. 2 A-B) shows a light brown ground colour and the typical large, dark brown saddles. Both potential fathers [E. notaeus, 2502296000049768 (Figs. 2 C-D), 00-01FO-7C39] are yellow-green coloured with small, black spots and the typical small, saddles. The Boaconda has black large roundish blotches on the flanks (Figs 2 F, 2 H), while the mother (Fig. 2 B) has rhombic blotches with greater distances to each other and the potential fathers (Fig. 2 D) have small blotches. The ventral side of the mother is cream-coloured with brownish blotches in greater distance to each other and the potential fathers have small black spots on a yellow ventral side, while in contrast the Boaconda has two rows of adjacent black blotches. The head of the Boaconda (Figs 2 E, 2 G) shows a median stripe from the top of the snout and two stripes right and left of the median stripe, which begin at eye level. Additionally, the snake has a large black blotch before and a large black stripe after the eye. The mother shows the typical small light brown central stripe and laterally a thinner stripe behind the eye (Fig. 2 A). The potential fathers have three stripes, which are only slighter darker than the yellow-green ground colour. Laterally E. notaeus (Fig. 2 C) has a small blotch in front of the eye and a thinner stripe behind the eye.
Principal Component Analyses of the discussed characters (ellipses indicate estimation where 95% of the individuals of the population are expected to fall; DNA/HEL – ratio between distance of nares and head length, DOR – dorsal scale rows at midbody, DSE/HEL – ratio between distance of eyes and head length, EYD/HEL – ratio between eye diameter and head length, HEL/TOL – ratio between head length and total length, IFL – numbers of infralabial scales, SUL – numbers of supralabial scales, TAL/TOL – ratio between tail length and total length).
DISCUSSION

Hybrid individuals do not always show morphologically intermediate characteristics between the distinct characters known from their parent species (Ross & Cavender, 1981; Mebert, 2008, 2010; Toda & Hikida, 2011) but at the same time not all morphological intermediates are hybrids (Wilson, 1992; Dowling & Secor, 1997). Sometimes hybrid offspring have absolutely no detectable morphological unique characteristics but only show those characteristics which are already present in one of the parent species as recently shown in the study of Mebert (2010) about hybrid zones between the colubrid snakes Nerodia fasciata and N. sipedon and in the study of Toda & Hikida (2011) about the hybrids of the geckos Gekko yakuensis and G. hokouensis.

The SEM and morphological analyses also show that some intermediate characteristics are present but others show clear tendencies to the traits present in one of the parent species. The SEM analyses show that although there are scale microstructures of the hybrid which are intermediate between Boa c. constrictor and Eunectes notaeus (00-01FO-7C39), there is a pronounced tendency towards the typical structures observed in B. c. constrictor. Assuming one does not know in advance that the scales analysed are those of a hybrid specimen, at first glance, the scale microstructure could lead to the false assumption that these are the scales of a Boa c. constrictor. Some characters are indicative of the hybrid status, e.g. one remarkable intermediate scale microstructure is the shape of the cell borders of the dorsal and ventral scales of the hybrid. As these specific structures are not routinely analysed, such deviations in character states can be easily overlooked. Only few morphological characters of BOACONDA show clear intermediate states towards the parental species (Figs. 5 E-F), but some other characters (ventral scales, DNA/HEL, DSE/HEL) fall directly in the range of the maternal species B. c. constrictor (Figs. 5 A-B) and some other characters (EYD/HEL, HEL/TOL) fall in the range of the paternal species E. notaeus (Figs. 5 C-D). Therefore, not only the analyses of mitochondrial gene fragments of questionable hybrid specimens can lead to false assumptions, namely that the hybrid is not identified as a hybrid but is assigned to the maternal species (see discussion below), but also in-depth morphological data can lead to the assumption that such a hybrid snake specimen is wrongly identified as a member of one of the parental species.

In this case the hybrid was born in captivity. But considering the recently published paper about the Pituophis catenifer sayi x Pantherophis vulpinus hybrids which are indeed naturally occurring hybrids (LeClere et al., 2012), it can be assumed that also naturally occurring hybridisation between Eunectes notaeus and Boa constrictor may be possible for several reasons, among them the fact that the geographic distribution areas of both species overlap in larger parts (see Fig. 1). Both species are sympatric in the northern part of the Pantanal (western Brazil) and along the upper river section of the Rio Guaporé in Bolivia. Additionally, E. notaeus and B. constrictor show very similar aspects regarding their reproductive biology, as well as in sexual dimorphism and mating habits. Adult females of both E. notaeus and B. constrictor are distinctly larger than the corresponding adult males. During the mating season both species form mating aggregations (Dirksen, 2002; Bertona & Chiaraviglio, 2003; Rivas & Burghardt, 2005). The mating season of E. notaeus is between September and
December (Dirksen, 2002) and the mating season of *B. constrictor* is during the dry season starting approximately in June and lasting until September (Bertona & Chiaraviglio, 2003; Pizzatto & Marques, 2007). Based on the similar mating habits, the overlapping mating season and the sympatric occurrence in the same habitat of both species it is quite likely that the mechanism which should prevent hybridisation can easily break down e.g. due to habitat disturbance – be it caused by climate change or human impact (Bullini, 1985; Barton & Bengtsson, 1986; Birky, 2013).

The potential high competitiveness (through heterosis) of most hybrid species can be explained by the increased enhancement of heterozygosity in a single generation where interspecific hybridisation occurs (Bullini, 1985). Grant & Grant (1994) discovered that hybrids and backcrosses of the Ground Finches *Geospiza fortis*, *G. scandens* and *G. fuliginosa* on the island Daphne Major in the Galápagos Archipelago exhibit higher fitness levels than their parental species. Furthermore, hybridisation and introgression can probably more rapidly increase genetic diversity through production of new recombinant genotypes than it is possible by mutation (Dowling & Secor, 1997) and such enhanced variability could allow organisms to expand their range in unfavourable habitats and to adapt more readily to environmental changes (Stebbins, 1959; Dowling & Secor, 1997; Martinez-Freiria et al., 2010). Such an increase of the genetic diversity and adaptation to a changing environment can benefit speciation. Another possibility to establish a stable hybrid zone or population is by parthenogenesis (Murphy et al., 2000; Schmitz et al., 2001; Strasburg et al., 2007; Bengtsson, 2009). But not only parthenogenetic stable communities can establish evolutionary isolated lineages. Recent genetic studies reveal evidence that the red wolf (*Canis rufus*) has originated from the coyote (*Canis latrans*) by historical hybridisation with the grey wolf (*Canis lupus*) (Wayne & Jenks, 1991; Roy et al., 1994; von Holdt et al., 2011).

All these factors discussed above may lead to a generally increased hybridisation rate in the long run, and thus to complications in efficiency of modern fast screening techniques like DNA barcoding. The main intent of the DNA barcoding is to rapidly identify unknown taxa and to facilitate the discovery of new species using large-scale screening (Hebert et al., 2003; Stoeckle, 2003; Eaton et al., 2010; Nagy et al., 2012). For this approach mostly mitochondrial gene fragments have been used. Although intergeneric hybridisation is still mostly regarded as uncommon and thus should theoretically have only little impact on DNA barcoding (Hebert & Gregory, 2005) the increasing identification of hybrid specimens (Bullini, 1985) shows that the problems these specimens cause in barcoding screenings should not be underestimated (Eaton et al., 2010). In our case study the true hybrid status of the *BOACONDA* was not correctly identified in any of the three phylogenies despite using different and commonly used genetic markers. While we accept the concept of DNA barcoding as a useful first screening technique, we want to draw attention to the fact that there are aspects which can easily be overseen or can lead to false assumptions even when dealing with seemingly well-known taxa. When using mitochondrial gene fragments for barcoding as currently established, you will always fail to detect a hybrid since a hybrid specimen will always be identified as an individual belonging to its maternal species (see Fig. 3 – 16S tree). But even following the current trend to use additional gene fragments, e.g. using nuclear genes to resolve the deeper nodes in a phylogeny, a
hybrid will be mostly positioned in an isolated clade which will be intermediate somewhere between the (also well supported) clades containing both parental species; thus, it could easily be considered as a new undescribed taxon. Since even phylogenetic programs like the widely used MrBayes, which handle heterozygous data as missing data (Potts et al., 2014), may recover intermediate positions for hybrids in phylogenetic trees, only a direct analysis of heterozygous sites, and a specific integration into molecular datasets, e.g. using the 2ISP-informative approach (Potts et al., 2014) or by phasing the nuclear gene haplotypes and analysing the alleles separately (Weisrock et al., 2012), can clarify whether the specimen in question is of hybrid origin or not and properly determine its phylogenetic position.

Dubois (1981a, 1981b, 1983, 1988a, 1988b, 2004) and Dubois & Bour (2010) raised an interesting aspect concerning intergeneric hybrids. They propose that two species, which are able to produce (either under natural or artificial conditions) viable adult hybrids, should not be included in different genera. The genus as a systematic unit should be seen as a species or a group of species of presumably common phylogenetic origin which is separated by a decided gap from other similar groups (Mayr, 1942; Lemen & Freeman, 1984; Dubois, 1988). While it is clear that the allocation of taxa to genera is an artificial and subjective method to categorise these taxa, the existing data leave no doubt about the validity of both the genera *Boa* and *Eunectes*. The morphological, genetic, and ecological data known for these two genera and their closest relatives [*Epicrates* s.l. (Caribbean Islands), *Epicrates* s.l. (South America), and *Corallus* (Caribbean Islands, Central and South America)] show clear separations and differentiations between each of them (Tolson, 1987; Kluge, 1989; Burbirk, 2005; Noonan & Chippindale, 2006; Lee et al., 2007; Rivera et al., 2011; Reynolds et al., 2014; this study). Furthermore, following the "strategy of temporal banding" (Avise, 2008), the known age of the different genera also implicates that the recognition in different groups is justified. The combination of the above mentioned data leads to our working definition of the term genus: clear differentiations between several groups together with similarities between species within those groups in morphology, genetics, ecology and evolutionary time estimations indicate the uniqueness of the specific species groups. If we would adopt Dubois' proposal (1981a,b, 1983, 1988a,b, 2004) we would rate down the weight of all morphological, genetic, and ecological data, all of which implicate the differentiation between the four species groups in favour of a single criterion. To fuse all these distinct genera in one single genus would mean to lose quite a lot of information about their evolutionary diversity.

In this work we have shown that the potential problems associated with hybrid specimens should not be underestimated. We emphasise that hybrids both captive bred and naturally occurring ones are inherently a rich source of information, and while for a long time hybrids were considered as less fit or as a weakening factor for the associated species population, several new studies have shown that hybridisation is not always a negative factor but that hybridisation can even be a catalyst for speciation (Stebbins, 1959; Remington, 1968; Bullini, 1985; Wayne & Jenks, 1991; Roy et al., 1994; Dowling & Secor, 1997; Seehausen, 2004; Mebert, 2008, 2010; Martinez-Freiria et al., 2010). Ignoring potential hybrids can be problematic, since fast morphological and genetic screening techniques of high biodiversity areas are progressively gaining
favour. With the increasing rate of such studies, the results of those studies influence political decisions on the future of the studied regions (conservational status, clearings, etc.). When specific biological information like the occurrence of hybrid zones and the taxonomic status of the parental species are not properly identified, then those missing data can lead to decisions which may even be unfavourable for the parents themselves. A typical case of such mistakes can be observed after the introduction of *Iguana iguana* in the West Indies where it clearly hybridises with the endemic *Iguana delicatissima* leading to the extinction of the latter on some islands (Breuil, 2002), but these hybrids have only been recently recognised. A similar situation can be found on the island Utila where the endemic iguanid lizard *Ctenosaura bakeri* is threatened by the hybridisation with the widespread *Ctenosaura similis* (Pasachnik et al., 2009).

**ACKNOWLEDGEMENT**

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N. ERNST ET AL.


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APPENDIX I

The used GenBank accession numbers are as follows: for 16S: AF215273, AF215274, AF512737, AF512743, AM236347, AY336061, AY336071, EF545050, EF545051, EF545052, EF545053, EF545068, EU419841, EU419850, GQ200595, HQ267803; for BDNF: AY988027, AY988028, AY988029, AY988030, AY988031, AY988032, AY988033, AY988040, AY988041, AY988042, DQ465555, DQ465566, DQ465570, DQ465579, EU402629, EU402631, EU402638, EU402639, EU402649, FJ433967, FJ433969, FJ433970, FJ433971, FJ433972, FJ433973, FJ433974, FJ433976, FJ433977, FJ433978, FJ433979; for RAG1: AY444061, DQ465556, DQ465564, DQ465567, DQ465577, DQ465571, DQ465580.

GenBank accession numbers for the newly generated sequences are as follows: *Boa constrictor* (250228500004090); 16S: KF576911, BDNF: KF576915; RAG1: KF576748); *Boa c. constrictor* (25022870001763); 16S: KF576910, BDNF: KF576914; RAG1: KF576751); *Boa c. constrictor* (NE4.5: BDNF: KF576787); *Boa c. imperator* (E17.5: BDNF: KF576816; RAG1: KF576905); *Boa c. imperator* (NE1.17: BDNF: KF576812; RAG1: KF576901); *Boa c. ornitii* (NE1.18: KF576811; RAG1: KF576900); *Calabaria reinhardtii* (NE2.2: 16S: KF576930); *Eunectes notaeus* (0001FO7C39); 16S: KF576912, BDNF: KF576916; RAG1: KF576749); *Eunectes notaeus* (2502296000049768); 16S: KF576913, BDNF: KF576917; RAG1: KF576750).

APPENDIX II

Morphological data were obtained from following specimens of the collection of the Natural History Museum of Geneva (MHNG). *Eunectes notaeus* specimens: MHNG 1348.17; MHNG 1501.06; MHNG 1501.67; MHNG 1551.82; MHNG 2194.3; MHNG 2424.33; MHNG 2424.34; and *Boa c. constrictor* specimens: MHNG 12.34; MHNG 1325.33; MHNG 1337.37; MHNG 1456.83; MHNG 2238.13; MHNG 2424.44; MHNG 2424.45; MHNG 2424.46.
The Far Eastern species of *Thinobius* Kiesenwetter, 1844 (Coleoptera: Staphylinidae, Oxytelinae) lacking female modified genital appendage

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The Far Eastern species of *Thinobius* Kiesenwetter, 1844 (Coleoptera: Staphylinidae, Oxytelinae) lacking female modified genital appendage.

The Far Eastern members of *Thinobius* Kiesenwetter, 1844 without female modified genital appendage are reviewed. Besides the previously described Japanese (*T. ootsukai* Naomi, 1995 and *T. yabakeinis* Naomi, 1995) and Russian (*T. zerchei* Gildenkov, 1998) species, the genus is reported from Korea for the first time, with three species described here as new: *T. injae* sp. nov. (Injae-gun district), *T. schillhammeri* sp. nov. (Seorak-san), *T. paraminor* sp. nov. (Injae-gun district), belonging to three different species groups, respectively. Another taxon, *T. shavrini* sp. nov. is described from the USA (Alaska) and Russia (Chita area) and is believed to have a distribution connecting these locations. *T. delicatulus* is reported from Romania, while by the correction of an earlier record *T. hummleri* is mentioned from Mongolia. The male genital characters are illustrated for all species by line drawings, colour plates show the habitus of the new taxa, SEM images depict external morphology of all species.

**Keywords:** East Palaearctic - Nearctic - Romania - *Thinobius* - taxonomy - new species.

**INTRODUCTION**

During a collecting trip in Korea as a cooperative effort with the National Institute of Biological Resources, Incheon, Korea (NIBR) in September 2010 the author obtained some material of *Thinobius* Kiesenwetter, 1844, a genus not so far reported from Korea; all from the northeastern mountainous areas of South Korea (Gangwon-do) – three of which are described here as new. The East Palaearctic *Thinobius* fauna is poorly studied, although it seems that the genus is widely distributed there. The species can be collected with the flotation method which is not very frequently used by non-specialist workers and collectors. This somewhat explains the poor record of *Thinobius* from this region.

South Korea is known to be an area with very high human populations. One would expect the rivers to be in poor condition and having no natural habitats at all. Currently this is one of the greatest nature protection problems in Central Europe where almost all the rivers have been regulated and the banks built up. As a consequence the species of *Thinobius*, specialized to gravelly-sandy riverbanks with an un-
interrupted flow of natural (mineral and organic) debris has become near extinct. Many taxa were not collected in the last 100 years and specimens of this group, though once common, are now rarely encountered. Yet, in spite of low expectations it was surprisingly easy to find a natural riverbank with several Thinobius species, near the city Inje (In-jae in the older transliteration) at the Naerincheon river. As a general trend, the lower the altitude, the higher the number of Thinobius species is — but also the greater the habitat destruction is, therefore it is much harder to find natural, gravelly-sandy banks. Mountain streams (like the Osaekcheon stream) have fewer species but are more often found in good condition, the best habitats are sandy-gravelly spots between larger rocks or even under stones.

The species of Thinobius can be divided according to the presence or absence of a female modified genital appendage. The section having this apparently derived, unique structure is often referred to as Thinobius s.str. in the literature, for including the type species of the genus. The section lacking it has the female terminalia in the primitive condition with coxites and styli, paired plates. Further subgeneric names exist for groups within this latter unit, and while the system appears to be reasonably applicable for the East Palearctic fauna, the author is not convinced that this division works for other (especially tropical) faunas. This is the main reason for which the use of the subgeneric names is ill-advised until the worldwide diversity is better known. The T. delicatulus group (Makranczy, 2009) should be separated because of the unique formation of the asymmetrical aedeagus and also the spike-like, asymmetrical sternite IX – this group is dealt with in some literature as the subgenus Oedarthrothinophilus Scheerpeltz, 1959. A rather well-established group exists with a post-occipital groove separating the neck from the rest of the head — the T. linearis group, also known as Thiophonilus Tottenham, 1939 was subject to some recent revisional studies (Makranczy & Schülke, 2001; Makranczy, 2014). The remaining species are in fact a loose assemblage of taxa that are not particularly closely related, essentially just what is left when other species groups are formed; these all have symmetrical aedeagi and lacking a post-occipital groove. This group currently stands under the subgeneric name Platyderothinophilus Scheerpeltz, 1959, but the T. major group is preferred herein.

MATERIAL AND METHODS

Transliteration of Korean placenames is a particularly difficult task. Romanisation rules have changed significantly after 2000, but one can still see place-names in several different versions. For names of major places, the 2010 edition of the Lonely Planet travel book (as the possible most recent printed source) was followed, smaller entities were transliterated directly from Korean language maps with the help of locals.

The label data of the types for previously described taxa are reproduced literally between “”, the symbol “;” is a separator between each individual label, while “;” means line breaks. Text within brackets [ ] is explanatory and was not included in the original labels.
Abbreviations of collections whose materials were used in the present study are as follows:

CMIC  Chiba Natural History Museum and Institute, Chiba, Japan (A. Saito, S-I. Naomi)
CNCI  Canadian National Collection of Insects, Ottawa, ON, Canada (A. Davies)
HNHM  Hungarian Natural History Museum, Budapest, Hungary
KUEC  The Kyushu University Museum, Fukuoka, Japan (M. Maruyama)
MHNG  Muséum d’histoire naturelle, Genève, Switzerland (G. Cuccodoro)
NIBR  National Institute of Biological Resources, Incheon, Korea
NHMW  Naturhistorisches Museum Wien, Wien, Austria (H. Schillhammer)
SDEI  Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany (L. Behne, S. Blank)

Coll. Schülke = private collection of Michael Schülke, Berlin, Germany
Coll. Shavrin = private collection of Alexey Shavrin, Daugavpils, Latvia

Abbreviations for the measurements: HW = head width with eyes; TW = head width at temples; PW = maximum width of pronotum; SW = approximate width of shoulders; AW = maximum width of abdomen; HL = head length (in middle-line, from front margin of clypeus to the beginning of neck); EL = length of eye; TL = length of temple; PL = length of pronotum in the middle-line; SL = length of elytra from shoulder; SC = length of elytra from hind apex of scutellum; FB = forebody length (combined length of head, pronotum and elytra); BL = approximate body length. All measured from dorsal view.

For descriptions and measurements a Leica MZ 12.5 stereoscopic microscope was used. For the line drawings permanent preparations were made in Euparal mounting medium on plastic cards pinned with the specimens. Techniques are described in detail in Makranczy (2006). Drawing was done with a Jenalab (Carl Zeiss, Jena) compound microscope and drawing tube (camera lucida). SEM images were taken of uncoated specimens with a Hitachi S-2600 N scanning electron microscope. Colour habitus photographs were made with a Leica DFC 490 camera attached to a Leica MZ16 stereoscopic microscope and layers montaged by AutoMontage software, then treated in Photoshop.

TAXONOMY

**Thinobius injae** sp. nov.  

Figs 1, 9-10, 23, 31, 43, 51-52, 73-77

**Type Material:** HNHM, holotype (♂); “S-KOREA, Gangwon-do, Injae-gun district, 2 km E Inje, Naeirancheon river, sand at W end of bridge, 200 m, gravel/sand border at water, flotation (2B), 38°03’59”N, 128°11’27”E; 08.IX.2010; [leg.] Makranczy & al”.

**Paratypes** (2): MHNG 1, NIBR 1♂; same data as holotype.

**Description:** Habitus as in Fig. 1. Measurements (n=3): HW = 0.23 (0.22-0.25); TW = 0.22 (0.21-0.24); PW = 0.23 (0.22-0.26); SW = 0.25 (0.23-0.28); AW = 0.28 (0.25-0.31); HL = 0.21 (0.20-0.22); EL = 0.08 (0.075-0.08); TL = 0.07 (0.065-0.07); PL = 0.19 (0.18-0.21); SL = 0.36 (0.335-0.39); SC = 0.32 (0.30-0.36); FB = 0.76 (0.71-0.85); BL = 1.43 (1.30-1.53) mm. BODY rather conspicuously bicoloured. Head and pronotum slightly reddish dark brown, abdomen blackish dark brown, elytra medium to light brown but scutellar area broadly dark brown. Legs, mouthparts and
Figs 1-4

(1-2) Habitus of new Thinobius species. *T. injae* sp. n. (1), *T. paraminor* sp. n. (2). (3-4) Type locality of both *P. injae* sp. n. and *T. paraminor* sp. n.; wide view (3), close-up (4).
first two antennomeres medium to light brown, antennal articles 3-11 dark brown. All
main body parts with coriaceous (or rather imbricate on abdomen and some other parts,
like sides of head) microsculpture intermixed with fine and dense punctation, making
body moderately lustrous; in contrast, clypeus almost unsculptured. Punctuation stron-
gest on head, on pronotum very fine, as also on elytra, indistinct on abdomen, latter
being strongly microsculptured. Tergite VII not more lustrous than preceding tergites,
but on the mostly unexposed tergite VIII microsculpture is faded, so shinier.
Pubescence on forebody depressed, very fine, short; on abdomen even finer but some-
what longer setae plus a row of stronger and longer setae on apices of tergites.
Abdominal sides and apex with a few darker, much longer and stronger, erect bristles.
Strong dark bristle on outer side of supraantennal prominence at anterior border of eye
and on posterior edge of vertex adjacent to temples, similar ones right behind anterior
pronotal corner and another before posterior corner. Direction of setation on sides of
head anterior, on disc mostly medial, but posterior in midline and near hind edge; on
pronotal sides medial, most of disc antero-medial, midline anterior, posterior edge
lateral. Posterior edge of vertex as well as middle of anterior pronotal edge with
conspicuously long setae. Setation on abdomen posteriorly directed, but slightly
postero-lateral on elytra. Antennae, legs and mouthparts with very short, not conspi-
cuous setation, except for the stiff, darker bristle slightly distad from middle of each
tibia and ones near apices of femora. Elytra with three long, stiff and erect lateral setae,
posterior one slightly closer to middle.

Head (Fig. 23) 1.15x wider than long, temples almost straight, with only a
gentle curve anteriorly, but narrowly rounded on posterior part. Vertex rather flat,
supraantennal prominences strongly developed, anterior edges rather shiny. Anterior
border of neck not marked with groove, only by change of microsculpture. Frontoclypeal
suture appearing as fine, often shinier groove and dark line connecting
supraantennal tubercles, similarly darker spots situated at both sides on middle of
vertex. ANTENNAE (Fig. 51) with antennomeres 4-8 moderately to strongly transverse,
as opposed to terminal antennomeres (Fig. 52) with article 9 as long as broad and 10
elongate.

Pronotum (Fig. 9) slightly transverse, 1.30x wider than long, not appearing
wider than head, with narrowly rounded anterior and rather narrowly rounded posterior
corners. Anterior margin almost straight, as also sides (parallel) with slight concavity
behind middle; posterior margin strongly but not evenly arched, almost straight in
outer thirds, giving pronotum a faint pentagonal feel. No consistent and characteristic
impressions, but both sides of anterior half of disc gently impressed as well as sides
behind middle. Pronotal marginal bead visible on posterior margin. Scutellum large,
setose and very strongly sculptured (Fig. 31). ELYTRA (Fig. 10) long, one elytron more
than twice as long as broad, gently curved in cross-section, parallel-sided (very little
dilation posteriorly). Shoulders moderately developed. Along suture with thin marginal
bead, but broader right behind scutellum. Sutural corners broadly rounded. LEGS of
medium length, tarsal lobes thin but relatively long (but not reaching apex of last
femur). Tibiae strongly fusiform, appear a lot wider in middle than at ends.

Abdomen (Fig. 43) very weakly fusiform, sides more or less straight and
parallel; widest at posterior 1/3, very slightly less wide than elytra at broadest point.
Posterior margin of tergite VII with moderately broad palisade fringe.
PRIMARY AND SECONDARY SEXUAL FEATURES: Sexes not appearing different in regular dorsal view. Posterior corners of tergite VIII (similar in both sexes) gently protruding, posterior edge otherwise straight. Male sternite VIII as in Fig. 73, tergite IX as in Fig. 74, sternite IX as in Fig. 75. Aedeagus as in Figs 76-77.

ETYMOLOGY: The species is named after the city near the type locality, deliberately in the older spelling (noun in apposition).

REMARKS: The male holotype has slightly larger body size than the two para-types. However, with only three specimens known this does not allow for conclusions on possible sexual differences. This taxon belongs in the *T. delicatulus* group. Its aedeagal structures are very similar to the sibling species *T. delicatulus* Kraatz, 1857 and *T. hummleri* Bernhauer, 1940. During the checking of Thinobius taxon names described from the East Palaearctic, it was discovered that the specimens Smetana identified as *T. delicatulus* from Mongolia (Smetana, 1975) are in fact *T. hummleri*. The proper distinguishing features were not known at the time. Comparison of the new species to the European relatives also revealed that a pair of specimens with conspicuously transversal antennomeres (data: Romania, jud. Maramureș, Valea Vișeului, [river] Vișeu, 1.5 km S Tisa confluence, W bank, sandy shoal N hanging bridge, 360 m, from gravelly spots in sandbank, after high water, flotation (305), 47°54'04"N, 24°09'33"E, 11.VI.2007, [leg.] Gy. Makranczy) actually belong to *T. delicatulus*, which confirms its occurrence in Romania. Shapes of individual antennomeres turn out to be rather variable in this genus, making this character difficult to use in diagnosis.

DISTRIBUTION: The species is known only from the type locality (Figs 3-4).

BIOMONICS: Seems to be associated with lower rivers, more open, sunny gravelbanks.

*Thinobius ootsukai* Naomi, 1995  
Figs 11-12, 24, 37-39, 64-66, 81


TYPE MATERIAL EXAMINED: CMIC, holotype (♂); “[JAPAN: Honshu,] Chiba Pref; Mt. Kiyosumi; 27.V.1990; I. Ootsuka coll. \ Holotype; Thinobius ootsukai; Naomi 1995. \ CBM - ZJ; 33876 \ Holotypus; Thinobius; ootsukai Naomi; ver. Makranczy, 2011 \ Thinobius; ootsukai Naomi; det. Makranczy, 2011”.

REDESCRIPTION: Measurements (n=1): HW = 0.33; TW = 0.31; PW = 0.38; SW = 0.44; AW = 0.46; HL = 0.27; EL = 0.11; TL = 0.075; PL = 0.295; SL = 0.54; SC = 0.50; FB = 1.08; BL = 1.93 mm. BODY unicoloured. Head dark brown with only supraantennal tubercles appearing lighter. Pronotum dark brown, elytra somewhat lighter (but unicolorous) dark brown. Abdomen dark brown to blackish dark brown. Mouthparts and antennae slightly reddish dark brown, legs medium to dark brown, tarsi somewhat lighter. All main body parts with coriaceous microsculpture intermixed with fine and dense punctuation, making body moderately lustrous. Punctuation on head (especially anterior half of vertex) stronger, moderately deep, pronotum slightly less strong and more dense, elytra even finer and denser, on abdomen (Fig. 37) more indistinct; on tergite VII both coriaceous microsculpture and punctuation fading posteriorly (as also on mostly unexposed tergite VIII), making tip of abdomen much shinier than rest. Pubescence on forebody rather depressed, short, fine and dense (on elytra the most dense), on abdomen somewhat less dense but short and extremely fine setae,
FIGS 9-13

(9-10) Thinobius injae sp. n.; head and pronotum (9), elytra (10). (11-12) T. ootsukai Naomi; head and pronotum (11), eye (12). (13) T. shavrini sp. n.; side of head. Scale bar = 0.05 mm for 12, 0.1 mm for 9-10, 13, 0.14 mm for 11.
(14) Thinobius shavrini sp. n.; elytra. (15-16) T. schillhammeri sp. n.; head and pronotum (15), side of head (16). (17) T. yabakeinis Naomi; head and pronotum. (18) T. paraminor sp. n.; side of head (11). Scale bar = 0.1 mm for 16, 18, 0.2 mm for 15, 0.25 mm for 14, 17.
apices of tergites with a row of conspicuously long setae, abdominal sides and apex with a few darker and stronger bristles. Strong dark bristle on outer side of supraantennal prominence at anterior border of eye and on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and on side at 3/5 length. Setation on head medially directed except distinctly posterior on anterior part of vertex (a bristle on each side). Pronotal setation mostly antero-medially directed, but near posterior and side edges and at midline direction more anterior. Posterior edge of vertex as well as middle of anterior pronotal edge with rather large setae. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker bristle around middle of each tibia and ones near apices of femora. Sides of elytra with three such stiff but inconspicuous setae distributed on side, the middle one shifted towards apex from middle.

Head (Fig. 11) 1.40x wider than long, temples shorter than eyes (Fig. 12), gently curved anteriorly, narrowly rounded posteriorly. Middle of vertex with slight impression, supraantennal tubercles moderately developed. Anterior border of neck not marked with groove, only by change of microsculpture. Frontoclypeal suture appearing as fine, often shinier groove and darker line connecting supraantennal tubercles. Antennae moderately elongate (Fig. 39), antennomeres 4 and 6 smaller than adjacent ones and as long as broad, other antennomeres slightly elongate.

Pronotum transverse, 1.40x wider than long, significantly wider than head, anterior margin almost straight, anterior corners noticeable but obtuse-angled, sides strongly arched, forming a rather unbroken arch with posterior margin, posterior angles barely marked. Pronotal midline slightly elevated, rest of middle of disc gently impressed. Pronotal marginal bead visible on posterior margin. Scutellum large, setose and dull. Elytra (Fig. 38) long, one elytron slightly more than twice as long as broad, gently curved in cross-section and parallel-sided (very little dilation posteriorly). Shoulders moderately developed. Along suture only with traces of marginal bead, mostly at broadly rounded sutural corners. Legs of medium length, tarsal lobes thin but relatively long (not reaching apex of last tarsomere), tibiae slightly fusiform, appear much wider in middle than at ends.

Abdomen very weakly fusiform, sides more or less straight and parallel; widest in the middle, with just about the same width as elytra at broadest point. Posterior margin of tergite VII with palisade fringe, strongly widening in middle.

Primary and secondary sexual features: Posterior corners of tergite VIII (similar in both sexes) gently protruding (Fig. 24), posterior edge otherwise straight. Male sternite VIII as in Fig. 64, tergite IX as in Fig. 65, sternite IX as in Fig. 66. Aedeagus as in Fig. 81.

Remarks: The description also mentions one male paratype. As the holotype was received undissected, obviously the aedeagus drawing in the original description must be based on the paratype; its whereabouts are unknown. It was neither deposited with the holotype (CMIC) nor with the paratypes of T. yabakeinis, of which no previously dissected male specimen was included in the available set of paratypes (KUEC) although an aedeagus drawing appears among the illustrations in Naomi (1995).
(19) *Thinobia* paraminor sp. n.; pronotum. (20-22) *T. shavrii* sp. n.; head (20), pronotum (21), abdominal tip, dorsal view (22). (23) *T. injiae* sp. n.; head. (24) *T. ootukai* Naomi; abdominal tip, dorsal view. Scale bar = 0.1 mm for 19, 23, 0.18 mm for 20-21, 24, 0.22 mm for 22.
DISTRIBUTION: The species is known only from Mt. Kiyosumi (Chiba prefecture) in Japan (Honshu).

BIONOMICS: Unknown.

*Thinobius paraminor* sp. nov.

**Type material:** HNHM, holotype (♂); "S-KOREA, Gangwon-do, Injae-gun district, 2 km E Inje, Naerincheon river, sand at W end of bridge, 200 m, gravel/sand border at water, floatation (2B), 38°03'59"N, 128°11'27"E; 08.IX.2010; [leg.] Makranczy & al."

**Paratype:** MHNG, 1 ♂, Same data as holotype.

**Description:** Habitus as in Fig. 20. Measurements (n=2): HW = 0.20 (0.195-0.20); TW = 0.20 (0.195-0.205); PW = 0.21 (0.21-0.215); SW = 0.22 (0.21-0.22); AW = 0.26 (0.25-0.26); HL = 0.19 (0.18-0.19); EL = 0.07 (0.07-0.07); TL = 0.06 (0.06-0.06); PL = 0.17 (0.16-0.17); SL = 0.30 (0.29-0.305); SC = 0.27 (0.265-0.27); FB = 0.64 (0.63-0.64); BL = 1.22 (1.21-1.23) mm. **Body** very slightly bicoloured. Head and pronotum reddish medium to dark brown, abdomen dark brown, apically more blackish; elytra medium brown, slightly darker at shoulders and scutellum. Legs light brown, mouthparts and antennae medium brown, basal antennomeres slightly lighter. Fine and dense punctation of body parts intermixed with (and thereby obscured by) microsculpture, but still well observable on forebody, body appearing weakly lustrous. Coriaceous or at places rather imbricate microsculpture covering all body parts (strongest on abdomen), but neck conspicuously smooth and shiny, transversally substriigate. Compared to preceding plates, tergite VII notably shinier towards apex, as also tergite VIII (but barely exposed). Pubescence on forebody fine, very short and depressed, dust-like; on abdomen medium dense short setae and on apical edges of tergites a row of conspicuously long setae. Abdominal sides and apex with a few darker, medium long, stronger bristles. Strong dark bristle on outer side of supra-antennal prominence at anterior border of eye and on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and on side at 3/5 length. Direction of setation on head and pronotum almost exclusively anterior, except posterior part of vertex where mixed. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker bristle slightly distad from middle of each tibia and ones near apices of femora. Sides of elytra with three stiffer setae equally distributed on side (anterior one little behind shoulder, posterior little before outer corner).

Head (Fig. 25) 1.25× wider than long, temples (Fig. 18) usually straight, with a gentle curve (if any) anteriorly, rather broadly rounded posteriorly. Vertex rather flat, supraantennal prominences weakly developed. Anterior border of neck not marked with groove, only by change of microsculpture. Frontoclypeal suture appearing as fine, often shinier groove and dark line connecting supraantennal tubercles, similarly darker spots situated at both sides on middle of vertex. **ANTENNAE** with antennomeres 4 and 6 appearing smaller and much more transverse than adjacent (more or less as long as broad) ones (Fig. 53), articles 9-10 somewhat longer than broad.

Pronotum (Fig. 19) slightly transverse, 1.33× wider than long, just a little wider than head, anterior margin gently arched, with even a slight concavity before anterior corners, latter narrowly rounded. Sides and posterior marginal form an almost perfect
Figs 25-31

(25) *Thinobius paraminor* sp. n.; head and pronotum. (26-29) *T. zerchei* Gildenkov; head and pronotum, ♂ (26), elytra (27), proleg (28), base of tibia (29), antennomeres 4-8 (30). (31) *Thinobius iniae* sp. n.; apex of scutellum. Scale bar = 0.075 mm for 31, 0.1 mm for 25, 29-30, 0.2 mm for 26-28.
arch of circle, posterior corners inconspicuous. Pronotum with traces of impressions on middle of disc and around middle of sides. Pronotal marginal bead visible on posterior margin as a thin line. Scutellum large, setose and dull. Elytra (Fig. 32) long, one elytron more than twice as long as broad, gently curved in cross-section and parallel-sided (very little dilation posteriorly). Shoulders moderately developed. Along suture without marginal bead, sutural corners broadly rounded. Legs of medium length, tarsal lobes thin and appear quite short, tibiae strongly fusiform, appear a lot wider in middle than at ends.

Abdomen very weakly fusiform, sides more or less straight and parallel; widest in the middle, very slightly less wide than elytra at broadest point. Posterior margin of tergite VII with thin palisade fringe.

**PRIMARY AND SECONDARY SEXUAL FEATURES:** Posterior corners of tergite VIII (similar in both sexes) gently protruding, posterior edge otherwise straight. Male sternite VIII as in Fig. 55, tergite IX as in Fig. 56, sternite IX as in Fig. 57. Aedeagus as in Fig. 78.

**ETYMOLOGY:** The specific epithet refers to the confusing external similarity to *Thinobius minor*.

**REMARKS:** This taxon before the dissection appeared remarkably similar to *T. minor* Mulsant & Rey, 1870. However, based on the genital structures, it is closest to *T. ligeris* Pyot, 1874.

**DISTRIBUTION:** The species is known only from the type locality (Figs 3-4).

**BIONOMICS:** Collected with *T. injae*, at a lower river, open, sunny gravelbank.

*Thinobius schillhammeri* sp. nov. Figs 5, 15-16, 33-35, 50, 58-60, 79

**TYPE MATERIAL:** HNHM, holotype (♂); "S-KOREA, Gangwon-do, Seorak-san, Osaek-Oncheon, N branch of Osaekcheon stream, stony bank, 370 m, rough sand partly under stones, flotation (4A), 38°04'48"N, 128°26'58"E; 09.IX.2010; [leg.] Makranczy & al."

**PARATYPES** (5): HNHM 1 ♀, 1, NIBR 1, NHMW 1, MHNG 1; same data as holotype.

**DESCRIPTION:** Habitus as in Fig. 5. Measurements (n=6): HW = 0.28 (0.26-0.29); TW = 0.28 (0.265-0.295); PW = 0.32 (0.305-0.325); SW = 0.33 (0.32-0.33); AW = 0.38 (0.36-0.40); HL = 0.22 (0.21-0.23); EL = 0.08 (0.08-0.085); TL = 0.08 (0.07-0.08); PL = 0.25 (0.24-0.255); SL = 0.39 (0.35-0.415); SC = 0.34 (0.33-0.355); FB = 0.86 (0.82-0.90); BL = 1.48 (1.35-1.55) mm. Body slightly bicoloured. Head, pronotum and abdomen blackish dark brown with occasional reddish tint; elytra medium brown, but narrowly darker around scutellum. Mouthparts, antennae and legs medium to dark brown, tibiae and tarsi lighter, yellowish light brown. Forebody with microsculpture intermixed with fine and dense punctation, making it moderately lustrous; abdomen with microsculpture composed of transversal micro-ridges and microsetation (Figs. 34-35) resulting in a dull, iridescent appearance. Head and pronotum with coriaceous microsculpture and inconspicuous punctation. Elytra dominated by more imbricate microsculpture and only very obscured, dense and tiny punctures. Abdominal tergites with only traces of scattered punctuation, rather shallow and indistinct; surface dominated by transversal substriate microsculpture. Tergite VIII rarely exposed but with smoother surface. Pubescence on head and pronotum fine, medium
(32) Thinobius paraminor sp. n.; elytra and abdominal base. (33-35) T. schillhammeri sp. n.; elytra and abdominal base (33), left half of tergite IV (34), tergal microsculpture (35). (36) T. shavrini sp. n.; left half of tergite III. (37) T. ootsukai Naomi; right half of tergite IV. Scale bar = 0.007 mm for 35, 0.06 mm for 34, 0.07 mm for 37, 0.08 mm for 32, 36, 0.1 mm for 33.
short and depressed; elytra with extremely fine and short, more dense setae. Abdomen with short and very sparse setae, plus a row of conspicuously long setae on apical edges of tergites. Abdominal sides and apex with a few darker, not too long but stronger bristles. Strong dark bristle on outer side of supraantennal tubercle at anterior border of eye and on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and on side at 3/5 length. Direction of setation on head and pronotum anterior in midlines plus posterior edge of pronotum, on discs anteromedial; anteriod neck rather mixed. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker bristle near middle of each tibia and ones near apices of femora. Sides of elytra with three stiffer (but inconspicuous) setae equally distributed on side, closer to each other (anterior one more behind shoulder, posterior more before outer corner) than usual.

Head (Fig. 15) 1.30x wider than long, temples (Fig. 16) usually straight or slightly narrowing, with a gently curve anteriorly, narrowly rounded posteriorly. Marked groove at inner edge of eye, continuing at side of a ridge at outer border of supraantennal prominence, latter with deep groove marking its inner border with clypeus; clypeus as strongly microsculptured as rest of head. Anterior border of neck marked with strong, curved groove. Frontoclypeal suture appearing as fine, shinier groove connecting supraantennal tubercles. ANTENNAE moderately elongate (Fig. 50), antennomeres 4-8 all slightly elongate, 9 and 10 significantly larger than preceding ones.

Pronotum slightly transverse, 1.30x wider than long, a little wider than head. Weakly arched sides plus anterior and posterior margins with narrowly rounded anterior and posterior corners giving pronotum a distinctly rectangular appearance. Pronotal disc inconspicuously impressed around middle of disc as well as slightly behind middle of sides; areas of posterior corners slightly elevated. Pronotal marginal bead visible on posterior and side margins. Scutellum large, setose and dull. ELYTRA (Fig. 33) moderately long, one elytron up to twice as long as broad, quite flat and parallel-sided (very little dilation posteriorly). Shoulders moderately developed. Along suture without marginal bead, sutural corners moderately broadly rounded. LEGS of medium length, tarsal lobes thin but relatively thin but long (sometimes reaching apex of last tarsomere), tibiae rather fusiform, appear much wider in middle than at ends.

Abdomen very weakly fusiform, sides more or less straight and parallel; widest in the middle, very slightly less wide than elytra at broadest point. Posterior margin of tergite VII with thin palisade fringe, posterior corners conspicuously broadly rounded.

PRIMARY AND SECONDARY SEXUAL FEATURES: Sexes not appearing different in regular dorsal view. Posterior corners of tergite VIII (similar in both sexes) gently protruding, posterior edge otherwise straight. Male sternite VIII as in Fig. 58, tergite IX as in Fig. 59, sternite IX as in Fig. 60. Aedeagus as in Fig. 79.

ETYMOLOGY: Named after Dr. Harald Schillhammer (Wien, Austria), who provides continuous help with colour habitus photography in a quality rarely seen for such tiny insects.

REMARKS: As for body size no sexual dimorphism was experienced with this species. A member of the Thinobius linearis group, it is the closest known relative of
(38-39) Thinobius ootsukai Naomi; elytron (38), antenna (39). (40-42) T. yabakeinis Naomi; elytron (40), antenna (41), side of head (42). (43) T. injae sp. n.; abdomen, dorsal. (44) T. zercei Gildenkov; abdomen, dorsal. Scale bar = 0.06 mm for 42, 0.1 mm for 38, 0.13 mm for 40, 43, 0.16 mm for 39, 41, 0.2 mm for 44.
Thinobius shavrini sp. nov.  

**Figs. 6, 13-14, 20-22, 36, 48-49, 61-63, 80, 84, 86**  

**Type Material:** CNCI, holotype (♂); "ALASKA, Alaska Range, Antimony Crk. [63°08'N, 149°22'W], 3500', 2.5mi E. mi. 181, G[eorge] Parks Hwy.; 27.VI.[19]78; [leg.] [A.] Smetana & [E.C.] Becker".


**Description:** Habitus as in Fig. 6. Measurements (n=3): HW = 0.37 (0.36-0.37); TW = 0.38 (0.37-0.38); PW = 0.42 (0.405-0.425); SW = 0.43 (0.42-0.44); AW = 0.51 (0.49-0.53); HL = 0.32 (0.32-0.33); EL = 0.08 (0.075-0.08); TL = 0.12 (0.115-0.12); PL = 0.32 (0.31-0.325); SL = 0.49 (0.48-0.51); SC = 0.45 (0.44-0.46); FB = 1.22 (1.21-1.23); BL = 2.51 (2.43-2.66) mm. Body more or less unicoloured. Head, pronotum and abdomen reddish brown, elytra reddish medium brown. Legs, mouthparts and antennae reddish medium to light brown. All main body parts with coriaceous microsculpture intermixed with fine and dense punctation, making body moderately lustrous. Head with fine and dense punctation but on vertex with larger and deeper punctures, on larger interspaces microsculpture visible; pronotum and elytra with very fine and very dense punctation, microsculpture stronger (slightly imbricate) on elytra. Abdomen with transversal coriaceous microsculpture (Fig. 36) plus fine and dense punctation especially posteriorly, apex of tergite VII and the whole tergite VIII shiny (transversal coriaceous microsculpture), almost without punctures. Pubescence on forebody depressed, very fine, medium short; on abdomen fine and medium short setae plus a row of stronger and longer setae on apices of tergites (a few similar setae occasionally also on discs of tergites). Abdominal sides and apex with a few darker, longer and stronger bristles. Strong dark bristle on outer side of supraantennal prominence at anterior border of eye and on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and on side at 3/5 length. Direction of setation anterior on sides of head, medial on most of disc, postero-medial in midline; anterior on pronotal sides, posterior edge and midline, antero-medial on rest of disc. Stronger setae in middle of anterior pronotal edge. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker bristle slightly distal from middle of each
(45-47) Thinobius zerchei Gildenkov; scutellum (45), δ sternite VIII, dorsal view (46), antenna (47). (48-49) *T. shavrini* sp. n.; scutellum (48), antenna (49). (50) *T. schillhammeri* sp. n.; antenna. (51-52) *T. injae* sp. n.; antenna (51), antennomeres 10-11 (52). (53) *T. paraminor* sp. n.; antennomeres 3-6. (54) *T. yabakeinis* Naomi; tergites IV-VII. Scale bar = 0.035 mm for 53, 0.055 mm for 45, 53, 0.07 mm for 48, 51, 0.1 mm for 46, 0.12 mm for 50, 54, 0.14 mm for 47, 49.
tibia and ones near apices of femora. Sides of elytra with three stiffer setae on side but middle one slightly shifted posteriorly.

Head (Fig. 20) 1.18x wider than long, temples (Fig. 13) slightly widening anteriorly and are curved, narrowing and more narrowly rounded posteriorly. Anterior part of vertex slightly impressed on both sides near inner borders of supraantennal prominences. Anterior border of neck not marked with groove, only by change of microsculpture. Frontoclypeal suture appearing as fine, often shinier groove and darker line connecting supraantennal tubercles. ANTENNAE rather short (Fig. 49) with antennomeres 4 and 6 slightly transverse, 5, 7 and 8 conical apically.

Pronotum (Fig. 21) transverse, 1.40x wider than long, a little bit wider than head, anterior margin gently arched, anterior corners rather narrowly rounded, but more or less obtuse-angled. Sides more strongly arched in anterior half than posterior, posterior angles not too conspicuous, but sides not forming evenly arched line with posterior margin, latter more or less narrowly concave in the middle 1/5. Very gentle impressions on pronotal disc at both sides of midline but further away from it; anterior part of disc and middle of sides with similarly inconspicuous impressions. Pronotal marginal bead visible on posterior margin. Scutellum (Fig. 48) large, setose and dull. ELYTRA (Fig. 14) moderately long, one elytron up to twice as long as broad, quite flat and parallel-sided (very little dilation posteriorly). Shoulders weakly developed. Along suture with thin marginal bead. Sulcal corners moderately broadly rounded. LEGS of medium length, tarsal lobes thin but relatively long (but not reaching apex of last tarsomere), tibiae rather fusiform, appear much wider in middle than at ends.

Abdomen very weakly fusiform, sides more or less straight and parallel; widest in the middle, at least as wide as elytra at broadest point. Posterior margin of tergite VII with palisade fringe, moderately broad but somewhat widening in middle.

PRIMARY AND SECONDARY SEXUAL FEATURES: Sexes not appearing different in regular dorsal view. Posterior corners of tergite VIII (similar in both sexes) gently protruding (Fig. 22), posterior edge otherwise straight. Male sternite VIII as in Fig. 61, tergite IX as in Fig. 62, sternite IX as in Fig. 63. Aedeagus as in Fig. 80, female genital appendage as in Fig. 84, spermatheca as in Fig. 86.

ETYMOLOGY: The species is named after one of the collectors of the Siberian paratype, Alexey V. Shavrin (currently Daugavpils, Latvia) who contributed most interesting East Palaearctic material to several revisional projects of mine.

REMARKS: A species with rather small and flat eyes, transverse antennomeres and relatively short elytra.

DISTRIBUTION: Known from two distant localities (Alaska Range and Chita Area), but expected to have a distribution connecting these areas.

BIONOMICS: According to the collector of the holotype (Aleš Smetana) the collecting place was in a mountain valley with a fairly large, fast creek, where Thinobius was obtained from under small rocks along edges of the creek (low grassy vegetation and some moss), and by sifting wet moss and various debris at the same habitat. The Siberian paratype was collected from litter near gravel (Fig. 8) or from wet gravel together with specimens of Ochthophilus, Lobrathium, Stenus etc.
(55-57) *Thinobius paraminor* sp. n. ♂; sternite VIII (55), tergite IX (56), sternite IX (57). (58-60) *T. schillhammeri* sp. n. ♂; sternite VIII (58), tergite IX (59), sternite IX (60). (61) *T. shavrini* sp. n. ♂; sternite VIII. Scale bar = 0.07 mm for 60, 0.08 mm for 56-57, 0.1 mm for 55, 58-59, 0.2 mm for 61.
**Thinobius yabakeinis** Naomi, 1995

Figs 17, 40-42, 54, 68-70, 82, 85, 87


**Type material examined:** CMIC, holotype (♀); “[JAPAN: Kyushu.] Chikush; Yabakei; Fukuoka [pref.]; 16.iii.1986; S. Nomura” \Thinobius; yabakeinis; Naomi 1995 [reddish-orange label, without the word Holotype] \CBM - ZI; 33877 \Holotypus; Thinobius; yabakeinis Naomi; ver. Makranczy, 2011 \Thinobius; yabakeinis Naomi; det. Makranczy, 2011”. – Paratypes (14); KUEC 1, KUEC 10, HNHM 1♀ 1♂, MHNG 1♂; same data as holotype, “[JAPAN: Shikoku.] Mt. Odami [33°32’N, 132°51’E, 950m]; Ehime-pref.; 11-13.vi.1981; S. Naomi leg. \Paratype; Thinobius; yabakeinis; Naomi 1995 \Paratypus; Thinobius; yabakeinis Naomi; ver. Makranczy, 2012 \Thinobius; yabakeinis Naomi; det. Makranczy, 2012”.

**Redescription:** Measurements (n=3♀) HW = 0.33 (0.33-0.34); TW = 0.32 (0.315-0.32); PW = 0.38 (0.375-0.385); SW = 0.44 (0.43-0.45); AW = 0.46 (0.43-0.48); HL = 0.28 (0.26-0.29); EL = 0.11 (0.105-0.11); TL = 0.08 (0.075-0.08); PL = 0.29 (0.28-0.29); SL = 0.55 (0.52-0.56); SC = 0.47 (0.46-0.48); FB = 1.12 (1.07-1.15); BL = 1.87 (1.76-1.95); (n=4♂) HW = 0.33 (0.32-0.34); TW = 0.31 (0.295-0.32); PW = 0.37 (0.355-0.38); SW = 0.43 (0.40-0.44); AW = 0.47 (0.45-0.48); HL = 0.27 (0.265-0.28); EL = 0.11 (0.10-0.11); TL = 0.08 (0.075-0.08); PL = 0.27 (0.26-0.295); SL = 0.51 (0.48-0.54); SC = 0.47 (0.44-0.49); FB = 1.07 (1.00-1.12); BL = 1.77 (1.67-1.87) mm. Body more or less unicoloured. Head and pronotum reddish dark brown, abdomen blackish dark brown, elytra medium brown except darker area around scutellum, legs medium brown. Mouthparts and antennae reddish dark brown. All main body parts with microsculpture intermixed with very fine and very dense punctuation, making body gently lustrous. Forebody with inconspicuous imbricate microsculpture; middle of vertex with larger punctures. Fine and scattered punctures posteriorly on tergites, microsculpture a mixture of imbricate and subimbrigate. Tergite VII apical edge shinier, as well as tergite VIII (partly unexposed). Pubescence on forebody depressed, very fine, medium short; on abdomen extremely fine and medium short setae plus a row of stronger and longer setae on apices of tergites. Abdominal sides and apex with a few darker, longer and stronger bristles. Strong dark bristle on outer side of supraantennal prominence at anterior border of eye and on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and on side at 3/5 length. Direction of setation posterior on anterior part of vertex (a bristle on each side), anterior on sides of head, medial or antero-medial on rest of vertex; anterior on pronotal sides, posterior edge and midline, antero-medial on rest of disc. Posterior edge of vertex as well as middle of anterior pronotal edge with rather large setae. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker setae around middle of each tibia and ones near apices of femora. Sides of elytra with three rather inconspicuous stiffer setae on side, middle one slightly shifted posteriorly.

Head (Fig. 17) 1.40x wider than long, temples (Fig. 42) shorter than eyes, gently curved anteriorly, narrowly rounded posteriorly. Middle of vertex with slight impression, supraantennal tubercles moderately developed. Anterior border of neck not marked with groove, only by change of microsculpture. Frontoclypeal suture appearing as fine, often shinier groove and darker line connecting supraantennal tubercles. **Antennae** moderately elongate (Fig. 41), antennomeres 4 and 6 somewhat shorter than adjacent ones, rest of antennomeres distinctly elongate.
Figs 62–68

(62–63) Thinobius shavrini sp. n. ♂; tergite IX (62), sternite IX (63). (64–66) T. ootsukai Naomi ♂; sternite VIII (64), tergite IX (65), sternite IX (66). (67) T. zerchei Gildenkov ♂; sternite VIII. (68) T. yabakeinis Naomi ♂; sternite VIII. Scale bar = 0.1 mm for 64–65, 68, 0.12 mm for 66–67, 0.15 mm for 62–63.
Pronotum strongly transverse, 1.50x wider than long, just a little wider than head, anterior margin almost straight, anterior corners noticeable but obtuse-angled, sides strongly arched, and although posterior corners barely marked, posterior margin appears to be much more weakly arched. Pronotal midline slightly elevated, rest of middle of disc gently impressed. Pronotal marginal bead visible on posterior margin. Scutellum large, setose and dull.ELYTRA (Fig. 40) long, one elytron slightly more than twice as long as broad, gently curved in cross-section and parallel-sided (very little dilation posteriorly). Shoulders moderately developed. Along suture only with traces of marginal bead, mostly at broadly rounded sutural corners. LEGS of medium length, tarsal lobes thin but relatively long (not reaching apex of last tarsomere), tibiae slightly fusiform, appear much wider in middle than at ends.

Abdomen very weakly fusiform (Fig. 54), sides more or less straight and parallel; widest in the middle, very slightly less wide than elytra at broadest point. Posterior margin of tergite VII with palisade fringe, strongly widening in middle.

PRIMAR Y AND SECONDARY SEXUAL FEATURES: Sexes only appearing very slightly different (somewhat wider temples) in regular dorsal view. Posterior corners of tergite VIII (similar in both sexes) gently protruding, posterior edge otherwise straight. Male sternite VIII as in Fig. 68, tergite IX as in Fig. 69, sternite IX as in Fig. 70. Aedeagus as in Fig. 82, female genital appendage as in Fig. 85, spermamethca as in Fig. 87.

REMARKS: A very slight sexual dimorphism is experienced in the size, therefore measurements are made separate for males and females, respectively. One paratype of this species has turned out to be a Hydrosmelecta (Staphylinidae: Aleocharinae).

DISTRIBUTION: The species is known only from the material in the original description, from Shikoku and Kyushu islands of Japan.

BIONOMICS: Unknown.

Thinobius zerchei Gildenkov, 1998

Figs 26-29, 30, 44-47, 67, 71-72, 83


TYPE MATERIAL EXAMINED: SDEI, holotype (♂); “♂ [on mounting card] \ Russia: Primorskiy kray; Sikhote-Alin, Biol. Stat.; 30km SE Chuguyevka; 44°05' N 134°12' E; 31.V.1993 650m; leg. L. Zerche \ Holotypus; Thinobius; zerchei; M. Gildenkov 1996 \ DEI Müncheberg; Col-03055 \ Holotypus; Thinobius; zerchei Gildenkov; ver. Makranczy, 2012 \ Thinobius; zerchei Gildenkov; det. Makranczy, 2012”. – PARATYPE (1): SDEI, 1♂; “♀ [on mounting card] \ Russia: Primorskiy kray; Sikhote-Alin, Biol. Stat.; 30km SE Chuguyevka; 44°05' N 134°12' E; 01.VI.1993 650m; leg. L. Zerche \ Paratypus; Thinobius; zerchei; M. Gildenkov 1996 \ DEI Müncheberg; Col-03056 \ Paratypus; Thinobius; zerchei Gildenkov; ver. Makranczy, 2012 \ Thinobius; zerchei Gildenkov; det. Makranczy, 2012”.

OTHER MATERIAL EXAMINED: coll. Shavrin 1♀, NHMW 1♂, MHNG 1♂; RUSSIA, Primorskiy kraj. [Primorskiy kray], Siniy hr. [Siniy mountain range], 4 km B Ewseveki [4 km E Byeseveka, 44°24’31"N, 132°57’22"E], 7.9.8.[1999], [leg.] A. Shavrin [A. Shavrin], – HNHM 1♂; RUSSIA, Primorskiy kraj. [Primorskiy kray], поима р. Пойма [flood plain of Poima River, 42°49’37"N, 131°21’46"E]; 30.07-6.08.[1999]; [leg.] A. Shavrin [A. Shavrin], – coll. Schönle 3♀, HNHM 1♀; RUSSIA, Ussuriousky district, Suvorovka Fluss [43.6198° N, 132.5181° E], 100-150m; 02.VIII.1994; leg. B. Maier (110280), Kiesiges Ufer.
(69-70) Thinobius yabakeinis Naomi δ; tergite IX (69), sternite IX (70). (71-72) T. zerchei Gildenkov δ; tergite IX (71), sternite IX (72). (73-77) T. iniae sp. n. δ; sternite VIII (73), tergite IX (74), sternite IX (75), aedeagus lateral (76), aedeagus frontal (77). Scale bar = 0.08 mm for 76-77, 0.1 mm for 74-75, 0.11 mm for 73, 0.13 mm for 69, 0.15 mm for 70-71, 0.18 mm for 72.
REDESCRIPTION: Measurements (n=4♀) HW = 0.39 (0.375-0.405); TW = 0.40 (0.38-0.415); PW = 0.41 (0.395-0.43); SW = 0.44 (0.43-0.44); AW = 0.48 (0.46-0.50); HL = 0.33 (0.315-0.35); EL = 0.10 (0.09-0.10); TL = 0.14 (0.135-0.15); PL = 0.30 (0.29-0.31); SL = 0.52 (0.51-0.52); SC = 0.46 (0.44-0.47); FB = 1.20 (1.16-1.26); BL = 2.36 (2.19-2.44); (n=3♀) HW = 0.35 (0.35-0.355); TW = 0.35 (0.345-0.35); PW = 0.36 (0.355-0.36); SW = 0.41 (0.40-0.41); AW = 0.46 (0.44-0.47); HL = 0.30 (0.295-0.30); EL = 0.10 (0.095-0.10); TL = 0.11 (0.105-0.12); PL = 0.28 (0.27-0.28); SL = 0.48 (0.47-0.49); SC = 0.43 (0.41-0.44); FB = 1.10 (1.09-1.10); BL = 2.07 (1.85-2.29) mm. BODY unicoloured. Head, pronotum and abdomen blackish dark brown with reddish tint, elytra somewhat lighter, reddish dark brown, occasionally darker around scutellum. Mouthparts and antennae slightly reddish dark brown, legs reddish medium brown. All main body parts with microsculpture intermixed with fine and dense punctuation, making body moderately lustrous. On forebody fine eoriaceous microsculpture, larger and deeper punctures on middle of vertex and anterior middle of pronotal disc. Abdominal tergites with extremely fine, scattered, indistinct punctuation. Tergite VII with posteriorly fading (isodiametric) microsculpture, more lustrous, as well as tergite VIII (partly unexposed). Pubescence on forebody depressed, very fine, medium short; on abdomen fine and medium short setae plus a row of stronger and longer setae on apices of tergites (a few similar setae occasionally also on discs of tergites). Abdominal sides and apex with a few darker, somewhat longer and stronger bristles. Strong dark bristle on outer side of supraantennal prominence at anterior border of eye and one (from a small pit) on posterior edge of vertex adjacent to temples, similar ones right behind anterior pronotal corner and a longer one on side at 3/5 length. Direction of setation posterior on vertex, postero-lateral on supraantennal prominences, anterior on sides of head; medial or antero-medial on pronotal sides and disc except hind edge and midline where anterior. Elytra and abdomen with posteriorly directed setae. Elytra and abdomen with posteriorly directed setae. Antennae, legs and mouthparts with very short, not conspicuous setation, except for the stiff, darker bristle near the middle of each tibia and ones near apices of femora. Sides of elytra with three stiffer setae (rather inconspicuous) equally distributed on side.

Head (Fig. 26) 1.35x wider than long, temples usually broadening in males (temples broader than head width at eyes), more straight in females, only slightly curved anteriorly, narrowly rounded posteriorly. Anterior part of vertex rather conspicuously impressed on both sides near inner borders of supraantennal prominences. Anterior border of neck not marked with groove, only by change of microsculpture. Fronto-clypeal suture appearing as fine, often shinier groove and darker line connecting supraantennal tubercles. ANTENNAE medium long (Fig. 47), 6th antennomere (Fig. 30) appearing smaller (less wide) than adjacent ones.

Pronotum transverse, 1.48x wider than long, as wide as (male) or wider (female) than head, anterior margin almost straight, anterior corners rather narrowly rounded (but obtuse), margin with rather marked concavities proximad (within these marginal bead apparent). Sides more strongly arched in anterior half than posterior, posterior angles inconspicuous, posterior halves of sides forming almost even arch line with posterior margin, latter almost straight in the middle 1/5. Pronotal midline rather noticeably elevated and disc impressed on both sides, area of inconspicuous
(78-83) Aedeagi of Thinobius species. *T. paramenor* sp. n. (78), *T. schillhammeri* sp. n. (79), *T. shavrini* sp. n. (80), *T. ootsukai* Naomi (81), *T. yabakeinis* Naomi (82), *T. zerchei* Gildenkov (83). (84-85) Female genital appendages. *T. shavrini* sp. n. (84), *T. yabakeinis* Naomi (85). (86-87) Spermathecae. *T. shavrini* sp. n. (86), *T. yabakeinis* Naomi (87). Scale bar = 0.04 mm for 78, 0.06 mm for 79, 0.07 mm for 81, 0.08 mm for 82, 0.1 mm for 80, 0.115 mm for 84-85.
posterior corners marked with a pair of slight elevations. Pronotal marginal bead visible on posterior margin and conspicuously in middle of anterior margin. Scutellum (Fig. 45) large, setose and dull. Elytra (Fig. 27) moderately long, one elytron about twice as long as broad, quite flat and parallel-sided (very little dilation posteriorly). Shoulders moderately developed. Along suture with rather broad marginal bead, but missing right behind scutellum. Sutural corners rather narrowly rounded. LEGS of medium length, tarsal lobes relatively thin but long (sometimes reaching apex of last tarsomere), tibiae slightly fusiform, appear much wider in middle than at ends.

Abdomen (Fig. 44) very weakly fusiform, sides more or less straight and parallel; widest in the middle, about as wide as elytra at broadest point. Posterior margin of tergite VII with rather thin palisade fringe.

PRIMARY AND SECONDARY SEXUAL FEATURES: Sexes appearing quite different in regular dorsal view: males with modified prolegs (Figs 28-29) and much wider temples. Posterior corners of tergite VIII (similar in both sexes) gently protruding, posterior edge otherwise straight. Male sternite VIII as in Figs 46, 67, tergite IX as in Fig. 71, sternite IX as in Fig. 72. Aedeagus as in Fig. 83.

REMARKS: As this species has a conspicuous sexual dimorphism, measurements are made separate for males and females, respectively.

DISTRIBUTION: This species is so far known from the Russian Far East, exclusively.

BIONOMICS: For one paratype "in forest litter, near river" is given as bionomical data; the other specimens are without such records on their labels.

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Part of this study was made within the framework of a cooperation between HNHM and NIBR. The author would like to thank Michael Schülke for his continuous help and for information about a great many of Thinobius types and undetermined material studied by him. Thanks are also due to all the curators listed under the material section for lending types and material under their care. The cooperation and guidance of the Korean colleagues in the field work is gratefully acknowledged, as well as the company of the other members of the expedition, Drs. László Forró and Dávid Murányi (HNHM, Budapest). A significant number of SEM images were taken with financial help of the Hungarian Scientific Research Fund (OTKA No. 69235, principal investigator Zoltán Korsós).

REFERENCES


Edaphus von Japan (Coleoptera: Staphylinidae)
118. Beitrag zur Kenntnis der Euaesthetinen

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Edaphus from Japan (Coleoptera: Staphylinidae) 118th Contribution to the knowledge of Euaesthetinae. - 22 new species and new records of the genus Edaphus Motschulsky are described from Japan (exclusive the South Japanese islands): Edaphus bishamon sp. n. (Honshu), E. bosatsu sp. n. (Honshu), E. daimio sp. n. (Shikoku), E. haniwa sp. n. (Shikoku), E. kanzeon sp. n. (Kyushu), E. mikado sp. n. (Shikoku), E. peramicus sp. n. (Shikoku), E. perangustus sp. n. (Honshu), E. percongruus sp. n. (Kyushu), E. pergraecilis sp. n. (Shikoku), E. pergratus sp. n. (Honshu), E. perillustris sp. n. (Honshu), E. permacer sp. n. (Honshu), E. permolestus sp. n. (Kyushu), E. perparvus sp. n. (Kyushu), E. persubtilis sp. n. (Kyushu), E. perplexabilis sp. n. (Kyushu, Shikoku), E. propinquus sp. n. (Shikoku), E. persimplex sp. n. (Shikoku), E. sakura sp. n. (Kyushu), E. samurai sp. n. (Kyushu), E. shogun sp. n. (Shikoku, Honshu), and E. tanuki sp. n. (Honshu). An identification key to the species is provided.

Key words: Coleoptera - Staphylinidae - Edaphus - new species - taxonomy - Japan.

EINLEITUNG


Über die Variationsbreite der einzelnen Arten liegen bisher leider nur unzureichende Kenntnisse vor. Mehrere Arten mit verlängertem basalem Mittelfältchen des Pronotums scheinen in Bezug auf dieses Merkmal variabel, weshalb in solchen Fällen eine Untersuchung der Sexualcharaktere des Männchens unerlässlich bleibt. Zum Glück bieten die Männchen hier sechs verschiedene Charaktere an: (a) die äußere Gestalt der Abdominalventrite, (b) Stellung und Anzahl der Muskelansatzstellen

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(Wabenfelder) auf dem 9. Sternit, (c) die Gestalt der Spermapumpe, (d) die Gestalt der vesica seminalis und (e) den Aedoeagus. Dieser kann, je nach Ausstilpzustand, unterschiedlich aussehen, die stark sklerotisierten Elemente des Innensacks bilden aber ein gutes Vergleichsmerkmal. Man beachte auch die unterschiedliche Gestalt von dorsalem und ventralem Blatt der Apikalpartie des Medianlobus und die unterschiedliche Beborstung desselben und der Parameren.

Die Arten der aeneas-Gruppe (Puthz, 2010: 304) sind bisher die einzigen in Japan, bei denen Männchen dorsale Auszeichnungen an den Tergiten 4-6 tragen können. Wie REM-Aufnahmen zeigen, besitzen diese Arten feinste Poren daselbst, und die Beborstung der Tergite ist unterschiedlich dicht/gebürstet im Vergleich zu der des 3. und der Tergite 7 und 8 (vgl. Abb. 31-36, 38, 42). Bei mehreren japanischen Arten dieser Gruppe wird man zu einer genaueren Unterscheidung diese Tergite bei starker Vergrößerung untersuchen müssen, vor allem dann, wenn nur schwache oder kaum deutliche Eindrücke vorhanden sind. Die Gestalt des Aedoeagus ähnet sich bei verschiedenen Arten mit klar unterschiedlichem Bau der Tergite außerordentlich, so dass dieser allein nicht zur Artdifferenzierung ausreicht. Bemerkenswert erscheint mir ferner, dass keine der brachyptereren oder apteren Arten besondere Schultermerkmale (Zähnchen, Kanten) besitzen, wie wir sie von ähnlich kurz geflügelten Gattungsvertretern kennen. Um die Gruppenzugehörigkeit der Arten auch im Namen zu signalisieren, tragen alle Artnamen die Vorsilbe „per-“.


MATERIAL UND METHODEN


Als Abkürzungen gelten: cP = coll. Puthz (im SMNS); DE = distance between eyes, innerer Augenabstand; E = Edeagus, Aedoeagus; EL = greatest length of elytra, größte Elytrenlänge; EW = elytral width, Elytrenbreite; FB = forebody, Vorderkörper; FMCh = Field Museum of Natural History, Chicago; ha = dorsal honeycomb areas on sternum 9 of male, dorsales Wabenfeld am 9. Sternum des Männchens; HT = holotype, Holotypus; HW = head width, Kopfbreite; dlbc = distance of laterobasal carinae of pronotum, Seitenfaltenabstand am Pronotum; LE = length of eyes, Augenlänge; LG = length of genae, Wangenlänge; LT = length of temples, Schläfenlänge; MHNG = Muséum d’histoire naturelle, Genf; NHMW = Naturhistorisches Museum Wien; NMSNT = National Museum of Nature and Science, Tokyo; PL = length of pronotum, Pronotumlänge; PM = proportional measurements [1 Einheit = 0,0085 mm]; PT/T =
**TAXONOMIE**

**Edaphus bishamon** sp. n.  

**Holotypus:** SMNS ohne Nummer; ♂; JAPAN: Honshu: Tochigi pref., Oku-Nikko, oberhalb 1500 m, Weg zum Lake Murunuma, 29.VII.1999, V. Puthz.  

**Paratypus:** MHNG ohne Nummer; 1♂; JAPAN, Gunma pref., Joh-shin-etsu Kogen N. P., Shirane, 1750 m, ravin boisé avec ruisselet, tamisage de feuilles mortes et d’humus le long d’un tronc pourri, 22.VII.1980, I. Löbl.  

**Beschreibung:** Länge: 1,3-1,5 mm (Vorderkörperlänge: 0,7-0,8 mm). Brachypter, rotbraun, Abdomen dunkler braun, bis auf die Insertionspunkte der dichten, am Pronotum etwas wolligen Beborstung unpunktiert, aber nicht glatt.  

PM des HT: HW: 34; DE: 24; LE: 7,5; LT: 2,5; LG: 3; PW: 40; PL: 36; dlbc: 29; EW: 53; EL: 41; SL: 33.  


Bemerkungen: Diese neue Art lässt sich von den übrigen japanischen Arten leicht durch ihr fast fehlendes Mittelfältchen des Pronotums, die Brachypterie und die Oberflächenstruktur unterscheiden; vgl. auch die Bestimmungstabelle.  

**Etymologie:** Der Name ist von einem der sieben buddhistischen Glücksgötter genommen.

**Edaphus haniwa** sp. n.  

**Holotypus:** MHNG ohne Nummer; ♂; JAPAN: Shikoku: Ehime pref.: Ishizuchi N. P., Mt. Ishizuchi, 1550 m, tamisage de mousses, feuilles mortes et bois pourri au pied de vieux pins et hêtres, 13.VIII.1980, I. Löbl.
Aedeagus, zum Teil ausgestülpt: (1) Edaphus shogun sp. n., HT. (2) E. samurai sp. n., HT. (3) E. bishamon sp. n., HT. (4) E. sakura sp. n., PT. (5) E. nakayamaensis Puthz, Mt. Otake. (6) E. daimito sp. n., PT. (7) E. bosatsu sp. n., HT. (8) E. hantiwa sp. n., HT. (9) E. mikado sp. n., HT.- Maßstab = 0,1 mm.

Paratypen: MHNG, SMNS ohne Nummer; 4♀♀; wie für Holotypus. – MHNG ohne Nummer; 1♀; ibidem 1400 m, 14.VIII.1980, C. Besuchet.

Beschreibung: 1,2-1,4 mm (Vorderkörper: 0,7 mm). Brachypter, mittelbraun bis kastanienbraun, schwach glänzend, Pronotum dicht, leicht gekörnt skulptiert, restlicher Körper bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.


In den meisten Punkten äußerlich kaum von E. bishamon sp. n. zu unterscheiden, die seitlichen Längsfurchen der Stirn aber hinten, neben den Augen, deutlich zu einer Grube erweitert, in die das 2 Fühlglied gut hineinpassen würde. Das basale Mittelfältchen des Pronotums ist deutlich ausgebildet, erreicht aber nicht den Hinterrand des Pronotums, an der Basis werden 6-8 Grübchen unterschiedlicher Größe sichtbar. Der Mittelkiele des 3. Tergits reicht weit über die Tergitmitte hinaus.


Edaphus daimio sp. n.  


PARATYPEN: MHNG, MNSNT, SMNS ohne Nummer; 7♂♀, 2♀♀; für Holotypus. – MHNG, SMNS ohne Nummer; 7♂♀, 2♀♀; ibidem 1350 m, tamisage sous des écorces de hêtre, 13.VIII.1980, C. Besuchet. – MHNG ohne Nummer, 1♂♀, 1♂♀; ibidem 1400 m, 14.VIII.1980, idem. – MHNG ohne Nummer; 2♂♀; via Mt. Ishizuchi, 1350 m, tamisage de feuilles au pied d’un vieux hêtre (avec bambou), 13.VIII.1980, I. Löbl. – MHNG ohne Nummer, 1♂♀; ibidem, 1000 m, idem. – FMC, Nummer. – FMCh ohne Nummer, 1♂♀, 1♀♀; Ishizuchi N. P., Kamegamori, 1650 m, Abies & moss litter w/fungi, 11.-18.VIII.1980, S. & J. Peck.

BESCHREIBUNG: Länge: 0,9-1,1 mm (Vorderkörperlänge: 0,55-0,6 mm). Brachyptery, schlank, fast gleichbreit, mäßig glänzend, Vorderkörper kastanienbraun, Abdomen dunkler braun, bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.


Kopf deutlich schmäler als das Pronotum, Augen ziemlich fein facettiert, mehr als doppelt so lang wie die deutlichen Schläfen, hintere Querfurche der Stirn deutlich eingeschnitten, vordere Seitenfurchen ebenfalls, vorderer Mittelteil so breit wie jedes der Seitenenteile, leicht beugig erhoben, ohne besondere Absetzung in den Clypeus übergehend, vordere Seitenenteile oberhalb der Augen höckrig erhoben, im hinteren Teil mit großer Grube, in die fast das 10. Fühlglied hineinpassen würde, im vorderen Teil
Edaphus nipponensis Puthz, 1975


Bemerkungen: Diese Art gehört zu den häufigsten Vertretern der Gattung auf Honshu und ist auch aus Kyushu bekannt.

Edaphus tanuki sp. n.


Paratypus: MHNG ohne Nummer; 1♀; wie für Holotypus.

Beschreibung: Länge: 1,0 mm (Vorderkörperlänge: 0,6 mm). Makropter, mittelbraun, matt schimmernd, unpunktiert, aber sehr fein und dicht mikroskulptiert, unauffällig, anliegend beborstet.


**BEMERKUNGEN:** Diese neue Art kann wegen ihrer langen und dicht mikroskulptierten Elytren mit keiner bisher bekannten japanischen *Edaphus*-Art verwechselt werden. Sie ähnelt stark dem indischen *E. chalcographus* Puthz. Von ihm unterscheidet sie sich durch längere Elytren, das längere, kräftig ausgebildete basale Mittelfältchen des Pronotums und durch fehlende (undeutliche) Schläfen. Vom ceylonesischen *E. languidus* Puthz unterscheidet sie sich durch fehlende Schläfen, bis zur Basis durchgehendes Mittelfältchen und vier Grübchen des Pronotums sowie durch längere Elytren und anderen Stirnbau.- Ich habe das ♂ (ihm fehlt die rechte Elytre) zum HT bestimmt, weil beim ♀ das Pronotum an der Basis beschädigt ist.

**ETYMOLOGIE:** Ich wähle für diese winzige Art den Namen des japanischen Marderhundes Tanuki.

*Edaphus japonicus* Sharp, 1889


**MATERIAL:** SMNS, cNaomi; 4♂♀; 7♂♀; Honshu: Kure C., Haigamine, 18., 26.III.1999, Okamoto. — NMSNT; 1♂; Saga pref., Mt. Seburi, 18.IX.1977, H. Ohishi (NMSNT). — MHNG; 1♀; Gifu pref., 8 km SE Osaka, 750 m, plantation de Cryptomeria, tronc pourri avec champignons, sur et sous écorces, I.VIII.1980, 1. Löbl. — MHNG, SMNS; 2♂♀; Nara pref., Nara Park, 8.VIII.1980, idem. — MHNG; 2♂♀; Kyoto pref., Seryô-Tôgê, 13 km N Kyoto, 500-600 m, sur les buissons, 6.VIII.1980, C. Besuchet. — NMSNT; 1♂, 1♀; Wakayama pref., Takatsumiyama, 7.XI.1971, I. Matoba (NMSNT).

**BEMERKUNG:** Auch diese Art scheint in Japan weit verbreitet zu sein.

*Edaphus mikado* sp. n. Abb. 9, 15

**HOLOTYPOUS:** MHNG ohne Nummer; ♀; JAPAN: Shikoku; Ehime pref., via Mt. Ishizuchi, 1350 m, L. Löbl.

**PARATYPEN:** MHNG, SMNS ohne Nummer; 4♂♀; 3♂♀; Mt. Ishizuchi 1350 m, tamisage sous des écorces de hêtre, 13.VIII.1980, Besuchet. — MHNG ohne Nummer; 1♂, 2♀♀; ibidem 1550 m, tamisage de mousse, feuilles mortes et bois pourri au pied de vieux pins et hêtres, 13.VIII.1980, Löbl. — MHNG ohne Nummer; 1♂, 1♀; ibidem 1350 m, tamisage de feuilles au pied d’un vieux hêtre (avec bambou), 13.VIII.1980, idem. — NMSNT, SMNS ohne Nummer; 4♂♀; Kyushu: Fukuoaka pref., Pk. Nakadake, Mt. Hikosan, 13.X.1992, S. Nomura.

**BESCHREIBUNG:** Länge: 1,0-1,2 mm (Vorderkörperlänge: 0,6 mm). Mikropter, Vorderkörper rotlichbraun, Abdomen dunkelbraun, bis auf die Insertionspunkte der feinen, anliegenden Beborstung unpunktiert.

PM des HT: HW: 27; DE: 20; LE: 6; LT: 2,3; LG: 3; PW: 30; PL: 27; dbc: 19; EW: 37; EL: 31; SL: 25.

Kopf schmäler als das Pronotum, etwa wie der des *E. daimio* sp. n. geformt, Schlafen deutlich. Fühler kurz, zurückgelegt nicht den Hinterrand des Pronotums erreichend, Keule zweigüldrig. 10. Glied deutlich breiter als lang. Pronotum wenig breiter als lang, hinten kräftig eingeschnürt, an der Basis mit kurzen Seitenfälchtern, einem bis zur Basis durchgehenden Mittelfälchtern und 4 Grübchen, die seitlichen breiter als die mittleren; die mittleren Grübchen setzen sich, erheblich schmäler werdend, fast bis ins vordere Pronotumdrittel fort, sie schließen die Verlängerung des Mittelfälchterns ein, die aber schmäler bleibt als das 2. Fühlerglied. Elytren klein, breiter als lang, an der Naht kürzer als das Pronotum, Schultern einfach; Oberfläche nicht ganz glatt, sondern undeutlich gekörnt. Der basale Mittelkiele des 3. Tergits erreicht die Tergitmitte.

**BEMERKUNGEN:** Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle. In meiner Tabelle der taiwanesischen *Edaphus* müsste die Art bei Leitziffer 39 eingeordnet werden: von *E. stanislavi* Puthz unterschiedet sie sich durch viel kleinere Elytren, stärker verlängertes Mittelfälchten des Pronotums und dunkleres Abdomen.

**ETYMOLOGIE:** Ich wähle für diese Art einen der Namen des japanischen Tenno.

*Edaphus sakura* sp. n.  

**HOLOTYPUS:** NMSNT ohne Nummer; ♂; **JAPAN:** Kyushu: Fukuoka pref., Mt. Shakadake, 1200 m, Yabe Valley, 25.X.1994, S. Nomura.

**PARATYPEN:** NMSNT, SMNS ohne Nummer; 1♂, 4♀; wie für Holotypus. – NMSNT ohne Nummer; 1♀; Fukuoka pref., Buzenboh, Mt. Hikosan, 13.X.1992, S. Nomura. – NMSNT ohne Nummer; 1♀; Miyazaki pref., Shiiba pass, Shiiba-Son, 2.VII.1993, S. Nomura.

**BESCHREIBUNG:** Länge: 1,0–1,2 mm (Vorderkörperlänge: 0,6 mm). Brachypter, rötlichbraun, mäßig glänzend, Elytren zerstreut punktiert, Beborstung kurz, anliegend.

PM des HT: HW: 27; DE: 20; LE: 6,5; LT: 2; LG: 4; PW: 30; PL: 27; dlbc: 19,5; EW: 35; EL: 31; SL: 25.


Kopf schmäler als das Pronotum, Augen fein facettiert, nicht sehr groß, Schläfen deutlich, etwa ein Drittel so lang wie die Augen, hintere Querfurche der Stirn deutlich eingeschnitten, vordere Längsfurchen ebenso, sie umgeben vorn linienförmig den kaum erhobenen vorderen Mittelteil und setzen ihr so vom Clypeus ab, vorderer Mittelteil so breit wie jedes der Seitenteile, diese von höckrig erhoben mit vorderem
(10-24) 8. Sternit der Männchen: (10) Edaphus shogun sp. n. (11) E. bishamon sp. n. (12) E. samurai sp. n. (13) E. nakayamaensis Puthz. (14) E. daimio sp. n. (15) E. mikado sp. n. (16) E. tanuki sp. n. (17) E. sakura sp. n. (18) E. bosatsu sp. n. (19) E. haniwa sp. n. (20) E. permicus sp. n. (21) E. perpropinquus sp. n. (22) E. pergratus sp. n. (23) E. perillusris sp. n. (24) E. perplexabilis sp. n.- Maßstab = 0,1 mm.

Quereindruck, hinten verschmäler, daselbst eine ziemlich große Grube. Fühler kurz, zurückgelegt nicht den Hinterrand des Pronotums erreichend, Keule zweigliedrig, 10. Glied deutlich breiter als lang. Pronotum wenig breiter als lang, hinten kräftig eingezogen, an der Basis mit deutlichen Seitenfältchen, einem bis zur Basis durchgehenden Mittelfältchen sowie 4 Grüben; das basale Mittelfältchen setzt sich linien-
förmig-dünn bis in vordere Pronotumviertel fort; keine Punktierung. Elytren breiter als lang, Schultern mit kaum erkennbarer winziger, kurzer Kante, Seiten flach konvex; Punktierung fein, deutlich, wenig dicht. Der basale Mittelkiel des 3. Tergits erreicht etwa die Tergitmitte.

**BEMERKUNGEN:** Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle.

**ETYMOLOGIE:** Ich wähle für diese Art den Namen der japanischen Kirschblüte, die von vielen Japanern festlich mit einem Ausflug begangen wird.

*Edaphus samurai* sp. n.  
Abb. 2, 12  
**HOLOTYPE:** Kyushi University Museum ohne Nummer; ♀; JAPAN: Kyushu: Kumamoto pref., Mt. Shiratori, 5.IV.1987, S. Nomura.  
**PARATYPEN:** Kyushu University Museum, NMSST ohne Nummer, SMNS; 4♂♂, 2♀♀; wie für Holotypus. – MHNG ohne Nummer; 1♂; Honshu: Gunma pref., E d’Usui Pass, 850 m, forêt dans un ravin avec ruisselet, tamisage de bois pourri et de feuilles mortes sur une pente, 24.VII.1980, I. Löbl.  
**BESCHREIBUNG:** Länge: 1,2-1,4 mm (Vorderkörperlänge: 0,75-0,8 mm). Makropter, kastanienbraun, ziemlich glänzend, Pronotum und Elytren äußerst fein, wenig dicht punktiert, Beborstung anliegend.  
PM des HT: HW: 32; DE: 22,5; LE: 8; LT: 2,5; LG: 4; PW: 35,5; PL: 32; dbc: 25,5; EW: 44; EL: 48; SL: 40.  

Kopf und Fühler prinzipiell wie bei *E. daimio* sp. n. Pronotum wenig breiter als lang, hinten kräftig eingeschnürt, an der Basis mit deutlichen Seitenfältchen (die nicht ganz die Mitte des Pronotums erreichen), mit einem bis zur Basis durchgehenden Mittelfältchen sowie 4-6 Grübchen; das basale Mittelfältchen setzt sich messerscharf bis zum Vorderrand des Pronotums fort; die Punktierung ist sehr fein, wenig deutlich, die Punkte sind feiner als die Augenfacetten, ihre Abstände größer als die Punkte. Elytren breiter als lang, Schultern einfach, Seiten schwach, lang-konvex konvex; Punktierung äußerst fein, Punktabstände doppelt so groß wie die Punkte. Der basale Mittelkiel des 3. Tergits erreicht mindestens die Tergitmitte.

**BEMERKUNGEN:** Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle.

**ETYMOLOGIE:** Ich wähle für diese Art den Namen des Kriegers bzw. Adligen, vor allem in der Tokugawa-Zeit.

*Edaphus kanzeon* sp. n.  
Abb. 59  
**HOLOTYPE:** NHMW ohne Nummer; ♀; JAPAN: Kyushu: Fukuoka pref., Soeda town, sifted, 14.V.2006, T. Lackner.  
**PARATYPEN** (alle Fukuoka pref.): SMNS ohne Nummer, coll. Assing (Hannover); 1♂, 1♀; wie für Holotypus. – coll. Assing; 1♀; Munataka city, Mt. Jouyama, 13.V.2006, T. Lackner.

BESCHREIBUNG: Länge: 1,2-1,5 mm (Vorderkörperlänge: 0,7-0,8 mm). Makropter, kastanienbraun, glänzend, unpunktiert, Beborstung unauffällig, anliegend.

PM des HT: HW: 30; DE: 22; LE: 8; LT: 2,5; LG: 4; PW: 35,5; PL: 31; dbc: 24; EW: 46; EL: 42; SL: 34.


Insgesamt dem E. samurai n. sp. täuschend ähnlich, der vordere Stirnmittelteil aber deutlich längsbeulig erhoben, das Pronotum mit 4 Basalgrübchen, die mittleren länger, spitzwinklig nach vorn verlängert und wenig breiter als das dünne, fast bis nach vorn das verlängerte Mittelfältchen begleitend. Elytren im Unterschied zu denen des E. samurai glänzend, fast glatt.

BEMERKUNGEN: Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle.

ETYMOLOGIE: Diese Art ist mit dem japanischen Namen der buddhistischen Gottheit des Mitleids bezeichnet.

Edaphus shogun sp. n.


PARATYPEN: MHNG ohne Nummer, SMNS ohne Nummer; 2♂♂, 1♀; wie für Holotypus. – MHNG ohne Nummer, 1♀; Kyoto pref., Kyoto, Arashiyama, tamisage de feuilles mortes et de bois pourri dans un petit ravin boisé, 18.VIII.1980, C. Besuchet. – Shikoku: MHNG ohne Nummer, SMNS ohne Nummer; 2♂♂, 1♀; Ehime pref., Mt. Ishizuchi, 1350 m, tamisage sous des écorces de hêtre, 14.VIII.1980, idem. – MHNG ohne Nummer, 1♂; ibidem 1400 m, 14.VIII.1980, idem. – MHNG ohne Nummer, 1♀; Ishizuchi N. P., au-dessus de Omogo, env. 700 m, forêt de chênes, tamisage de feuilles mortes et de bois pourri, sur une pente rocailleuse, 12.VIII.1980, I. Löbl. – FMCh ohne Nummer; 1♂; Ishizuchi N. P., Mt. Tsutsujo, 1600 m, Betula-Fagus logs, stump & moss litter, 14.VIII.1980, S. & J. Peck.

BESCHREIBUNG: Länge: 1,2-1,4 mm (Vorderkörperlänge: 0,7-0,8 mm). Makropter, hellbraun, glänzend, bis auf die Insertionspunkte der feinen, anliegenden Beborstung unpunktiert.

PM des HT: HW: 30; DE: 22; LE: 7; LT: 2; LG: 4; PW: 36; PL: 32; dbc: 25; EW: 47; EL: 43; SL: 34.


Kopf deutlich schmäler als das Pronotum, Augen fein facettiert, mäßig groß, Schläfen etwa ein Drittel so lang wie die Augen, Wangen länger, hintere Querfurche

BEMERKUNGEN: Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle.

ETYMOLOGIE: Ich wähle für diese Art den Namen eines Oberbefehlshabers, erblich dem Minamoto-Geschlecht verliehen.

Edaphus nakayamaensis Puthz, 1980

Abb. 5


MATERIAL: MNHG, SMNS; 4♂♂, 1♀; Honshu: Gunma pref., E d’Usui Pass, 850 m, forêt dans un ravin avec ruisselet, tamisage de bois pourri et de feuilles mortes sur une pente, 24.VII.1980, I. Löbl. – MNHG; 1♂; Tochigi pref.: Nikko N. P., Chuzenji, 1850 m, lisière de la forêt, tamisage de feuilles mortes (bambou) et bois pourri, 14.VII.1980, idem. – MNHG, SMNS; 3♂♂, 2♀; Gifu pref.: 8 km SE Osaka, 750 m, plantation de Cryptomeria, tronc pourri avec champignons, sur et sous écorce, 1.VIII.1980, idem. – MNHG; 1♂; Nara Park, 8.VIII.1980, idem. – NMHG; 1♀; Shikoku: au-dessus de Omogo, env. 700 m, forêt de chênes, tamisage de feuilles mortes et de bois pourri, sur une pente rocailleuse, 12.VIII.1980, idem. – MNHG; 1♂; Ishizuchi N. P., Mt. Ishizuchi, 1550 m, tamisage de mousse, feuilles mortes et bois pourri au pied de vieux pins et hêtres, 13.VIII.1980, idem. – NMSNT; 1♂, 1♀; Kagoshima pref., Mt. Otake Shimo Koshiki, 23.-24.V.1994, T. Ueno. – SMNS, cAssing; 3♂♂, 3♀; Fukuoka pref., Soeda town, sifted, 14.V.2006, T. Lackner.

BEMERKUNG: Diese Art war bisher nur vom Holotypus aus Hokkaido bekannt, sie ist durch ihre inneren Haken des Aedoeagus gut erkennbar (Abb. 5), das 9 Sternit des Männchens zeigt zwei Felder zu je 5-8 ha.

Edaphus bosatsu sp. n.

Abb. 7, 18

HOLOTYPUS: MHNG ohne Nummer; ♂; JAPAN: Honshu: Nara pref., Nara, Nara Park, tamisage de mousse, bois pourri et feuilles mortes le long d’un grand tronc pourri, 8.VIII.1980, I. Löbl.

PARATYPEN: MHNG ohne Nummer, SMNS ohne Nummer; 2♂♂, 1♀; wie für Holotypus.

BESCHREIBUNG: Länge: 1,0 mm (Vorderkörperlänge: 0,65 mm). Makropter, rötlichbraun, glänzend, bis auf die Insertionspunkte der feinen, anliegenden Beborstung unpunktiert.

In vielen Punkten dem *E. shogun* sp. n. sehr ähnlich, aber kleiner: Stirn/Augen ebenso, Pronotum breiter, ebenfalls mit kurzen Seitenfältchen, einem bis zur Basis durchgehenden Mittelfältchen sowie 4-6 basalen Grübchen; das basale Mittelfältchens setzt sich ebenfalls nach vorne fort, ist aber in der Pronotenmitte schmaler als das 2. Fühlerglied, die es seitlich begleitenden Längsfurchen sind weniger scharf eingeschnitten als bei *E. shogun*.

**BEMERKUNGEN:** Vom sehr ähnlichen *E. napporoensis* Puthz unterscheidet sie sich auch durch ihre ha-Felder am 9. Sternit des Männchens (bei der genannten Art fehlen diese). Zur Unterscheidung von den übrigen Arten der japanischen Hauptinseln vgl. die Bestimmungstabelle.

**ETYMOLOGIE:** Ich wähle für diese Art den Namen der Wesen, die die Erleuchtung erfahren haben, aber auf den Eingang ins Nirvana verzichten.

*Edaphus persubtilis* sp. n.

**HOLOTYPE:** NMSNT ohne Nummer; ♀; JAPAN: Kyushu: Ohita pref., Mt. Sobo, 4.V.1984, S. Nomura.

**PARATYPEN:** SMNS ohne Nummer; 1♂; Ohita pref., Shinyabakei, 30.III.1985, S. Nomura. – NMSNT ohne Nummer; 1 Ex. (ohne Abdomen); Ohita pref., Osa, 7.XII.1985, A. Miyata.

**BESCHREIBUNG:** Länge: 0,9-1,0 mm (Vorderkörperlänge: 0,55 mm). Makropter, hellbraun, schwach glänzend, Vorderkörper sehr dicht körnig skulptiert, Beborstung am Pronotum leicht abstehend.

PM des HT: HW: 23; DE: 15,5; LE: 6; LT: 1,5; LG: 3; PW: 25,5; PL: 24; dlibc: 19; EW: 35; EL: 32; SL: 25.

Männchen: Unbekannt.


**BEMERKUNGEN:** Diese neue Art gehört in die aeneas-Gruppe (Puthz, 2010a: 304) und ähnelt stark dem ähnlich skulptierten *E. silvius* Puthz von den südjapanischen Inseln. Von ihm unterscheidet sie sich durch ihre Makropterie und weniger raue Oberflächenstruktur, von den übrigen japanischen Arten wie im Bestimmungsschlüssel angegeben.
ETYMOLOGIE: Ich nenne diese Art wegen ihrer Kleinheit „persubtilis“ (Lat. = sehr zart).

*Edaphus perplexabilis* sp. n.  
**Abb. 31, 24, 58**

**HOLOTYPUS:** NMSNT ohne Nummer; ♂; **JAPAN:** Kyushu: Kumamoto pref., Mt. Shiratori, 17.XI.1980, H. Takemoto.  

**BESCHREIBUNG:** Länge: 1,2 mm (Vorderkörperlänge: 0,6-0,65 mm). Makropter, hellbraun, schimmernd, bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert (Abb. 31).

PM des HT: HW: 28; DE: 19; LE: 7,5; LT: 2,0; LG: 4,5; PW: 30,5; PL: 28; ddbc: 20; EW: 39; EL: 36; SL: 29.


**BEMERKUNGEN:** Auch diese neue Art gehört in die aeneas-Gruppe, sie unterscheidet sich von den übrigen Arten der japanischen Hauptinseln wie in der Bestimmungstabelle angegeben. Von ähnlichen taiwanesischen *E. amata* Puthz trennt man sie durch ihre subquadratischen Elytren, feinere Skulptur der Oberseiten und den längeren Mittelkiel des 3. Tergits.


*Edaphus percongruus* sp. n.  
**Abb. 53**

**HOLOTYPUS:** NMSNT ohne Nummer; ♂; **JAPAN:** Kyushu: Ohita pref., Shinyabakai, 30.III.1985, S. Nomura.
**Edaphus persimplex** sp. n.  

**Abbild. 57**

**Holotypus:** MHNG ohne Nummer; ©; JAPAN: Shikoku: Ehime pref., via Mt. Ishizuchi, 1350 m, tamisage de feuilles au pied d’un vieux hêtre (avec bambou), 13.VIII.1980, I. Löbl.

**Paratypus:** MHNG ohne Nummer; 1©; wie für Holotypus.

**Beschreibung:** Länge: 1,3 mm (Vorderkörperlänge: 0,7 mm). Makropter, mittelbraun, schimmernd, bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.

PM des HT: HW: 29; DE: 18; LE: 8,5; LT: 1; LG: 4; PW: 32; PL: 29; dlbc: 22; EW: 46; EL: 42; SL: 34.


Der *E. perplexabilis* sp. n. in fast allen Punkten zum Verwechseln ähnlich, die Augen aber größer, die eingezogenen Schläfen kürzer, wenig deutlich, Stirnbau wie bei der verglichenen Art. Pronotum und Elytren wie bei *E. perplexabilis* sp. n. Der basale Mittelkiel des 3. Tergits erreicht fast den Tergithinterrand, das 4. und das 5. Tergit zeigen angedeutete Mittelkiechlen.


**Etymologie:** Für diese Art wähle ich den Namen „persimplex“ (Lat. = besonders einfach).

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**Edaphus perpropinquuus** sp. n.  

**Abbild. 21, 41, 48, 56**

**Holotypus:** NMSNT ohne Nummer; ©; JAPAN: Kyushu: Saga pref., Mt. Kusenbusan, Tosu C., 23. II. 1992, S. Nomura.
PARATYPUS: NMSNT ohne Nummer; 1♂; Saga pref., Ikebaru, Nanayama Village, 24.X.1992, S. Nomura.

BESCHREIBUNG: Länge: 1,2-1,3 mm (Vorderkörperlänge: 0,7 mm). Makropter, mittelbraun, schimmernd, bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.

PM des HT: HW: 28,5; DE: 18; LE: 8; LT: 1,5; LG: 3,5; PW: 34; PL: 32; dbcf: 23; EW: 44; EL: 43; SL: 33.


Dem E. perplexabilis sp. n. in den meisten Punkten sehr ähnlich, das Pronotum aber mit kräftigem bis zur Basis durchgehenden Mittelfältchen (vgl. u.), das nach vorn, kurz vor der Pronotummitte erlischt, und 6-8 kleinen Grübchen; jederseits des Mittelfältchens wird ein langer, wenig breiter, flacher, aber sehr deutlicher Längseindruck erkennbar. Der basale Mittelkiel des 3. Tergits reicht über die Tergitmitte hinaus, das 4. Tergit besitzt ebenfalls einen langen Mittelkiel.


ETYMOLOGIE: Wegen ihrer Nähe zur E. perplexabilis nenne ich diese Art „perpropinquus“ (Lat. = sehr nahe verwandt).

Edaphus peramicus sp. n. Abb. 20, 55

HOLOTYPUS: MHNG ohne Nummer; 2♂; JAPAN: Shikoku: Ehime pref.: 1♀: Ishizuchi N. P., au-dessus de Omogo, env. 700 m, forêt de chênes, tamisage de feuilles mortes et de bois pourri, sur une pente rocallieuse, 12.VIII.1980, I. Löbl.

PARATYPUS: MHNG ohne Nummer; 1♀; wie für Holotypus.

BESCHREIBUNG: Länge: 1,1-1,3 mm (Vorderkörperlänge: 0,7-0,75 mm). Makropter, hellbraun, schimmernd, abgesehen von den Insertionspunkten der anliegenden Beborstung unpunktiert.

PM des HT: HW: 29,5; DE: 18; LE: 9,5; LT: 1; LG: 7; PW: 35; PL: 30; dbcf: 24; EW: 45; EL: 43; SL: 33.


In fast allen Punkten äußerlich mit E. perpropinquus sp. n. übereinstimmend, das basale Mittelfältchen des Pronotums aber schwächer ausgeprägt und nicht bis zur Pronotumbasis durchgehend. Der basale Mittelkiel des 3. Tergits erreicht fast den Tergithinterrand, das 4. Tergit zeigt auch nicht die Spur eines Mittelkieles.
Abb. 43-50

(43-45, 48) Spermapumpe und vesica seminalis. (46, 49, 50) Aedoeagus. (47) Distale "Trompete" der Spermapumpe: (43) Edaphus pergracilis sp. n. (44) E. pergratus sp. n. (45) E. perplexabilis sp. n. (46) E. permolestus sp. n. (47) E. perillustris sp. n. (48) E. perpropinquus sp. n. (49, 50) E. perparvus sp. n. [Shiba Pass: 49; Mt. Sefurisan (50)].


*Edaphus perincommodus* sp. n.

HOLOTYPUS: MHNG ohne Nummer; ♀; JAPAN: Kyushu: Shizuoka pref., near Amagi, 4.X.1960, Y. Shibata.

BESCHREIBUNGEN: Länge: 1,1-1,2 mm (Vorderkörperlänge: 0,7 mm). Makropter, Kopf, Pronotum und Abdomen kastanienbraun, Elytren heller (mittelbraun), schimmernd, Seitenteile der Stirn mit sehr feinen Punkten, im Übrigen bis auf die Insertionspunkte der anliegenden Beborstung unpunktiiert.

PM des HT: HW: 29,5; DE: 18,5; LE: 8,5; LT: 1; LG: 4; PW: 34; PL: 30; dbc: 23; EW: 44; EL: 42; SL: 34.

Männchen: Unbekannt.

Von *E. peramicus*-♀ nur durch fein punktierte vordere Seitenstücke der Stirn und deutlichen, kurzen basalen Mittelkiele des 4. Tergits unterschieden. Das noch unbekannte ♂ muss die Entscheidung darüber erlauben, ob die genannten Unterschiede in die Variationsbreite des *E. peramicus* sp. n. gehören oder nicht.

ETYMOLOGIE: Weil diese neue Art wegen ihrer Ähnlichkeit zu *E. perpropinquus* keine Freude macht, nenne ich sie „perincommodus“ (Lat. = sehr ungelegen).

*Edaphus perigracilis* sp. n.


PARATYPEN: MHNG, NMSNT, SMNS ohne Nummer; 16♂♂, 20♀♀; wie für Holotypus. – MHNG ohne Nummer; 1♂: Ishizuchi N. P., au-dessus de Omogo, env. 700 m, forêt de chênes, tamisage de feuilles mortes et de bois pourri, sur une pente rocailluse, 12.VIII.1980, I. Löbl. – MHNG ohne Nummer; 1♂, 1♀; via Mt. Ishizuchi, 1350 m, tamisage de feuilles au pied d’un vieux hêtre (avec bambou), 13.VIII.1980, idem. – MHNG ohne Nummer; 1♀; ibidem („Skyline road”), ca. 1000 m, sur une pente raide, ravin avec rivière, tamisage de feuilles mortes et bois pourri, 14.VII.1980, idem. – MHNG ohne Nummer; 1♂; Mt. Ishizuchi, 1600-1700 m, tamisage de feuilles et d’herbes mortes au-dessus de la forêt, parmi les bambous nains, 13.VIII.1980, C. Beschuet. – MHNG ohne Nummer; 2♂♂, 3♀♀; ibidem, tamisage sous des écorces de hêtre, idem. – FMCh, SMNS ohne Nummer, 9♂♂, 3♀♀; Ishizuchi N. P., Mt. Kamegamori, Shiraga Pass, 1500 m, Berlese *Fagus* logs and litter, 11.-18.VIII.1980, S. & J. Peck. – FMCh ohne Nummer; 4♀♀; ibidem, 1650 m, Berlese *Abies* moss litter with mushrooms, idem. – MHNG ohne Nummer; 4♂♂, 3♀♀; ibidem, Mt. Tsutsujo, 1600 m, Berlese *Betula-Fagus* log, stump, moss litter, 11.-18.VIII.1980, idem. – MHNG, SMNS ohne Nummer, 7♂♂, 7♀♀; ibidem, Mt. Kamegamori, 1650 m, *Abies* & moss litter w/fungi, 15.VII.1980, idem. – MHNG ohne Nummer; 1♀; ibidem, Omogo valley, 700 m, Berlese fungi on mossy logs, warm temperate forest, 18.-23.VIII.1980, idem.

BESCHREIBUNGEN: Länge: 1,1-1,3 mm (Vorderkörperlänge: 0,65 mm). Apter, rötlichbraun, mäßig schimmernd, Stirn, Pronotum und Elytren fein und sehr dicht punktiert, Beborstung anliegend, nur am Pronotum kurz wollig abstehend.


Kopf etwas schmäler als das Pronotum, Augen mäßig grob facettiert, mäßig groß, gut so lang wie die Wangen, Schläfen deutlich, eingezogen, hintere Querfurche der Stirn kurz, deutlich eingeschnitten, vordere Seitenfurchen ebenfalls deutlich, vorn verflachend, vorderer Mittelteil der Stirn etwas schmäler als jedes der Seitenteile, im hinteren Teil mit kleiner Beule, vorn ohne besondere Absetzung in den Clypeus übergehend, Punktionierung deutlich. Fühler kurz, zurückgelegt nicht den Hinterrand des Pronotums erreichend, 10. Glied breiter als lang. Pronotum wenig breiter als lang, hinten kräftig eingeözen, an der Basis mit kurzen Seitenfältchen und 6-8 winzigen, wenig deutlich getrennten Grübchen; zwischen den mittleren Grübchen befindet sich ein kaum erkennbares, äußerst dünnles Fältchen, das im hinteren Pronotumdrittel nach vorn verlängert ist (Abb. 29); Punktionierung fein und dicht, Punkte etwas kleiner als die Augenfacetten, ihre Abstände kleiner als die Punkte; auch der Hinterrand es Pronotums hinter den Basalgrübchen ist punktiert. Elytren trapezoid, breiter als lang, kürzer als das Pronotum, Schultern einfach, Seiten flach konvex, wenig erweitert, Punktionierung etwas weniger fein als am Pronotum, ebenfalls sehr dicht. Der basale Mittelkiegel des 3. Tergits reicht über die Tergitmitte hinaus.


ETYMOLOGIE: Ihres schlanken Körperbaues wegen nenne ich diese Art „*pergracilis*“ (Lat. = sehr schlank).

**Edaphus perversus** Puthz, 1994

*Euaesthetus japonicus* Bernhauer, 1907: 380.


BEMERKUNGEN: Diese Art gehört, wie ich 1994 bereits mitgeteilt habe, in die Gattung *Edaphus* und hier in die *aeneas*-Gruppe.

Länge: 1,4 mm (Vorderkörperlänge: 0,75 mm). Mikropter, rötlichbraun, schwach glänzend, fein und dicht punktiert, anliegend beborstet.


(51-58) Aedoeagi: (51) *E. perversus* Puthz, HT. (52) *E. pergratus* sp. n., HT. (53) *E. percongruus* sp. n., HT. (54) *E. perillusiris* sp. n., PT, Tensyo Pass. (55) *E. peramicus* sp. n., HT. (56) *E. propinquus* sp. n., HT. (57) *E. persimplex* sp. n., HT. (58) *E. perplexabilis* sp. n., HT. (59) *E. kann-zeon* sp. n., PT. Maßstab = 0,1 mm.


Zur Unterscheidung von den Nahverwandten vgl. die Bestimmungstabelle.

*Edaphus perillustris* sp. n.  
Abb. 23, 47, 54


Paratypen: NMSNT, SMNS ohne Nummer; 2 ♀; wie für Holotypus. – MHNG ohne Nummer; 1 ♂; Gifu pref., 9 km E Gero, 450-500 m, forêt sur une pente raide, près d’une rivière, 31.VII.1980, I. Lobl. – NMSNT ohne Nummer; 1 ♂; Niigata pref., Renge spa. Itoigawa, 14.VIII.1983, S. Nomura.
BESCHREIBUNG: Länge: 1,3-1,4 mm (Vorderkörperlänge: 0,65-0,7 mm). Brachypter, mittelbräun bis kastanienbraun, schwach glänzend, Stirn sehr fein, Pronotum sehr fein und dicht, Elytren sehr fein, ziemlich dicht punktiert, Beborstung anliegend.

PM des HT: HW: 33,5; DE: 25,5; LE: 8; LT: 2,5; LG: 7; PW: 35; PL: 33; dlbc: 23; EW: 40; EL: 33; SL: 25.


ETYMOLOGIE: Wegen der sehr auffälligen Auszeichnung der Männchen nenne ich diese Art „perillustris“ (Lat. = sehr auffällig).

Edaphus perangustus sp. n.


PARATYPEN: NMSNT, SMNS ohne Nummer; 3♂♂, 10♀♀; wie für Holotypus. – NMSNT ohne Nummer; 2♂♂, 2♀♀; Wakayama pref., Mt. Ohto, Ohsugi-Dani, 6.V.1994, S. Nomura.

BESCHREIBUNG: Länge: 1,1-1,3 mm (Vorderkörperlänge: 0,55 mm). Apter, hellbraun bis kastanienbraun, schwach schimmernd, Kopf und Pronotum sehr fein und dicht punktiert, Elytren sehr fein und dicht körnig skulptiert, Beborstung anliegend.


Dem E. pergracilis sp. n. in allen Punkten prinziell sehr ähnlich, aber deutlich schlanker, die Punktionierung des Pronotums noch feiner, vor den mittleren Pronotumgrübchen eine winzige, sehr schmale, punktfreie Partie, die Elytren dichter, feinkörnig skulptiert, die Stirn dicht punktiert-skulptiert, die seitlichen Längsfurchen fast völlig erloschen, die Beule im hinteren Mittelteil der Stirn sehr klein, schwach ausgeprägt.

BEMERKUNGEN: Zur Unterscheidung von den Nahverwandten vgl. die Bestimmungstabelle.

ETYMOLOGIE: Wegen ihres sehr schmalen Körperbaues nenne ich diese Art „perangustus“ (Lat. = sehr schmal).

**Edaphus permacer** sp. n.


**PARATYPEN:** NMSNT, SMNS ohne Nummer; 9♂♂, 20♀♀: wie für Holotypus.

**BESCHREIBUNG:** Länge: 1,2-1,4 mm (Vorderkörperlänge: 0,5-0,6 mm). Apter, rötlichbraun, schwach schimmernd, Seitenteile der Stirn fein punktiert, bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.


Im Unterschied zu E. perangustus sind die seitlichen Stirnfurchen deutlich ausgeprägt, die mittlere Beule ist größer, das Pronotum nicht so deutlich punktiert (Insertionspunkte der Beborstung), vor den mittleren Basalgrübchen des Pronotums befindet sich in der Mitte ein winziges, äußerst schmales Fältchen, die Elytren besitzen eine flachere, nicht ganz so dichte Oberflächenskulptur. Insgesamt ist die Art auch schlanker als E. perangustus.


ETYMOLOGIE: Wegen ihres schlanken Körperbaues nenne ich diese Art „permacer“ (Lat. = sehr mager).

**Edaphus perparvus** sp. n.

**HOLOTYPUS:** NMSNT ohne Nummer; JAPAN: Kyushu: Ohita pref., Mt. Sobo, 4.V.1984, S. Nomura.

BESCHREIBUNG: Länge: 1,2-1,3 mm (Vorderkörperlänge: 0,55-0,6 mm). Apter, rötlichbraun, schwach schimmernd, Stirn sehr fein. Pronotum sehr fein und sehr dicht punktiert, die übrige Oberseite bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert (Abb. 34).


BEMERKUNGEN: Zur Unterscheidung von den Nahverwandten vgl. die Bestimmungstabelle.

ETYMOLOGIE: Wegen ihrer geringen Größe nenne ich diese neue Art „perparvus“ (Lat. = sehr klein).

Edaphus pergratus sp. n.  

**Edaphus permollestus** sp. n.

**Holotypus:** MNSNT ohne Nummer; ♂; **JAPAN:** Kyushu: Ohita pref., Mt. Kurodake, Kujyo, 16.IX.1985, S. Nomura.

**Paratypus:** MNSNT ohne Nummer; 1♂; Ohita pref., Yonouzu, 13.VI.1985, A. Miyata.

**Beschreibung:** Länge: 1,2-1,3 mm (Vorderkörperlänge: 0,6-0,65 mm). Apter, rötlichbraun, schimmernd, Stirn sehr fein punktiert, Elytren fein und dicht körnig skulptiert, restliche Oberseite bis auf die Insertionspunkte der anliegenden Beborstung unpunktiert.


Dem *E. permacer* sp. n. sehr ähnlich, aber robuster, die Augen größer, die Auszeichnung des 4. und Tergits beim ♂ anders.

**Bemerkungen:** Von *E. perplexabilis* sp. n. und *E. perparvus* sp. n., die beide auch am Mt. Kurodake erbeutet wurden, unterscheidet sich die neue Art so: vom
ersteren durch ihre Apterie, vom zweiten durch unpunktiertes Pronotum und die dicht und fein gekörnte Elytrenskulptur, von beiden durch die Sexualcharaktere des ♂. Zur Unterscheidung von den übrigen Arten vgl. die Bestimmungstabelle.

ETYMOLOGIE: Weil diese Art die Identifizierung der apteren Arten der aeneas-
Gruppe weiter erschwert, nenne ich sie „permolestus“ (Lat. = sehr lästig“).

KEY TO THE EDAPHUS FROM JAPAN
[EXCLUSIVELY SOUTH JAPANESE (RYUKYU) ISLANDS]

1a  Lateral furrows of frons distinct, becoming broader posteriorly near eyes (forming an impression, which may become as large as antennal segment 10 (Fig. 25) (exception: E. bishamon sp. n., where the lateral furrows are only angulated behind, slightly broadened) ........................................ 2

1b  Lateral furrows of frons less distinct, very narrow, slightly curved (Figs 26, 27) .................................................. 16

2a  Mediobasal carina of pronotum absent or not extending to base proper ........ 3

2b  Mediobasal carina of pronotum extending to base proper .......................... 4

3a  Lateral furrows of frons not broadened behind, antennal segment 10 distinctly broader than long. ♂: Abdominal tergites simple. ♂: E (Fig. 3). 1.3-1.5 mm (FB 0.7-0.8 mm). HON .............................. bishamon sp. n.

3b  Lateral furrows of frons becoming broader behind (about as in Fig. 25). E (Fig. 8). 1.2-1.4 mm (FB 0.7 mm). SHI ..................... haniwa sp. n.

4a  Mediobasal carina of pronotum short, not elongated anteriad, not extending to the middle of pronotum ........................................ 5

4b  Mediobasal carina of pronotum longer, elongated anteriad, longer than half the length of pronotum (Figs 28, 30) .................................. 9

5a  Sutural length of elytra shorter than or at most as great as pronotal length. ♂: E (Fig. 6). 0.9-1.1 mm (FB 0.55-0.6 mm). SHI ........... daimio sp. n.

5b  Sutural length of elytra greater than pronotal length ............................... 6

6a  Elytra sparsely punctate. ♂: E (fig. 4, Puthz, 1975). 1.0-1.2 mm (FB 0.7 mm). HON, KYU ...................... nippolensis Puthz

6b  Elytra impunctate .................................................. 7

7a  Anterolateral portions of frons with a distinct impression anteriorly. Pronotum with four large basal foveae. ♂: E (fig. 5, Puthz l. c.). 1.0-1.1 mm (FB 0.65-0.7 mm). HON, KYU .............. japonicus Sharp

7b  Anterolateral portions of frons without a distinct impression anteriorly. Pronotum with six small basal foveae. ♂: E (figs 1-3, Puthz, l. c.). 0.91-1.1 mm (FB 0.6-0.7 mm). HON. Holarctic region ... lederi Eppelsheim

8a  Brachypterous, sutural length of elytra less than pronotal length ............. 9

8b  Macropterous, sutural length of elytra as long as or greater than pronotal length .................................................. 10

9a  Mediobasal carina of pronotum very narrow, thread-like, elongated anteriad ♂: E (Fig.4). Elytra punctate. 1.0-1.2 mm (FB 0.6 mm). KYU ............................... sakura sp. n.

9b  Mediobasal carina of pronotum, broadened anteriad, narrowly Y-shaped. ♂: E (Fig. 9). 1.0-1.2 mm (FB 0.6 mm). SHI, KYU .......... mikado sp. n.
10a Mediobasal carina very narrow, thread-like, elongated anteriad (Fig. 28) ........................................ 11
10b Mediobasal carina of pronotum less narrow, ± Y-shaped elongated anteriad (Fig. 30) ............................... 13
11a Smaller, FB 0.6 mm. Pronotum broader than long. ♂: E (fig. 6, Puthz, l. c.). 1.0-1.1 mm HON, SHI .................. carinicollis Bernhauer
11b Larger, FB 0.75-0.8 mm. Pronotum about as broad as long. ................................................................. 12
12a Anteromedian portion of frons flat; elytra very finely and densely punctate (setiferous punctures). ♂: E (Fig. 2). 1.2-1.4 mm. HON, KYU ................................................................. samurai sp. n.
12b Anteromedian portion of frons callus-like elevated; elytra impunctate. ♂: E (Fig. 59). 1.2-1.5 mm (FB 0.7-0.8 mm) .......... kanzeon sp. n.
13a Smaller, FB ≤ 0.7 mm .......................................................................................................................... 14
14a Temples less than one quarter as long as eyes. ♂: E (Fig. 5). 1.1-1.5 mm (FB 0.6-0.7 mm). HOK, HON, SHI, KYU .. nakayamaensis Puthz
14b Temples longer than one quarter of eye length ......................................................................................... 15
15a ♂: E (Fig. 3, Puthz, 1980); Sternite 9 without fields of ha. 1.1-1.3 mm (FB 0.6-0.7 mm). HOK .................. napporoensis Puthz
15b ♂: E (Fig. 7), Sternite 9 with fields of 3-4 ha. 1.0 mm (FB 0.65 mm). HON .............................................. bosatsu sp. n.
16a Lateral portions of frons with a minute impression anteriory. Pronotum and elytra densely reticulate, slightly shiny. ♂: S8 (Fig. 16), SpP without any trumpet. 1.0 mm (FB 0.6 mm). HON .............................................................. tanuki sp. n.
16b Lateral portions of frons without an impression anteriory. ♂ often with special sexual characters on tergites 4 and 5 (e. g. Figs 32, 35), SpP with a distal trumpet (e. g. Figs 39-41, 43-45, 47, 48) .................. aeneas-group. 17
17a Macropterous ............................................................................................................................................ 18
17b Micropterous or brachypterous, sutural length of elytra distinctly less than pronotal length, at most equal in length ................................................................................................................................. 24
18a Pronotum and elytra with dense granular sculpture. No median carina on tergite 4. ♂: Unknown. 0.9-1.0 mm (FB 0.55 mm). KYU .................. persubtilis sp. n.
18b Pronotumand elytra indistinctly punctate ................................................................................................. 19
19a ♂: Tergite 4 and 5 with median impressions ............................................................................................. 20
19b ♂: Tergite 4 and 5 simple ......................................................................................................................... 21
20a ♂: E (Fig. 58). 1.2 mm (FB 0.6-0.65 mm). KYU, SHI .......... perplexabilis sp. n.
20b ♂: E (Fig. 53). 1.0-1.1 mm (FB 0.6 mm). KYU .................. percongruus sp. n.
21a Mediobasal carina of pronotum stronger, very distinct, mediobasal impressions of pronotum distinct, deeper ........................................................................................................................................ 22
21b Mediobasal carina of pronotum less strong, nearly indistinct, mediobasal impressions of pronotum shallower, less distinct ................................................................................................................................. 23
22a ♂: E (Fig. 57). 1.3 mm (FB 0.7 mm). SHI .................. persimplex sp. n.
22b ♂: E (Fig. 56). 1.2-1.3 mm (FB 0.7 mm). KYU .................. perpropinquus sp. n.
23a Anterolateral portions of frons impunctate. ♂: E (Fig. 55). 1.1-1.3 mm (FB 0.7-0.75 mm) SHI .................. peramicus sp. n.
23b Anterolateral portions of frons finely punctate. ♂: Unknown. 1.1-1.2 mm (FB 0.7 mm). HON ....................... **perincommodus** sp. n.

24a Pronotum punctate .......................................................... 25

24b Pronotum (besides of setiferous punctures) impunctate ....................... 29

25a Elytra impunctate. ♂: Tergite 4 with a distinct impression postero-
medially, tergite 5 with a shallow median impression (Fig. 35), E (Figs 49, 50). 1.2-1.3 mm (FB 0.55-0.6 mm). KYU ....................... **perparvus** sp. n.

25b Elytra punctate or granulose ............................................... 26

26a Elytra punctate .............................................................. 27

26b Elytra granulose. ♂: Tergite 4 and 5 with very shallow impressions medially. Postero-median callus of frons very small. 1.1-1.3 mm (FB 0.55 mm). HON ....................... **perangustus** sp. n.

27a Punctuation of elytra denser, interstices smaller than punctures. ♂: Tergites 4-6 with very shallow impressions medially, E (about as in Fig. 51). 1.1-1.3 mm (FB 0.65 mm). SHI ....................... **per gracilis** sp. n.

27b Punctuation of elytra less dense, interstices larger than punctures. ♂: Tergites 4 and 5 with distinct impressions medially ....................... 28

28a E (Fig. 54). 1.3-1.4 mm (FB 0.65-0.7 mm). HON ....................... **perillustris** sp. n.

28b E (Fig. 51). 1.4 mm (FB 0.75 mm). HON ....................... **perversus** Puthz

29a Larger, FB >0.7 mm. ♂: Tergites 4 and 5 with distinct impressions medially, E (Fig. 52). 1.4-1.5 mm (FB 0.75 mm). HON ....................... **per gratus** sp. n.

29b Smaller, FB 0.5-0.6 mm ..................................................... 30

30a Eyes smaller, elytra very shallowly, densely sculptured. ♂: Tergites 4 and 5 with an area of dense granulae, E (about as in Fig. 51). 1.2-1.4 mm (FB 0.5-0.6 mm). HON ....................... **permacer** sp. n.

30b Eyes larger, elytra densely and finely granulose. ♂: Tergite 4 with a very shallow apicomedial impression, tergite 4 and 5 with an area of less dense pubescence medially, E (Fig. 46). 1.2-1.3 mm (FB 0.6-0.65 mm). KYU ....................... **permolestus** sp. n.

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LITERATUR


Nouvelles indications de Cetoniinae (Coleoptera: Scarabaeidae) pour la péninsule Arabique

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New findings of Cetoniinae (Coleoptera: Scarabaeidae) for Arabian Peninsula. - Presence of Aethiessa floralis (Fabricius, 1787), Protoeta (Potosia) cuprea ignicollis (Gory & Percheron, 1833), Tropinota squalida pilosa (Brullé, 1832) and Tropinota ilariae Dutto, 2007 are reported for the first time from Saudi Arabia. Some of these species might have been accidentally imported and seem now acclimatized.

Keywords: Cetoniidae - Potosia - Aethiessa - Tropinota - Arabian Peninsula.

INTRODUCTION

La péninsule Arabique représente un territoire de transition entre la faune paléarctique, éthiopique et orientale (Löbl & Smetana, 2006; Vigna Taglianti et al., 1992). Pour ce qui concerne les Scarabaeidae Cetoniinae, la péninsule Arabique comprend à ce jour des éléments typiquement nord-africains (Baraud, 1985) et afrotropicaux (Rigout, 1989; Sipek et al., 2012; El-Hawagry et al., 2013).

La faune des cétoines de la péninsule Arabique est particulièrement limitée et comprend, selon le catalogue de Löbl & Smetana (2006), 14 espèces appartenant à 4 genres: Pachnoda cverenka Krajcik, 2002; P. fasciata (Fabricius, 1775), P. histrio (Fabricius, 1775), P. histrioniodes Pouillaude, 1914, P. interrupta (Olivier, 1789), P. leclercqui Rigout, 1985, P. marginata s. str. (Drury, 1773), P. polita Blanchard, 1842, P. thoracica (Fabricius, 1775), Rhabdotis arabica Rigout & Allard, 1992, Homothyrea helena (Schaum, 1848), H. inornatipennis (Gahan, 1903), H. thoracica (Schaum, 1841) et Valgus arabicus Nonfried, 1895; à cette liste doivent être ajoutées Tropinota squalida (Scopoli, 1763) (Walker & Pittaway, 1987) et Stalagmosoma albella (Pallas, 1781) (Arrow, 1910; Gillett & Gillett, 1997).

Dans cet article, les auteurs signalent pour la première fois la présence en Arabie saoudite de trois taxons jusque-là connus en Afrique du Nord et au Moyen-Orient. La présence de Tropinota squalida pilosa (Brullé, 1832) en Arabie saoudite est confirmée.

TAXONOMIE

Aethiessa floralis (Fabricius, 1787)


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**Protaetia (Potosia) cuprea** ssp. *ignicollis* (Gory & Percheron, 1833)

**MATÉRIEL EXAMINÉ:** 2 exx. (♀ ♂) Saudi Arabia, Riyadh (Ar-Riyad), 02/1988. Collection G. Sabatinelli.


**Tropinota squalida pilosa** (Brullé, 1832)


**Tropinota ilariae** Dutto, 2007

**MATÉRIEL EXAMINÉ:** 1 ex. ♂. Saudi Arabia, Badanah, 16/03/2002. Collection M. Dutto.

**OBSERVATIONS:** Cette espèce décrite d’Israël (Tiberiade) a été retrouvée en 2010 à environ 200 km plus au nord en Syrie (Krak des Chevalier, Sabatinelli obs. pers.). L’exemplaire en question a été récolté sur une inflorescence jaune indéterminée.

**DISCUSSION**

Trois taxa signalés pour la première fois dans la péninsule Arabique portent à 19 le nombre d'espèces de Cetoniinae recensées pour cette région géographique. Ces exemplaires ont été récoltés dans des situations occasionnelles et n’ont pas fait l’objet de recherches plus approfondies. Aucune conclusion définitive ne peut donc être avancée sur l’origine de ces introductions. L’aire de distribution connue de ces trois espèces (*A. floras, P. cuprea* et *T. ilariae*) étant cependant séparée par des centaines de km de désert des nouvelles localités en Arabie saoudite, il est vraisemblable qu’il s’agisse d’importations accidentelles avec des fruits ou autres produits agricoles. La stabilisation de ces populations est possible, mais nécessite d’être confirmée ultérieurement.

Les importations accidentelles de Cetoniinae peuvent en effet facilement se produire par leur transport dans des tas de fruits et amendements organiques, pouvant conduire ensuite à des acclimatations, comme documenté pour *Tropinota hirta* (Poda, 1761) dans le Massachussets et l’Utah aux Etats-Unis (Hurpin, 1962; Arnett, 1963; Paulian & Baraud, 1982).
BIBLIOGRAPHIE


New species and new records of the spider genus *Otacilia* Thorell, 1897 (Araneae, Corinnidae) from Southeast Asia

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New species and new records of the spider genus *Otacilia* Thorell, 1897 (Araneae, Corinnidae) from Southeast Asia. - Five species of *Otacilia* Thorell, 1897 were collected from tropical forests of Southeast Asia. *Otacilia bifurcata* sp. n. and *O. truncata* sp. n. are described from evergreen hill forests of northern Thailand. *Otacilia papilla* sp. n. is described from Sumatra, Indonesia. An additional specimen of *O. parva* Deeleman-Reinhold, 2001 was obtained, and the female internal genitalia are re-illustrated. *Otacilia kao* Jäger & Wunderlich, 2012, previously only known from its type locality in Thailand, is recorded from Vietnam for the first time.

**Keywords:** Thailand - Sumatra - Indonesia - Vietnam - new record - biodiversity.

INTRODUCTION

The ground-dwelling spider genus *Otacilia* Thorell, 1897 is one of the most species-rich and common genera of Phrurolithinae in tropical forests of Southeast Asia. Prior to the present study, 29 species were formally assigned to *Otacilia* (Platnick, 2014). Together with the new species described here, the genus currently comprises 32 known species. Species of *Otacilia* vary greatly, having many species of great uniqueness in somatic and genital morphology (Deeleman-Reinhold, 2001; Jäger & Wunderlich, 2012). Each species possesses a relatively conservative morphology that easily distinguishes it from its congeners. Although the structural diversity of *Otacilia* provides a wealth of morphological characters, at the same time it presents an enormous challenge to our taxonomic classification in defining the genus. This is also the case demonstrated here, with new characters of unknown function being discovered (see below). The differences found among species currently placed in *Otacilia* leads to the conclusion that the genus may be paraphyletic and is a heterogeneous assemblage (Jäger & Wunderlich, 2012).

*Otacilia* is currently recognized by a combination of somatic and genital characters. In the present study, the genus diagnosis follows that of Deeleman-Reinhold (2001: 410), who revised and redefined the taxon, and discussed relationships to other phrurolithine genera of the Oriental fauna.

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MATERIAL AND METHODS

Material from the following collections has been studied: Museo Civico di Storia Naturale ‘Giacomo Doria’, Genoa, Italy (MSNG); Muséum d’histoire naturelle de la Ville de Genève, Switzerland (MHNG); Nationaal Natuurhistorisch Museum ‘Naturalis’, Leiden, the Netherlands (RMNH). New material of the species treated here will be deposited in the collections of the MHNG.

External morphology was examined, measured and illustrated with an Olympus SZX-12 stereomicroscope and an Olympus BX-40 compound microscope equipped with a drawing tube and photographic devices. All measurements are in millimetres (mm), with the measurements of leg segments taken on the dorsal side and given in the following order: total length (femur, patella + tibia, metatarsus, tarsus). The internal female genitalia were temporarily mounted on microscopic slides. The dorsal view of the internal genitalia was drawn in a cleared state after maceration in 96% lactic acid for 15-60 minutes. The male palps were expanded by placing them in distilled water. In the text ‘Fig.’ and ‘Figs’ refer to figures herein, while ‘fig.’ and ‘figs’ refer to figures published elsewhere.

Abbreviations used in the text and in the figures are as follows: A, epigynal atrium; AER, anterior eye row; ALE, anterior lateral eye; AME, anterior median eye; B, bursa; C, conductor; CD, copulatory duct; CO, copulatory orifice; D, epigynal depression; DTA, dorsal tibial apophysis; E, embolus; FD, fertilization duct; FR, femoral ridge; MOQ, median ocular quadrangle; P, papilla; PER, posterior eye row; PLE, posterior lateral eyes; PME, posterior median eyes; RTA, retrolateral tibial apophysis; S, spermatheca; SA, spermathecal appendage; SD, sperm duct; T, tegulum.

TAXONOMY

Corinnidae

*Otacilia* Thorell, 1897

**Type species:** *Otacilia armatissima* Thorell, 1897, by original designation.

*Otacilia truncata* sp. n.  Figs 1-16

**Holotype:** ♄; Thailand, Chiang Mai Province and District, Doi Suthep-Pui National Park, 1180 m; pitfall traps 28.IV.-30.V.1986; leg. P.J. Schwendinger (MHNG).

**Paratypes:** 3 ♀, 3 ♂; same data as for holotype (MHNG).

**Diagnosis:** The male of *O. truncata* sp. n. can be distinguished from its congeners by the thick and sinuous retrolateral palpal tibial apophysis (Figs 1, 4, 7, 9-10, 12), by the dorsal tibial apophysis gradually tapering then abruptly becoming a thread-like filament at its half length (Figs 2-4, 11), and by the sigmoid membranous conductor (Fig. 1). The female can be recognized by the elongated V-shaped copulatory ducts (Figs 5-6, 13) connected to posteriorly located spermathecae (Figs 6, 13).

**Relationship:** Males of this new species resemble those of *O. onoi* Deleman-Reinhold, 2001 (RMNH, examined) in having a large, apical conductor and a curved embolus, but differ in having a palpal tibial apophysis of different shape. Females closely resemble those of *O. armatissima* Thorell, 1897 (MSNG, examined) in having elongated, V-shaped copulatory ducts, but in *O. armatissima* the epigynal region is
NEW SPECIES OF OTACILIA

Otacilia truncata sp. n., male holotype (1-4), female paratype (5-6). (1) Male palp, ventral view. (2) Same, retrolateral view. (3) Same, prolateral view. (4) Same, dorsal view. (5) Epigyne, ventral view. (6) Internal genitalia, dorsal view. Abbreviations: A, epigynal atrium; B, membranous anterior bursa; C, conductor; CO, copulatory orifice; D, epigynal depression; DTA, dorsal tibial apophysis; E, embolus; FD, fertilization duct; FR, ventral femoral ridge; RTA, retrolateral tibial apophysis; S, spermatheca; SD, sperm duct; T, tegulum. Scale lines = 0.1 mm.

much wider, occupying the entire epigastric region. The spermathecae of O. armatisima are digitiform (multilocular in O. truncata sp. n., Figs 6, 13).

ETYMOLOGY: The specific epithet refers to the large, truncated RTA of the male palp (Fig. 12).

DESCRIPTION OF MALE (HOLOTYPE): Total length 3.5; prosoma 1.6 long, 1.4 wide; opisthosoma 1.9 long, 1.0 wide.

Prosome: Broadest between coxae II and III, narrowed in cephalic region at coxae I, in profile highest just in front of fovea. Carapace yellowish brown, with dark green striae radiating from black, longitudinal fovea. Sternum yellow, subovoid, slightly longer than wide, posteriorly bluntly pointed, devoid of distinctive projection between leg coxae. Labium wider than long, anterior margin slightly curved. Palpal coxae subrectangular, with thin apical scopulae. Cheliceral fang slender, moderately
Otacilia truncata sp. n., expanded right male palp. (7) Distal articles of palp, retroventral view. (8) Tegulum, ventral view. (9) Apex of RTA showing lumen, dorsal view. (10) Distal articles of palp showing RTA, dorsal view. (11) Same showing DTA, dorsal view. (12) Apex of RTA showing truncate tip, dorsal view. Abbreviations: C, conductor; DTA, dorsal tibial apophysis; E, embolus; FR, ventral femoral ridge; RTA, retrolateral tibial apophysis; SD, sperm duct; T, tegulum.

long; fang grooves with three promarginal and two retromarginal teeth; frontal surface of chelicerae each with two slender bristles.

Eyes: Eight eyes arranged in two rows, occupying almost entire attenuated cephalic region; AER straight, PER slightly recurved; PME smallest, other eyes subequal in size; PME pale and circular, others circled with black, diffuse ring. Eye sizes and interdistances: AME 0.08, ALE 0.10, PME 0.08, PLE 0.09; AME-AME 0.14, AME-ALE 0.12, PME-PME 0.18, PME-PLE 0.10, ALE-PLE 0.08; MOQ 0.30 long, anterior width 0.22, posterior width 0.25.

Legs: Leg formula 4123. Measurements: leg I 7.3 (1.6, 2.6, 1.7, 1.4); leg II 4.7 (1.3, 1.6, 1.0, 0.8); leg III 4.1 (1.1, 1.3, 0.8, 0.9); leg IV 8.4 (2.1, 2.4, 2.0, 1.9). Legs pale yellow, armed with orange-brown spines. Spination: all femora armed with two dorsal bristles situated in proximal half, widely separated on posterior legs; femora I and II with three elongated prolateral spines; tibia I with six pairs of ventral spines; metatarsi I and II with three pairs of ventral spines; tibia II with seven pairs of ventral
NEW SPECIES OF *OTACILIA*

Otacilia truncata sp. n., female paratype (13-16); O. bifurcata sp. n., male holotype (17-19). (13) Internal genitalia, dorsal view. (14) Copulatory orifice, dorsal view. (15) Proximal part of copulatory duct with opening of anterior membranous bursa (indicated by arrow), dorsal view. (16) Secretory plug deposited in epigynal depression, ventral view. (17) Male palp, retrolateral view. (18) Basal spike of embolus (indicated by arrow), retrolateral view. (19) Same, enlarged. Abbreviations: B, membranous anterior bursa; CD, copulatory duct; CO, copulatory orifice; D, epigynal depression; FD, fertilization duct; S, spermatheca.

spines; femora III and IV lacking prolateral spines; other leg segments devoid of large spines.


Palp (Figs 1-4, 7-12): Femur with subtriangular translucent ridge (Figs 2-3, 7). Retrolateral tibial apophysis represented by enlarged, sinuous prong (Figs 1, 4, 7, 9-10,
12); its anterior and posterior margins parallel in retrolateral view (Fig. 2); microscopically with narrow lumen running throughout its length (Figs 7, 9, 12). Dorsal tibial apophysis consisting of broad proximal region gradually tapering in proximal part and abruptly becoming a thin filament at half length (Figs 2-4, 11); tip of distal filament bent (Fig. 4). Tegulum ovoid, with sigmoid sperm duct located distally (Fig. 1). Embolus hook-shaped, sclerotized, originating distoprolaterally, its sharp apex pointing retrolaterad (Figs 1, 8). Conductor membranous, sigmoid, situated posterior to embolus (Fig. 1).

**Description of Female (Paratype):** Total length 5.4; prosoma 2.2 long, 2.0 wide; opisthosoma 3.2 long, 2.6 wide. Eye sizes and interdistances: AME 0.10, ALE 0.10, PME 0.08, PLE 0.09; AME-AME 0.10, AME-ALE 0.14, PME-PME 0.24, PME-PLE 0.12, ALE-PLE 0.30; MOQ 0.32 long, anterior width 0.22, posterior width 0.26. Leg formula 1423. Measurements: leg I 8.6 (2.2, 3.1, 1.5, 1.8); leg II 6.8 (1.9, 2.3, 1.1, 1.5); leg III 5.5 (1.7, 1.6, 1.4, 0.8); leg IV 7.7 (2.4, 2.2, 2.0, 1.1). General appearance as in male but larger. Dorsum of opisthosoma entirely dark green.

**Genitalia** (Figs 5-6, 13-16): Epigynal region lightly sclerotized, delimited from epigastric area by a distinct margin. Epigynal depressions (Figs 5-6) shallow, semicircular, with deeper crescent-shaped atrium (Fig. 5). Copulatory orifices circular (Figs 5-6, 13-14). Copulatory ducts with thick-walled anterior part, aligned horizontally (Figs 6, 14-15); posterior part thin and narrow, descending obliquely to connect with posteriorly-located spermathecae (Figs 5-6, 13). Spermathecae consisting of three chambers, posterior one subspherical (Figs 6, 13). Fertilization ducts lanceolate, originating from anterior chamber of spermathecae (Figs 6, 13). Anterior membranous bursae spherical, opening into anterior part of copulatory ducts (Figs 6, 13, 15).

**Variation:** There appear to be seven (instead of six) retroventral spines on tibia II in one of the male paratypes. A mating plug on one side of the epigynal atrium apparently has changed the configuration of the internal duct system (Figs 5-6, 13, 16). This raises the question whether previously described specimens with a similar plug in situ require cleaning to ensure appropriate identification and comparison. Although the differences may be modest, they should be observed with caution.

**Natural History:** All type specimens of *O. truncata* sp. n. were collected by means of pitfall trapping in an evergreen hill forest.

**Distribution:** Known only from the type locality in northern Thailand.

**Otacilia bifurcata** sp. n.

**Holotype:** ♂; Thailand, Chaing Mai Province, Fang District, Doi Ankhang, 1450 m; 24.VIII.1990; leg. P.J. Schwendinger (MHNG).

**Paratypes:** 5♂; same data as for holotype (MHNG).

**Diagnosis:** *Otacilia bifurcata* sp. n. can be easily distinguished from its congeners by the triangular basal spike on the embolus of the male palp (Figs 18-20), and by retrolateral and dorsal tibial apophyses being subequal in size (Figs 20-22).

**Relationship:** Males of this new species resemble those of *O. zebra* Deeleman-Reinhold, 2001 (RMNH, examined) in having two large tibial apophyses on the male
palp, but in *O. zebra* the retrolateral tibial apophysis is significantly smaller. Both species also differ by their body color pattern.

**Etymology:** The specific epithet refers to the presence of two elongated tibial apophyses on the male palp.

**Description of Male (Holotype):** Total length 3.4; prosoma 1.6 long, 1.3 wide; opisthosoma 1.8 long, 1.2 wide.

**Prosoma:** Prosoma broadest between coxae I and II, narrowed in cephalic region in front of coxae I, in profile highest in front of fovea, gradually sloping posteriorly. Carapace reddish brown, with dark brown striae radiating from deep longitudinal fovea. Sternum yellow, with distinctly dark brown margin, subovoid, almost as long as wide, posteriorly bluntly pointed, devoid of distinctive projection between leg coxae. Labium wider than long, anterior margin slightly curved. Palpal coxae subrectangular, with thin apical scopulae. Cheliceral fang slender, moderately long; three small teeth each on promarginal and retromarginal fang grooves; frontal surface with two slender bristles.

**Eyes:** Eight eyes arranged in two rows, occupying almost entire attenuated cephalic region; AER straight, PER slightly recurved; eyes subequal in size, with pale and circular PME, other eyes circled with black, not clearly outlined ring. Eye sizes and interdistances: AME 0.10, ALE 0.10, PME 0.08, PLE 0.09; AME-AME 0.16, AME-ALE 0.14, PME-PME 0.20, PME-PLE 0.12, ALE-PLE 0.10; MOQ 0.36 long, anterior width 0.26, posterior width 0.28.

**Legs:** Leg formula 4123. Measurements: leg I 8.2 (1.9, 2.9, 1.8, 1.6); leg II 5.5 (1.5, 1.8, 1.2, 1.0); leg III 4.9 (1.3, 1.5, 0.9, 1.2); leg IV 9.9 (2.5, 2.9, 2.3, 2.2). All coxae pale yellow; anterior femora dark brown, posterior ones yellowish brown; other leg segments yellow. Spination: anterior femora armed with two dorsal bristles situated in proximal half, and with one distal bristle; posterior femora with two short bristles widely separated from each other; femur I with four elongated prolateral spines; tibia I with seven pairs of ventral spines; femur II with two elongated prolateral spines; tibia II with six pairs of ventral spines; metatarsi I and II with four pairs of ventral spines; femora III and IV lacking prolateral spines; other leg segments devoid of large spines.

**Opisthosoma:** Elongate-ovoid, sparsely clothed with fine pubescence. Dorsal scutum absent, but with conspicuous chitinized area extending over four fifths of dorsal area. Dorsum greenish brown, with yellow pigment shining through. Venter pale, without markings.

**Palp** (Figs 17-23): Femur with translucent ridge and a small projection ventrally (Figs 17, 22-23). Retrolateral and dorsal tibial apophyses represented by enlarged, triangular prong with slender distal half (Figs 20-22). Dorsal tibial apophysis slightly shorter than retrolateral one. Tegulum ovoid, with sigmoid sperm duct located distally (Fig. 20). Embolus hook-shaped, heavily sclerotized, originating distoprolaterally, its sharp apex pointing retrolaterad and basally carrying a sharply pointed retrolateral spike (Figs 18-20). Conductor membranous, rectangular, situated posterior to embolus (Fig. 20).

**Female:** Unknown.
Otacilia bifurcata sp. n., male holotype (20-23); O. papilla sp. n., female holotype (24-27); O. parva, new female from Sumatra (28). (20) Male palp, ventral view. (21) Same, retrolateral view. (22) Same, prolateral view. (23) Palpal femur showing ventral ridge on upper margin, retrolateral view. (24) Epigyne, ventral view. (25) Internal genitalia, dorsal view. (26) Anterior region of copulatory duct, ventral view. (27) Papilla on spermathecal chamber, dorsal view. (28) Right spermatheca, dorsal view. Abbreviations: SA, spermathecal appendage; P, papilla. Scale lines = 0.1 mm.

Natural History: All type specimens of O. bifurcata sp. n. were collected by sifting thick decomposing leaf litter and other organic humus in an evergreen hill forest.

Distribution: Known only from the type locality in northern Thailand.

Otacilia papilla sp. n. (Figs 24-27, 29-32)

Holotype:♀; Indonesia, Sumatra, West Sumatra Province, old secondary forest above Harau Canyon, north of Payakumbuh, 750 m; 7.VI.2006; leg. P.J. Schwendinger (MHNG, sample Sum-06/11).
**NEW SPECIES OF OTACILIA**

**DIAGNOSIS:** *Otacilia papilla* sp. n. can be easily distinguished from its congener by the large, triangular epigynal depression (Figs 25, 29), and by the presence of digitiform papillae on the multilocular spermathecae (Figs 27, 30-32).

**RELATIONSHIP:** The female of *Otacilia papilla* sp. n. resembles that of *O. sinifera* Deeleman-Reinhold, 2001 (RMNH, examined) in having several modified structures on the surface of spermathecae, but the new species is much smaller and lacks anterior membranous bursae.

**ETYMOLOGY:** The specific epithet refers to the digitiform papillae on the spermathecae of this species.

**DESCRIPTION OF FEMALE (HOLOTYPE):** Total length 3.4; prosoma 1.5 long, 1.4 wide; opisthosoma 1.9 long, 1.1 wide.

**PROSOMA:** Broadest between coxae II and III, narrowed in cephalic region in front of coxae I; in profile highest in front of fovca, gradually sloping posteriorly. Carapace yellow, without conspicuous markings. Sternum yellow, with distinctly dark brown margin, subovoid, as long as wide, devoid of distinctive projection between leg coxae. Labium wider than long, anterior margin slightly distinctive. Palpal coxae rectangular, with thin apical scopulae. Cheliceral fang slender, moderately long; two small teeth each on promarginal and retromarginal fang grooves; frontal surface with two short bristles.

**Eyes:** Eight eyes arranged in two rows, occupying almost entire attenuated cephalic region; both eye rows slightly recurved; eyes subequal in size; PME smallest, pale and circular, other eyes circled with black ring. Eye sizes and interdistances: AME 0.08, ALE 0.08, PLE 0.08; AME-AME 0.11, AME-ALE 0.12, PME-PME 0.14, PME-PLE 0.12, ALE-PLE 0.08; MOQ 0.34 long, anterior width 0.25, posterior width 0.26.

**Legs:** Leg formula 4123. Measurements: leg I 7.8 (2.2, 2.9, 1.7, 1.0); leg II 6.2 (1.6, 2.4, 1.2, 1.0); leg III 4.6 (1.4, 1.3, 1.0, 0.9); leg IV 8.5 (2.2, 2.6, 2.2, 1.5). All leg segments pale yellow. Spination: anterior femora armed with two widely separated dorsal bristles; femora I and II with one elongated prolateral spine; tibia I and II with six pairs of ventral spines; metatarsus I and II with two pairs of ventral spines; femora III and IV lacking prolateral spines; other leg segments devoid of large spines.

**Opisthosoma:** Truncate, sparsely clothed with fine pubescence. Dorsal scutum absent. Dorsum green. Venter pale yellow, without markings.

**Genitalia** (Figs 24-27, 29-32): Epigynal region very lightly sclerotized, without clear margin delimiting it from epigastric area, medially with large and prominent inverted-triangular lobe (Figs 24, 29). Copulatory orifices circular (Figs 24, 29), hidden underneath narrow end of funnel-shaped epigynal depression (Figs 25, 29-30). Copulatory ducts thick-walled, ascending anteriorly (Figs 25, 30), then descending to posteriorly located spermathecae. Spermathecae consisting of 3-4 chambers (Figs 25, 30-32), each chamber provided with digitiform papilla of unknown function (Figs 25, 30-32). Fertilization ducts falciform, originating from anterior lobe of spermathecae (Figs 25, 30). Bursae absent.

**MALE:** Unknown.
Otacilia papilla sp. n., female holotype (29-32); O. parva, new female from Sumatra (33-34).
(29) Internal genitalia, ventral view. (30, 33) Same, dorsal view. (31) Same as 30, different focus. (32) Papilla on spermathecal chamber, dorsal view [another papilla visible (but not in focus) on upper left wall of same chamber]. (34) Spermathecal appendage, dorsal view. Abbreviations: D, epigynal depression; CO, copulatory orifice; FD, fertilization duct; P, papilla; S, spermatheca; SA, spermathecal appendage.

NATURAL HISTORY: The type material of O. papilla sp. n. was collected by sifting thick decomposing leaf litter and other organic humus in a rain forest.

DISTRIBUTION: Known only from the type locality in the Barisan Mountains of western Sumatra.

Otacilia parva Deeleman-Reinhold, 2001

NEW SPECIES OF OTACILIA

Otacilia kao, new male (35-37) and female (38-41) from Vietnam. (35) Male palp, retroventral view. (36) Apex of male palp showing embolus and conductor, retrolateral view. (37) Apex of RTA, retrolateral view. (38) Detail of internal genitalia, dorsal view (arrow indicating 'bubble remnant of fused furrow' sensu Jäger & Wunderlich, 2012). (39) Posterior parts of internal genitalia showing elongated fertilization ducts, dorsal view. (40) Detail of internal genitalia showing copulatory orifice (indicated by arrow), dorsal view. (41) Right spermatheca, dorsal view.

**Type Material Examined:** 1 ♀ paratype; Indonesia, West Sumatra, Panti Reserve, north of Lebuksikaping (= Lubuksikaping), leaf litter in lowland primary forest; 4.VIII.1982; C.L. & P.R. Deeleman leg. (RMNH).

**New Material:** 1 ♀; Indonesia, Sumatra, West Sumatra Province, old secondary forest above Harau Canyon, north of Payakumbuh, 750 m; 7.VI.2006; leg. P.J. Schwendinger (MHNG, sample Sum-06/11).

**Remarks:** Deeleman-Reinhold (2001: 419) provided a description and illustrations of the female paratype. The female of this species is recognized by the absence of anterior membranous bursae, by the thick-walled copulatory ducts, and by the specific shape of the spermathecae (Fig. 33). We present here another unique character found only in the female of this species: a digitiform appendage situated on the anterior surface of each spermatheca (Figs 28, 33-34).

*Otacilia kao* Jäger & Wunderlich, 2012

*Otacilia kao* Jäger & Wunderlich, 2012: 258, figs 26-36, photos 21-29, description of male and female.
NEW MATERIAL: 1♀, 1♂; Vietnam, Kien Giang Province, Phu Quoc Island, Khu Rung Nguyen Sinh Forest Reserve, stream ca. 5 km southwest of Bai Thom Beach, evergreen rain-forest, 100-400 m; 14./16.VIII.2003; P.J. Schwendinger leg. (MHNG, sample SV-03/08). - 1♀; Thailand, Trat Province, Ko Chang (west side of island), forest near Kai Bae Beach, 50 m; 2.-6.XI.2006; A. Schulz leg. (MHNG, sample AS-TH06/03).

REMARKS: Otacilia kao is a pale species with extremely elongated and slender legs. There is a modest variation between the male holotype and the newly collected spiders examined and treated in the present study. The apex of the retrolateral tibial apophysis is slightly different from that of the male holotype (Figs 35, 37). The new male’s palpal configuration closely resembles that of O. sinifera and O. kao in having a simple, curved embolus and a minute conductor (Figs 35-36), but O. sinifera can be distinguished by the apex of the retrolateral tibial apophysis being hook-shaped, in addition to its conspicuous opisthosomal pattern. The shape of the retrolateral tibial apophysis in all three species seems to be somewhat similar, so it is difficult to make a conclusion about the taxonomic value of this character. They can be considered as a rather compact group of closely related species. It is possible that O. kao is a species with strong variability within the species and within its populations. However, the variation found in the new males is well within the known limits of the species and is not sufficient to warrant the status of a new taxon.

DISTRIBUTION: Thailand (Ko Chang, Trat Province) and Vietnam (new record).

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Two new species of *Pseudolathra* Casey from Borneo (Coleoptera, Staphylinidae, Paederinae)

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Two new species of *Pseudolathra* Casey from Borneo (Coleoptera, Staphylinidae, Paederinae). - Two new staphilinid beetles from Borneo are described and illustrated: *Pseudolathra borneensis* n. sp. and *P. lanceolatus* n. sp.

Keywords: Taxonomy - new species - Coleoptera - Borneo - Sabah - Malaysia.

INTRODUCTION

Members of the genus *Pseudolathra* occur in the Holarctic and Oriental regions. A recent much needed revision of the oriental species by Assing (2012, 2013) and a paper by Li & Solodovnikov (2013) have resulted in a total of 27 species known from central and eastern Asia, and enabled me to determine the following two new species found amongst the abundant collections of insects recently made for the Oxford University Museum of Natural History in North Borneo. Only one other species, the widespread SE Asian *P. pulchellus* (Kr.), was known from Borneo. The holotypes of both the new species are kept in the Oxford University Museum of Natural History; paratypes also in the author’s collection and in the Natural History Museum, Geneva.

METHODS

Descriptions and measurements were made using a VMZ 1x-4x binocular dissecting microscope with a mm eyepiece scale graticule. A difference between the figures of aedoeagi provided by Assing (2012) and those in this article is that for Assing’s paper the aedoeagi were cleared and photographed in transmitted light using a compound microscope, whereas the photographs below were made in reflected light using a Leica M165C binocular microscope linked to a Leica DFC 490 digital camera and photomontage software which gives greater depth of field but does not show many internal structures.

Abbreviations used on data labels and in the text of this article are as follows:

B.R.I. Borneo Rainforest Lodge, Danum valley, Sabah.
MHNG Muséum d’Histoire Naturelle de Genève.
OUMNH Oxford University Museum of Natural History, Oxford.
RCL Rougemont collection, London

Manuscript accepted 17.04.2014
**Pseudolathra borneensis** n. sp.

**Holotype:** OUMNH, ♂; MALAYSIA, Sabah, Lahad Datu, Ulu Segama For Res, Coupe 81 logging area, 04°58.660′N 117°53.410′E, iii.2005, FIT 2° Forest.


**Additional material seen:** 1 ex.: Malaysia, Sabah, Tawau, 11-17.x.2012, 4.66N 117.6E, 100 m Alt, Coll. C.L. Gray, SAFE project area, F.I.T Riparian forest, strip in oil palm, OUMNH -213-056 (in OUMNH).

**Taxonomy:** This new species belongs to the *nigerrima* group sensu Assing 2012 according to its colour, punctuation and conformation of the aedeagus.

**Description**

Length of body: 8-9 mm; length of fore-body: 4.2 mm.

Head, pronotum and abdomen black, the posterior margins of abdominal tergites narrowly and obscurely reddish; elytra light or dark brown, the posterior third to half more or less strongly infuscate.

Habitus (fore-body): Fig. 1. Labrum and antennae dark brown; legs dark testaceous.

Head transverse, 4/5ths wider than long, the vertex shiny, with several large setiferous punctures near eyes, a continuous transverse row of smaller punctures along base, and irregularly scattered micro-punctures on entire disc, sparser in the middle. Eyes large and salient, twice as long as temples measured to posterior angle of head. Antennae about 2.9 mm long, antennomeres 5-9 with very narrow bases, club-shaped.

Pronotum only slightly transverse, very slightly broader than head, with an inner discal series of about 5 punctures, an outer series of 4 larger punctures, and 3-4 marginal punctures; sparse scattered micro-punctures exceedingly small, scarcely visible.

Elytra much longer and broader than pronotum, with an entire sub-marginal carina and two rows of about 10 discal punctures each, those of outer row coarser than inner row, in addition to a juxta-sutural row of small punctures and a row of about 10 punctures on declivous lateral surfaces. Pro-tarsi broadly dilated in both sexes.

Abdomen a little narrower than elytra, finely and not very densely punctuate.

Male: abdominal sternite VII (Fig. 1b) with a small, shallow apical emargination; sternite VIII (Fig. 1c) with a deep narrow emargination. Aedeagus (Fig. 1a) characteristic, the dorsal blade very broad, apically sub-truncate, about as long as ventral blade, the latter with a conspicuous inwardly curving apical process on either side, and a sub-apical process bearing two ventral and two lateral spines.
**Remarks:** *P. borneensis* n. sp. most closely resembles *P. transversicollis* Assing from Thailand and *P. separanda* Assing from north India, especially in the colour of the elytra, but is a smaller insect than either of those and with a characteristic aedoeagus.

**Pseudolathra lanceolata** n. sp.  


**Taxonomy:** This new species also appears to belong to the *nigerrima* group according to its colour, size and punctuation, but has an aberrant type of aedoeagus.

**Description**

Length of body: 7-7.6 mm; length of fore-body: 3.8 mm.

Body entirely black; palpi, antennae and tarsi dark testaceous; femora and tibiae infuscate, the femora more strongly so.

Habitus (fore-body): Fig. 2. Head transverse, 4/5ths wider than long; vertex shiny, with 3-4 large setiferous punctures near inner anterior margin of eyes, another on margin of eye posteriorly, another behind eye, and a continuous row of small punctures along basal margin. Eyes very large, more than twice as long as temples measured from posterior margin of eye to posterior angles of head. Antennae about 2.4 mm long.

Pronotum scarcely elongate, 4/5ths longer and about as broad as head, with a discal series of 5 large punctures, an outer series of 3 punctures slightly divergent posteriorly to inner series, 3 punctures near lateral margin in anterior half of pronotum, besides a few small punctures on lateral margin itself. Elytra longer and broader than pronotum, with a juxta-sutural series of 8-10 small punctures, an inner discal series of 8-10 larger punctures, an outer series of 9-10 punctures, and a series of 7-8 punctures on lateral declivity of elytra. Hind wings fully developed. Abdomen much narrower than elytra, shiny, sparsely punctate.

Male: abdominal sternite VII (Fig. 2b) with a fairly large broad apical emargination, its lateral angles salient and furnished apically with a number of small black bristles; sternite VIII (Fig. 2c) with a deep, narrow sub-parallel-sided emargination extending to half the length of sternite; aedoeagus (Fig. 2a) with a long lanceolate dorsal blade of the median lobe, the ventral blade short, bi-lobed.
Pseudolathra borneensis (1) fore-body. (1a) Aedoeagus in ventral view. (1b) Male sternite VII. (1c) Male sternite VIII. Pseudolathra lanceolata (2) fore-body. (2a) Aedoeagus in ventral view. (2b) Male sternite VII. (2c) Male sternite VIII. (3) Pseudolathra. species indet. cf. lanceolata, aedoeagus in ventral view. Scale bars: 1 mm, except 1a = 0.1 mm.
**Remarks:** This new species superficially most closely resembles *P. nigerrima*, but is on average a little smaller, of the same colour but with darker legs, and differs moreover in its more transverse head, the puncturation of the pronotum, and the completely different aedoeagus.

*Pseudolathra* sp.

**Remarks:** A single male bearing the same data as the holotype of *P. lanceolata* n. sp. is indistinguishable externally from that species, except perhaps by the very slightly smaller emargination of the male sternite VIII, but has a different aedoeagus: shorter and with a much less acute apex of the dorsal blade (Fig. 3). This alone makes it look like a distinct species, but in the absence of any other material it is not here described as such. The specimen is housed in the OUMNH and bears the following determination label: “Pseudolathra cf. lanceolata n.sp., aedoeagus different! Det. 2013 G. de Rougemont”.

**Acknowledgements**

I thank James Hogan of the OUMNH for producing the plates of photographs that illustrate this paper. Specimens from the Danum Valley in the OUMNH were collected with the permission of the Danum Valley Management Committee and the Economic Planning Unit of the Prime Minister’s Department under permit no. UPE Ruj. UPE 40/200.1959 issued to Dr. Eleanor Slade, and project no. 224 under the Royal Society SEARRP.

**References**


An annotated list of the Orthoptera (Insecta) species described by Adolf Nadig with an account of the type material housed in the Muséum d’histoire naturelle de Genève

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An annotated list of the Orthoptera (Insecta) species described by Adolf Nadig with an account of the type material housed in the Muséum d’histoire naturelle de Genève. - Adolf Nadig was an amateur entomologist who accumulated an important collection of Orthoptera and described 32 species or subspecies, principally from the southern slopes of the Alps and from North Africa. He left his collection to the Muséum d’histoire naturelle de Genève, where it is kept as a separate collection under the terms of the gift. The names of his taxa are listed alphabetically, the sex, verbatim label data and condition of the primary type specimens is given, along with their location within the collection.

Keywords: Ensifera - Caelifera - Insubric region - Mahgreb - type catalogue.

INTRODUCTION
Adolf Nadig (1910-2003) was a Swiss entomologist specialising in the Orthoptera. Born in Chur in the canton of Graubünden, Nadig was the son of a well-known naturalist of the same name who specialised in Hymenoptera and Orthoptera, and some of Nadig’s early scientific contributions were joint publications with his father. The younger Nadig studied biology at Zürich University and then became a teacher, working first in Zürich, then in Chur and later in Zuoz. He also had a distinguished military career, and was involved in a project researching the environmental effects of the hydro-electric dams that were built in the Lower Engadine Valley, in Graubünden (Hauser, 2004). In his free time Nadig was an indefatigable entomologist, amassing a formidable collection of Orthoptera from Europe, particularly the Insubric region of the southern slopes of the Alps, and North Africa. After his retirement and return to Chur in 1975 he was able to devote more time to entomology and most of his Orthoptera publications appeared after this (Detzel & Coray, 2004). Nadig described thirty two species or sub-species of Orthoptera.

Nadig’s collection came to the MHNG in 2001 (Schwendinger & Lienhard, 2001), and under the terms of the legacy is kept as a separate collection. A list of the taxa described by Nadig is given by Coray (2004), who gives the type locality and the kind of type, but does not treat the condition of the primary types or enumerate the holdings of secondary types. Nadig described a number of taxa as forms or varieties

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rather than subspecies; these names, which are listed by Coray (2004), are unavailable under articles 45.5 and 45.6.3 of the International Code of Zoological Nomenclature (1999).

ARRANGEMENT AND FORMAT

The species are listed alphabetically. The format for each is:

**specific epithet** Author, publication: page [Original generic placement].

Provenance as given in the original description. Number and kind of type specimens. Specimen: “Label data” [format of label]. Following the recommendations of Ohl & Oswald (2004) the condition of primary type specimens is noted. Other comments. Location of material in the MHNG Nadig collection.

Currently valid combination following *Orthoptera Species File* (Eades et al., 2014).

Abbreviations used in the list:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISCM</td>
<td>Institut Scientifique Chérifen, now Institut Scientifique de l'Université Mohammed V, Rabat, Morocco</td>
</tr>
<tr>
<td>MCSN</td>
<td>Museo Civico di Storia Naturale “Giacomo Doria”, Genoa, Italy</td>
</tr>
<tr>
<td>MHNG</td>
<td>Muséum d'histoire naturelle, Genève, Switzerland</td>
</tr>
<tr>
<td>OSF</td>
<td><em>Orthoptera Species File Online</em> (Eades et al., 2014)</td>
</tr>
<tr>
<td>RMNH</td>
<td>Naturalis Biodiversity Center, Leiden, The Netherlands</td>
</tr>
<tr>
<td>SMTD</td>
<td>Museum für Tierkunde, Dresden, Germany</td>
</tr>
</tbody>
</table>

CATALOGUE

*alhoceimae* Nadig, 1994: 982-984 [Uromenus].

Marokko, Cala Iris. ♂ Holotype, 15 ♂ paratypes and 8 ♀ paratypes.

♂ Holotype with labels: “Maroc 68 MA 68: 32, Cala Iris, 0-15 m, 28.6.68, leg. Nadig” [printed on white card]; “U. alhoceimae sp. n. ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” handwritten]. Most of both antennae and the claws of the left hind leg are missing. Dissected genitalia are glued to a card mount secured on the original pin. The 15 ♂ paratypes are also present. There are 10 ♀ specimens labelled as paratypes (one as allotype) including four from the type locality for which Nadig only mentions two in the original description. It is not clear whether the number in the description is erroneous or whether two specimens were identified later and thus are not really part of the type series. Images on OSF. Box Nadig 250.

A junior synonym of *Uromenus pardoi* (Morales-Agacino, 1950)

*alpinus italoaustriacus* Nadig, 1987: 315 [Anonconotus].


[typed on yellow paper with “♂” added by hand]; “Holo-Typus” [printed on red card with “Holo-” handwritten]. The right antenna is missing. Dissected genitalia are glued to a card mount secured on the original pin. There are three ♂ paratypes and two ♀ paratypes. Images on OSF. Box Nadig 185.

*Anonconotus italoaustriacus* Nadig, 1987

**annamariae** Nadig, 1985: 329-333 [*Eupholidoptera*].


♂ Holotype with labels: “GRIE., KRETA 84:14 Nom. Lasithiou: Kato Zakros, 50 m, 14.6.84, leg. NADIG” [printed on white card]; “GRIE 84:14 No 1 (♂)” [handwritten on whitish paper]; “Eu. annamariae sp. n. NADIG, 1985 ♂ det. NADIG” [typed on white card with “♂” added by hand and “det. NADIG” printed]; “HOLO-Typus” [printed on red card with “HOLO-“ typed]. The claws of the left hind leg are missing. Dissected genitalia are glued to a card mount secured on the original pin. 10 ♂ paratypes and 13 ♀ paratypes, one labelled as allotype, are also present. According to the original description a pair of paratypes was deposited in the collection of Fer Willemsen, which is now in the RMNH. Box Nadig 170.

**Eupholidoptera annamariae** Nadig, 1985

**antaliae** Nadig, 1991: 127-131 [*Parapholidoptera*].

Türkei, Kap Anamur. ♂ Holotype, 1 ♂ paratype and 6 ♀ paratypes.

♂ Holotype with labels: “TR: S-Küste TR.88: 19, Anamur 1-50 m, 1.7.88 und 6.7.88, leg. Nadig” [printed on white card]; “Paraphol. Antaliae [sic] sp. n. NADIG, 1991 ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-“ typed]. Most of both antennae, the claws of the left hind leg and the entire right hind leg are missing. Dissected genitalia are glued to a card mount secured on the original pin. One ♂ and six ♀ paratypes, one labelled as allotype, are also present, as are the two other ♀ specimens mentioned in the original publication but not designated as paratypes. Images on OSF. Box Nadig 173.

**Parapholidoptera antaliae** Nadig, 1991

**azami minor** Nadig, 1961: 286-290 [*Roeseliana*].

Piano Scairolo (TI). ♂ Holotype, 122 ♂ paratypes and 136 ♀ paratypes.

♂ Holotype with labels: “Piano Scairolo, 16.VII.60 TI. Mähr-Sumpfviwes 280 m leg Nadig” [handwritten by Nadig on white card with “Nadig” printed]; “Type” [printed in red on white card with red printed border]; “Holotypus of R. azami minor Nadig 1961” [handwritten on red paper]. The claws of the right front leg and the last tarsal segment of the left front and middle legs are lost. The paratypes from the type locality are labelled as such but the others are not; there are 95 ♂ and 121 ♀ from the other localities mentioned in the original description, as well as numerous immature specimens. A pair of paratypes from the type locality is in the SMTD (images on OSF). Images on OSF. Boxes Nadig 135 & 136.

**Roeseliana fedtschenkoi minor** Nadig, 1961

Italien, Piemonte, Cle. Baracun. ♂ Holotype, 7 ♂ paratypes and 4 ♀ paratypes.

♀ Holotype with labels: “I: PIEMONTE: 85:54 V. Carboneri unt. Cle. Baracun, 2020 m, 30.8.85, leg. NADIG” [printed on white card]; “85 : 54 No. 1 (♀) Zeichn. Titill. aufgeklebt oben” [typed on yellow paper with “♀” added by hand]; “A. baracunensis n. sp. NADIG ♀ det. NADIG” [typed on white card with “♀” added by hand and “det. NADIG” printed; “Holo-Typus” [printed on red card with “Holo-” typed]. The right antenna is missing. Dissected genitalia are glued to a card mount with a sketch of the titillator on it secured on the original pin. There are seven ♂ paratypes and four ♀ paratypes, one labelled as allotype, also present. Images on OSF. Box Nadig 189.

Anonconotus baracunensis baracunensis Nadig, 1987

biguttulus marocanus Nadig, 1976b: 652-661 [Chorthippus].

Maroc, J. el Arz. ♂ Holotype and 1 ♀ paratype.

♂ Holotype with labels: “MAROC 70 MA 70: 73 Rif: J. el Arz (S.J. Tidirhine), 1700-1800 m, SE-Hang, 12.7.70, leg. Nadig” [printed on white card with “73” and “1700-1800 m SE-Hang” handwritten by Nadig]; “Photo, Mikro, Mio 71: II, 10-15 15-25” [handwritten on white card with “15-25” in red]; “Chor. biguttulus (L.) maroc. Nad. ♂ det. Nadig” [printed on white card with “maroc. Nad. ♂” handwritten]; “HOLO-Typus Typus” [printed on red card with “Holo-” typed]. Specimen set with right wings spread and left wings folded. The tibia and tarsi of the right front leg and the last tarsal segment of both middle legs are lost. The right hind leg is glued to a card mount secured on the original pin. There is a ♀ specimen labelled as allotype present. A label in the insect box states that all of the specimens with the same locality data (MA 70: 73), and with sample number MA 70: 74 are paratypes, but this is not mentioned in the original description and the individual specimens are not labelled as such. Box Nadig 818.

Chorthippus marocanus Nadig, 1976

bouiblani Nadig, 1995: 150-155 [Steropleurus].


♂ Holotype with labels: “MAROC 70 MA 70: 85, Moyen Atlas Nord-Est, J. Bou Iblane, 2000-2500m, S-Hang, 17./18.7.70, leg. Nadig” [printed on white card with “85” and “2000-2500m S-Hang” handwritten by Nadig]; “MA 70 : 85 No. 1” [typed on a strip of white paper]; “S. bouiblani NADIG, 1995 ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “Holo-” handwritten]. The right hind leg lacks two tarsal segments. There are dissected parts glued to a card mount secured on the original pin. The 21 ♂ paratypes and two immature paratypes are also present. There are 14 ♀ specimens labelled as paratypes (one as allotype), all with the same data as the holotype; it is not clear whether these were all used by Nadig for the description, in which case the number of paratypes cited in the original description is erroneous, or whether three of the specimens were identified later and are thus not really paratypes. Images on OSF. Box Nadig 259.

Uromenus bouiblani (Nadig, 1995)
choumarae Nadig, A. 1976a: 344 [Uromenus].
Maroc, Haut-Atlas, Tizi-n-Test. ♀ Holotype, 1 ♀ paratype and 2 ♂ paratypes. One ♂ paratype and one ♀ paratype. In the original description it is stated that the holotype and the other ♀ paratype (referred to as the allotype) are in the collection of the ISCM. Box Nadig 262.

Uromenus choumarae Nadig, 1976

cialancensis Nadig, 1986: 218-222 [Chorthippus].

♂ Holotype with labels: “I: Piemonte; 85: 52 13 Laghi - Pta. Cialancia, 2520-2750 m, 29.8.85, leg. NADIG” [printed on white card]; “Genit. extrah.” [typed on a strip of white paper]; “85 : 52 No. 1 (♂) Messungen” [typed on a strip of yellow paper with “♂” added by hand]; “Ch. Gl. cialancensis n. sp. ♂ det. NADIG” [printed on white paper]; “Holo-Typus” [printed on red card with “Holo-” typed]. Specimen set with right wings spread and left wings folded. The last tarsal segment of the right front leg is missing. The right hind leg is glued to a card mount with “Z: 157” handwritten on it and secured on the original pin. There are 14 ♀ paratypes and 20 ♀ paratypes, one labelled as allotype, also present. According to the original description a pair of paratypes was deposited in the collections of both Kurt Harz and Fer Willemse. The pair in the Harz collection is in the MHNG, the pair in the Willemse collection is in the RMNH. Boxes Nadig 814 & Harz 132b.

Chorthippus cialancensis Nadig, 1986

cockerelli timhaditensis Nadig, 1976a: 343-344 [Uromenus].

♂ Holotype with labels: “MAROC 70 MA 70: 91, Moyen Atlas Central, N-Teil: 2000 m, 8 km N Timhadite, 20.-22.7.70, leg. Nadig” [printed on white card with “91” and “2000 m, 8 km N Timhadite” handwritten by Nadig]; “St. cockerelli timhaditensis ssp. n. Nadig ♂ det. Nadig” [typed on white card with “♂” added by hand in red ink and “det. Nadig” printed]; “Type Holo-” [handwritten in red ink on white card with red printed border with “Type” printed in red]. Most of the left antenna is missing. Dissected genitalia are glued to a card mount secured on the original pin. There are 27 ♂ paratypes, 14 ♀ paratypes, one labelled as allotype, and four immature ♀ which are also labelled as paratypes but not mentioned in the original description. According to the description a pair of paratypes is in the ISCM. Box Nadig 262.

Uromenus cockerelli timhaditensis Nadig, 1976

Meride (TI). ♀ Holotype, 6 ♂ paratypes and 6 ♀ paratypes.

♂ Holotype with labels: “Meride (TI). “Camponaria”, 16.VII.60, 600 m, leg. Nadig” [handwritten on white card with “Nadig” printed]; “O. decipiens insubrica NADIG ♂ det. NADIG” [typed on white card with “♂” added by hand and “det. NADIG” printed]; “HOLO-Typus” [printed on red card with “Holo-” typed]. There are
six ♂ paratypes and six ♀ paratypes, one of them labelled as allotype, also present. Although the list of material studied was very extensive and includes many stations in Italy, the type series was explicitly restricted to the specimens from Meride in the Swiss canton of Ticino. Box Nadig 449.

Odontopodisma decipiens insubrica Nadig, 1980


Italien, Piemonte, La Bessa. ♂ Holotype, 9 ♂ paratypes and 13 ♀ paratypes. ♂ Holotype with labels: “L.Piemonte 84: 71 La Bessa (S. Biella), 250-300 m, 11.9.84 leg. Nadig” [printed on white card]; “84: 71 No. 1 (♂), Zeichn. Penisva.” [typed on yellow paper]; “Mi. formos. bessae ssp. n. Nadig ♂ det. NADIG” [printed on white card with “♂” added by hand]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. Specimen set with wings folded. There are 10 ♀ and 15 ♀ specimens with data corresponding to the original description labelled as paratypes (one ♀ labelled as allotype). It is not clear whether the number given in the description was erroneous or whether some of these individuals were identified later and are therefore not part of the type series. This subspecies is not included in OSF. Box Nadig 411.

Nadigella formosanta bessae (Nadig, 1989)

galvagnii Nadig, 1994: 1000-1002 [Uromenus].

Marokko, Rif, Chêchaouen. ♂ Holotype, 4 ♂ paratypes, 4 ♀ paratypes and 5 immature paratypes. ♂ Holotype with labels: “Maroc 68 MA 68: 12 Chêchaouen, 250 m, 19.6.68; leg. Nadig” [printed on white card with “12” and “250 m 19.” handwritten by Nadig]; “Urom. tuberculatus sp. nova NADIG ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “U. galvagnii sp. n. ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. The left antenna, the tarsi of the left middle leg and the entire right middle and hind legs are missing. There are four ♂ paratypes, four ♂ paratypes, one labelled as allotype, and five immature paratypes (one of which is not labelled as such) also present. Images on OSF. Box Nadig 252.

Uromenus galvagnii Nadig, 1994


Tunisien, Majoura. ♂ Holotype, 2 ♂ paratypes and 5 ♀ paratypes. ♂ Holotype with labels: “TUNISIA TU.77: 31 Majoura (E Gafsa), Hügelzone, 500m, 7.6.77, leg. NADIG” [printed on white card]; “U. (St.) gracilis sp. n. ♂ det. NADIG” [typed on white card with “♂” added by hand and “det. NADIG” printed]; “TU.77: 31 Steropl. spec. No. 5 MIKROPHOTO 1977/VII: .19” [typed on squared paper with “MIKROPHOTO 1977/VII :” in red and “.19” added by hand in red ink]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. The last tarsal segment of the left middle leg and the claws of the right hind leg are missing. Dissected genitalia are glued to a card mount secured on the original pin. There are two ♂ paratypes and five ♀ paratypes, one labelled as allotype also present. A sixth ♀ has a paratype label
but is not designated as such in the original description. Images on OSF. Box Nadig 254.

*Parasteropleurus gracilis* (Nadig, 1981)

**harzi** Nadig, 1988: 109-112 [*Omocestus*].

Maroc, Maor, J. Bou Iblane. ♂ Holotype, 8 ♂ paratypes and 10 ♀ paratypes.

♂ Holotype with labels: “Maroc 68 MA 68: 45, Taffert SW-Grat J. Bou Iblane, 2200-2550 m, 4./5.7.68 leg. Nadig” [printed on white card with “45, Taffert SW-Grat J. Bou Iblane, 2200-2550 m, 4./5.7.” handwritten by Nadig]; “No. 5” [typed on a strip of yellow paper]; “O. harzi sp. n. NADIG, 1988 det. Nadig” [typed on white card with “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. Specimen set with wings folded. The right hind leg is glued to a card mount with “1” (in red) and “Z: 25!” (in black) handwritten on it and secured on the original pin. There are eight ♂ and nine ♀ paratypes, one labelled as allotype, also present. The ♀ paratype stated to be in Harz’s collection in the original description could not be found in the MHNG. Box Nadig 673.

*Omocestus harzi* Nadig, 1988

**keisti** Nadig, 1989a: 80-83 [*Chrysochraon*].

Schweiz, St. Gallen, Toggenburg. ♂ Holotype, 6 ♂ paratypes and 12 ♀ paratypes.

♂ Holotype with labels: “CH: Churfirtsten 88: 46 Gamserrugg, 1800-1900 m, 10.9.88, leg. Nadig” [typed on white card with “det. Nadig” printed]; “No 2” [handwritten on a strip of yellow paper]; “46” [handwritten on green paper]; “Podismopsis keisti sp. n. det. Nadig” [typed on white card with “det. Nadig” printed]; “Holo-Typus” [printed on red card with “Holo-” handwritten]. Specimen set with right forewing spread and left forewing folded. There are six ♂ paratypes and 12 ♀ paratypes, one labelled as allotype, also present. Box Nadig 653.

*Podismopsis keisti* (Nadig, 1989)

**littoralis insubrica** Nadig, 1961: 275-278 [*Pholidoptera*].

Meride bei “Campagna” (TI). ♂ Holotype, 38 ♂ paratypes and 95 ♀ paratypes.

♂ Holotype with labels: “Meride (TI): “Campangna” [sic], 16.VII.60, 600 m, leg. Nadig” [handwritten by Nadig on white card with “Nadig” printed; the spelling of Meride is corrected in blue ink]; “Pholidoptera littoralis insubrica Nadig HOLOTYPE” [handwritten by Nadig on red card]; “Type” [printed on white card with printed red border]. A card mount with dissected genitalia glued to it is pinned in the insect box near the holotype and presumably belongs to it. The paratypes from the type locality are labelled as such, but the others are not; there 23 ♂ and 65 ♀ from the other localities mentioned in the original description also present. A pair of paratypes from the type locality is absent. Images on OSF. Box Nadig 156.

*Pholidoptera littoralis insubrica* Nadig, 1961

**melilae** Nadig, 1994: 980-982 [*Uromenus*].

Marokko, Melilla, Oued Kert. ♂ Holotype, 4 ♂ paratypes and 1 ♀ paratype.
♂ Holotype with labels: “Maroc 70 MA 70: 68, Oued Kert, SW Nador, 100-200 m, 10.7.70, leg. Nadig” [printed on white card with “68, Oued Kert, SW Nador 100-200 m 10.7.” handwritten by Nadig]; “MA 70 : 68 No. 1 (♂), Abd. Ende u. Titillat.” [typed on orange card with “♂” added by hand]; “U. melillae sp. n. ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-“ handwritten]. The right antenna, the tibia and tarsi of the left front leg, the tarsi of the right front leg and most of the tibia and the tarsi of the left middle leg are missing. Dissected genitalia are glued to a card mount secured on the original pin. The four ♂ paratypes and the ♀ paratype, labelled as allotype, are also present. Three ♂ from another locality (mentioned as “Weitere Exemplare” in the original description) have been erroneously labelled as paratypes. Images on OSF. Box Nadig 250.

_Uromenus melillae_ Nadig, 1994

**moulouyae** Nadig, 1995: 138-142 [Steropleurus].

_Maroc, Haute Moulouya. ♂ Holotype, 54 ♂ paratypes and 51 ♀ paratypes._

♂ Holotype with labels: “Maroc 68 MA 68: 57, Ob. Moulouya (S Zeida), 1450 m, 12.7.68, leg. Nadig” [handwritten by Nadig on white card with “Maroc 68 MA 68;” and “68 leg. Nadig” printed]; “MA 68 : 57 No. 6” [typed on a strip of white card]; “moulou, moulouyae sp. n. NADIG, 1995 ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-“ typed]. The right antenna, most of the left antenna and the tarsi of the left hind leg are missing. There are 53 ♂ paratypes and 50 ♀ paratypes, one labelled as allotype, also present in the collection. Images on OSF. Boxes Nadig 256 and 257.

_Uromenus moulouyae moulouyae_ (Nadig, 1995)

**moulouyae oumerrbiae** Nadig, 1995: 143-144 [Steropleurus].

_Maroc, zwischen Moulouya und Oued Serrou. ♂ Holotype, 6 ♂ paratypes and 1 ♀ paratype._

♂ Holotype with labels: “MAROC 70 MA 70: 130, Moyen Oum-Er-Rbia: Azrou-n-Âit-Lancem, 1720-1830 m, 29.7.-2.8.70, leg. Nadig” [printed on white card with “130” and “Azrou-n-Âit-Lancem 1720-1830 m” handwritten by Nadig]; “MIKROPH/ 1978: III: 19-23 ? Nº 1” [typed in red ink on squared white card with “? Nº 1” handwritten]; “moulouyae oumerrbiae ssp. n. NADIG, 1995 ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-“ typed]. There are dissected parts glued to a card mount secured on the original pin. The six ♂ paratypes and one ♀ paratype, labelled as allotype, are also present. Images on OSF. Box Nadig 257.

_Uromenus moulouyae oumerrbiae_ (Nadig, 1995)

**nerii picus** Nadig, 1981b: 625-628 [Uromenus].

_Haffouz, W Kairouan. ♂ Holotype, 3 ♂ paratypes, 6 ♀ paratypes and 1 immature paratype._

♂ Holotype with labels: “TUNISIA TU.77: 39 Haffouz, W Kairouan, 320 m, 11.6.77, leg. NADIG” [printed on white card]; “TU.77: 39 Steropl. spec. ♂ Nº 1
**Parasteropleurus nerii pictus** (Nadig, 1981)

*pedestris apuanus* Nadig, 1958: 31-37 [*Antaxius*].

Apuan Alps, Capriglia; Arni; Passo del Vestito. 6 ♂ syntypes, 6 ♀ syntypes and 1 immature syntype.

“Capriglia” handwritten]; “Antax. pedestris apuana ssp. n. ♂ det. Nadig” [typed in red on white card with “♀” added by hand and “det. Nadig” printed]; “Syntypus” [printed on red paper]. A ♀ syntype with labels: “Arni, Aug. 1957, Pisa-Masse (Nadig)” [printed on white card with “Arni” handwritten]; “Antax. pedestris apuana ssp. n. ♀ det. Nadig” [typed in red on white card with “♀” added by hand and “det. Nadig” printed]; “Syntypus” [printed on red paper]. Most of the right antenna, the tarsi of the right middle leg and the entire right hind leg are lost. A ♀ syntype with labels: “Capriglia, Aug. 1957, Pisa-Masse (Nadig)” [printed on white card with “Capriglia” handwritten]; “Ant. ped. ?” [typed on a strip of white paper]; “Antax. pedestris apuana ssp. n. ♀ det. Nadig” [typed in red on white card with “♀” added by hand and “det. Nadig” printed]; “Syntypus” [printed on red paper]. There are two juvenile ♀ specimens collected in 1956 but without precise localities one of which could be the immature syntype mentioned in the original description; Coray (2004) includes both in the type series. The original description states that a pair of syntypes was deposited in the MCSN. The date of the publication is given as 1959 on OSF. Images on OSF. Box Nadig 196.

_Antaxius pedestris apuanus_ Nadig, 1958

*sampeyrensis* Nadig, 1986: 224-227 [Chorthippus].

Italien, Cle. di Sampeyre. ♂ Holotype, 17 ♂ paratypes and 22 ♀ paratypes.

♂ Holotype with labels: “I: Piemonte 85: 62 Cle. di Sampeyre, Passhöhe, 2280-2300 m, 31.8.85, leg. NADIG” [printed on white card]; “85: 62 No. 2 (♂) Messungen” [typed on yellow paper with “♂” added by hand]; “Ch. Gl. sampeyrensis n. sp. NADIG ♂ det. NADIG” [printed on white paper]; “Holo-Typus” [printed on red card with “HOLO-” typed]. Specimen set with right forewing spread and left forewing folded. The right hind leg is glued to a card mount with “Z: 108?” handwritten on it and secured on the original pin. There are 12 ♂ and 17 ♀ paratypes, one labelled as allotype, also present. According to the original description a pair of paratypes was deposited in the collections of both Kurt Harz and Fer Willemsen; those in the Harz collection are in the MHNG, those in the Willemsen collection are in the RMNH. Boxes Nadig 814 and Harz 132b.

_Chorthippus sampeyrensis_ Nadig, 1986

*sardous* Nadig & Nadig, 1934: 18-19 [Euchortippus (sic)].

Sardinien, Gennargentu. ♂ Holotype, 1 ♂ paratype.

♂ Holotype with labels: “Gennargentu, Sard., 17.7.30, 1900, Ad. Nadig” [printed on white card with “1900” added by hand]; “Euchort. sardous n. sp. Nadig det. Nadig” [handwritten by Nadig with “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. Specimen set with left wings spread and right wings folded. The right antenna, left front leg, right middle leg and the tarsi of the right hind leg are lost. The ♂ paratype is also present. Box Nadig 825.

_Euchorthippus sardous_ Nadig, 1934

*silvae* Nadig, 1979a: 146-149 [Uromenus].

Maroc, J. Bou Iblane. ♂ Holotype, 6 ♂ paratypes, 3 ♀ paratypes and 2 immature paratypes.
Holotype with labels: “MAROC 70 MA 70: 85, Moyen Atlas Nord-Est, J. Bou Iblane, 2000-2500 m, S-Hang, 17./18.7.1970, leg. Nadig” [printed on white card with “85” and “2000-2500 m S-Hang” handwritten]; “U. (U.) silvae n. sp. NADIG ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. Dissected genitalia are glued to a card mount secured on the original pin. There are five ♂ paratypes, three ♀ paratypes, one labelled as allotype, and three immature paratypes present (presumably the most developed was counted with the males in the original description). The specimens from Tamtrouche mentioned in the original description are also in the MHNG. Images on OSF. Box Nadig 248.

Uromenus silvae Nadig, 1979

stigmaticus ketamensis Nadig, 1979b: 399-402 [Stenobothrus].

Maroc, Rif, Ebene von Ketama. ♂ Holotype, 116 ♂ paratypes and 95 ♀ paratypes.

Holotype with labels: “MAROC 70 MA 70: 81 Ketama, 1500 m, 14/15.7.70, leg. Nadig” [printed on white card with “81 Ketama 1500 m 14/15.7.” handwritten by Nadig]; “S. stigma. ketamensis NAD. ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]; “39 1,1 36 1: 42 1,16 48 1,3” [handwritten in pencil on squared paper]; “MIKROPHOTO : 71/III. 21-25, 71/V. 21-24” [typed in red on squared paper]. There is a further piece of squared paper with a sketched diagram and some figures. The left antenna, the last tarsal segment of the left front leg, the tarsi of the right front leg and the entire right hind leg are missing. There are 116 ♂ paratypes and 91 ♀ paratypes, one labelled as allotype, also present. Box Nadig 721.

Stenobothrus stigmaticus ketamensis Nadig, 1979


Holotype with labels: “I. San Remo 77 : 29, Mte. Bignone, 1100-1299 m, 19.8.77, leg. NADIG” [printed on white card]; “77 : 29 No. 1 ♂” [typed on a strip of white card with “♂” added by hand]; “E. caprai n. sp. ♂ det. NADIG” [typed on white card with “♂” added by hand and “det. NADIG” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. Most of the right antenna and the claws of the right front leg are missing. Dissected genitalia are glued to a card mount supported on the original pin. There are 16 ♂ paratypes, 10 ♀ paratypes, one labelled as allotype, and two immature paratypes also present. Images on OSF. Box Nadig 230.

Ephippiger terrestris caprai Nadig, 1980

tobogganensis Nadig, 1994: 984-988 [Uromenus].

Marokko, Tobbogan. ♂ Holotype, 9 ♂ paratypes and 6 ♀ paratypes.

Holotype with labels: “Maroc 68 MA 68: 35, Tobbogan, 1000 m, 1.7.68, leg. Nadig” [printed on white card with “35, Tobbogan 1000m, 1.7.” handwritten by Nadig]; “MIKROPH. Abd. -Ende, Titill./Pron. v. oben N° 1 (♂)” [typed on yellow
paper with “No 1 (♂)” handwritten; “U. tobboganensis sp. n. ♂ det. Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” handwritten]. The left front leg is missing. Dissected genitalia and the tarsi of the right hind leg are glued to a card mount secured on the original pin. The nine ♂ and six ♀ paratypes are also present. Images on OSF. Box Nadig 250.

Uromenus tobboganensis Nadig, 1994


Italien, Canavese, St. Elisabetta. ♂ Holotype, 25 ♂ paratypes and 38 ♀ paratypes.

♂ Holotype with labels: “I.: Piemonte: 85: 37. Canavese: St. Elisabetta, 1350 m, 25.8.85, leg. Nadig” [printed on white card]; “St. ursulae n. sp. ♂ det. NADIG” [printed on white card with “♂” added by hand]; “Holo-Typus” [printed on red card with “Holo-” typed]. Specimen set with right wings spread and left wings folded. The claws of the left hind leg are missing. There are 21 ♂ paratypes and 34 ♀ paratypes, one labelled as allotype, also present. According to the original description a pair of paratypes was deposited in the collections of Kurt Harz and Fer Willemse; the pair in the Harz collection could not be found in the MHNG, that in the Willemse collection is in the RMNH. Box Nadig 706.

Stenobothrus ursulae Nadig, 1986

vagans africanus Nadig, 1981a: 188-192 [Chorthippus].

Algerie, Grande Kabylie, Col Talmetz. ♂ Holotype, 17 ♂ paratypes and 21 ♀ paratypes.

♂ Holotype with labels: “Algerie ALG. 79: 63, Grande Kabylie: Col Talmetz, 1000 m, 18.7.79, leg. NADIG” [printed on white card]; “No. 3 (♂)” [typed on a strip of yellow paper with “♂” added by hand]; “Gl. vagans africanus ssp. n. NADIG ♂ det. Nadig” [photocopy on white paper]; “MIKROPHOTO 80/III, No. 8-I1, 81/1 No. 0-4” [typed in red on a strip of white card]; “Holo-Typus” [printed on red card with “Holo-” typed]. There is also a piece of card with various sketches and measurements on the pin. Specimen set with right wings spread and left wings folded. The right hind leg is glued to a card mount secured on the original pin. There are 15 ♂ paratypes and 15 ♀ paratypes, one labelled as allotype, also present. Labels in the insect box indicate that some paratypes were sent to Fer Willemse, whose collection is now in the RMNH. Box Nadig 809.

Chorthippus vagans africanus Nadig, 1981


Maroc, Haute Moulouya, Midelt. ♂ Holotype, 9 ♂ paratypes and 7 ♀ paratypes.

♂ Holotype with labels: “MAROC 70 MA 70: 52, Haute Moulouya: MIDELT, Fuss Tizi-n-Talrhemt, 1700 m, 3.7.70, leg. Nadig” [printed on white card with “52” and “MIDELT, Fuss Tizi-n-Talrhemt, 1700 m 3” handwritten by Nadig]; “MA 70 : 52 Nr. 1” [typed on a strip of white card]; “U. (ST.) vindti midelti ssp. n. NADIG ♂ det.
Nadig” [typed on white card with “♂” added by hand and “det. Nadig” printed]; “HOLO-Typus” [printed on red card with “HOLO-” typed]. The claws of the left hind leg are missing. There are dissected parts glued to a card mount secured on the original pin. The nine ♂ paratypes and seven ♀ paratypes, one labelled as allotype, are also present. Images on OSF. Box Nadig 258.

_Uromenus vindti midelti_ (Nadig, 1995)

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REFERENCES


First records of the order Siphonophorida from Madagascar and Mauritius (Diplopoda)

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First records of the order Siphonophorida from Madagascar and Mauritius (Diplopoda). - The first records of the colobognathan millipede order Siphonophorida from Madagascar and Mauritius are presented. Specimens representing both families of the order, Siphonophoridae and Siphonorhinidae, were discovered on Madagascar. The specimens were collected from 18 rainforest and montane rainforest localities using primarily the Winkler or Berlese extraction methods. The limited number of specimens (mostly less than 5) available from each site and the difficult taxonomic state of the order prevented the naming of any of the specimens. Specimens from one locality could be studied in more detail using SEM, and were tentatively determined as members of the Asian genus Siphonorhinus Pocock, 1894, presently known only from Asia. Four additional Siphonophorida samples representing at least two different species came from three localities on Mauritius, providing the first record of the order from the island. All Siphonophorida specimens should be carefully examined before taxonomic description attempts, as some might represent widespread tropical tramps.

Keywords: human introduction - rainforest - Siphonorhinidae - Siphonorhinus.

INTRODUCTION

With its 115 described species in an unknown number of genera (Jeekel, 2001), Siphonophorida is one of the least species-rich of the 16 orders of millipedes, class Diplopoda (Blanke & Wesener, 2014). The order includes not only the two leggiest millipede species (Illacme plenipes Cook & Loomis, 1928 with 750 legs, Siphonophora panamensis Loomis, 1961 with 742), but also those with the highest intraspecific segmental variation observed so far, a variation between 25 and 182 segments (Shelley & Hoffman, 2004; Read & Enghoff, 2009). The present concept divides Siphonophorida into two families, the more basal Siphonorhinidae, whose representatives still have discernible mouthparts (Attems, 1938; Fig. 1C), and the Siphonophoridae, whose representatives have a head that has been strongly modified into a sucking organ with a beak (= rostrum) and a very small opening. The majority of species in the order (104 of 115) belong to the Siphonophoridae.
The distribution of the order was recently reviewed (Shelley & Golovatch, 2011). Representatives of the order Siphonophorida inhabit the northern half of South America, Central America up to California and Texas, eastern South Africa, the Seychelles, Sri Lanka, the Himalayas, Southeast Asia, eastern Australia, New Zealand and several pacific islands. They are notably absent from Europe, northern Asia and Africa except for eastern South Africa. Here we report the first representatives from Madagascar and Mauritius.

Siphonophorida has been regarded as a taxonomist's nightmare (Hoffman, 1980) and received the hypothetical award for the least popular order of millipedes (Jeekel, 2001). It gained this reputation mainly because of the apparent lack of characters allowing generic- and species-level distinctions, and because of the huge number of insufficiently described species (including 48 nomina dubia in Siphonophora alone; Jeekel, 2001). The latter are often based only on one or a few specimens, mostly females. Descriptions of Siphonophorida species are difficult because, as representatives of the subclass Colobognatha (Blanke & Wesener, 2014), adult males continue to moult and grow, which leads to conspecific males of different sizes, showing a gradual development of the taxonomically important gonopods (Shelley & Hoffman, 2004).

There is little knowledge about the general morphology of the order, and that which exists is scattered (but see Hoffman, 1982; Read & Enghoff, 2009). Even basic questions regarding the absence or presence of defensive secretions and their potential chemical compositions remain unanswered.

The family Siphonorhinidae (with only 11 known species) will be relatively simple to revise, as recent integrative studies have been conducted (Marek et al., 2012). Siphonophoridae, despite an important revision (Shelley, 1996), remains nightmare. A first study of taxonomic characters of the Siphonophoridae was conducted recently (Read & Enghoff, 2009), but even though it included large series of two species and used scanning electron microscopy, no good taxonomic characters were discovered. The gonopods seem to be uniform, and setation seems to vary intraspecifically. The only characters that allow a distinction between species were the lengths of the beaks (= rostra), the colour, and length/width ratio, the latter of which is dependent on the size of the specimen.

With this in mind, and especially considering the possibility that some species of Siphonophoridae might be widespread tropical pests, the reader can understand why I currently refrain from naming any Malagasy forms, all of which are known only from at most a handful of specimens.

MATERIAL AND METHODS

ILLUSTRATIONS: Multi-layer photographs were taken of the specimens from Manjakatompo (MHNG Mad-89/21) with a Leica Z6 Imaging-System based at the ZFMK. Stacked images were put together using the software Auto-Montage (Syncroscopy). The specimen examined using scanning electron microscopy was carefully dissected under an Olympus SZX12 stereo-microscope with Dumont #5 Inox forceps. The samples were then dehydrated via an ethanol chain, mounted on stubs and dried overnight. The stub was sputter-coated with 100 nm of gold in a Hummer VI (Anatech, USA) sputtering system. Images were obtained using a Hitachi S-2460 SEM.
All images were later modified using Adobe Photoshop version CS2 and assembled onto plates using Adobe Illustrator version CS2.

**RESULTS**

**Specimens from Madagascar determined to genus-level**

*Siphonorhinus* sp.  

**Material examined:** MHNG Mad 89/21; 3 ♂, 2 ♀; Madagascar, Province Antananarivo, Ankaratra massif, Station Forestière Manjakatompo, près du sommet du Anosirivo, forêt primaire, prélèvement de sol dans une vieille souche, 1980 m; 26.xi.1989, leg. B. Hauser, extraction Berlese à Genève.

**Habitat:** The forest of Manjakatompo is one of the three last (99% has been destroyed) indigenous high plateau forests on Madagascar. It was planted by humans a few centuries ago, when it was still connected to now no longer existing fragments of pristine highland vegetation. It harbours rare and endemic genera and species of mammals, but lacks other faunal elements (such as lemurs) most likely due to the artificial origin of the forest and the lack of any fruit-bearing trees (Goodman et al., 1996).

**Remarks:** Largest specimen (male) about 11 mm long, 0.7 mm wide, with 61+1 segments. Colouration whitish orange (Fig. 1A). Only specimens of this species could be studied in more detail. While the author refrains from a formal description, the illustrated characters can be compared with those of properly revised species (Shelley & Hoffman, 2004; Marek et al., 2012) to allow a revision of the family in the future. This species is only tentatively placed in the genus *Siphonorhinus* Pocock, 1894, whose eight species occur in Indonesia, Vietnam, Cambodia, Laos and India (Jeekel, 2001). *Siphonorhinus* is characterized by an unmodified first leg in males where the coxa is fused to the sternite or stigmatic plate (Fig. 1B), by a pear-shaped head (Fig. 1C), and by the apical podomere of the posterior gonopod being divided into two branches lacking spines (Fig. 1D). In the South African genus *Nematozonium* Verhoeff, 1939 the posterior gonopods are different, with one of the branches wrapped around the second branch and with each of the branches carrying a spine (Shelley & Hoffman, 2004). The species of the other Asian genus, *Kleruchus* Attems, 1938 (originally assigned to the order Platydesmida), are much larger and wider, and feature thick modified first legs in males. The fourth genus, *Illacme* Cook & Loomis 1928, is known only from California, USA. It resembles the shorter species presented here, and features different, apically serrated posterior gonopods (compare Fig. 1D to Marek et al., 2012: fig. 6a).

**Specimens from Madagascar determined only to family level**

*Siphonorhinidae* Cook, 1895

The family Siphonorhinidae is characterized by a pyriform, subtriangular head that is not extended into a rostrum, devoid of macrosetae (Fig. 1C). Head with discer-
nable mouthparts, especially mandibles (Attems, 1938). Antennae bent between antennomeres 3 and 4, pits of sensory cones on articles 5 and 6 absent, only a field of sensilla basiciconica present (Fig. 1C). Containing 11 species grouped in four genera (Siphonorhinus, Illacme, Nematozonium and Kleruchus), distributed in California, South Africa and southeastern Asia (JeekeL, 2001).

**Material Examined:** FMNH-INS 4000; 1 ♀, 1 immature; Madagascar, Province Fianarantsoa, R. S. Ivohibe, 8 km east of Ivohibe, camp II, 22.4833°S, 46.9683°E, 1200 m, montane rainforest; coll. B. L. Fisher, 15.-21.x.1997, Winkler extraction. Remarks: Colouration light brownish white. Body densely pilose with long setae. – FMNH-INS 8012; 1 ♀; Madagascar, Province Toliara, Réserve Naturelle Intégrale d'Andohahela, parcelle 1, 20.0 km SE Andranondambo, 24.5617°S, 46.7217°E, 1875 m, montane rainforest; coll. S. M. Goodman, 27.xi.-05.xii.1995. Remarks: Colouration whitish, densely pilose, with short setae. – FMNH-INS 8036; 1 immature; same data as for FMNH-INS 8012. Remarks: Probably same species as FMNH-INS 8012. – FMNH-INS 8068; 5 ♀; same data as for FMNH-INS 8012. Remarks: 1 ♀ with eggs. Probably same species as FMNH-INS 8012. – FMNH-INS 8125; 1 ♀; Madagascar, Province Fianarantsoa, 40 km S Ambalavao, Rés. Andringitra, 22.2167°S, 46.9667°E, montane rainforest; coll. B. L. Fisher, 15.x.1993, Winkler extraction. Remarks: Colouration brown, with patches of white. Densely pilose with short setae.

**Siphonophoridae** Newport, 1844

Siphonophorida characterized by a head extended into a sharply acuminate 'beak' or rostrum, lower half of it formed by gnathochilium. Head with four macrosetae. Antennae straight, not elbowed, antennomeres 5 and 6 with large, conspicuous pit containing numerous sensory cones (Hoffman, 1982). Antennomere 2 of normal length. 104 species in ten genera distributed in America, SE Asia and the Indian subcontinent (including N Pakistan), Australia and New Zealand (JeekeL, 2001).

**Material Examined:** FMNH-INS 3978; 1 ♀; Madagascar, Province Antsiranana, R.S. Manongarivo, 20.4 km SW Antananarivo, 14.0467°S, 48.4017°E, 1860 m, montane rainforest; coll. B. L. Fisher, 03.xi.1998, Winkler extraction. Remarks: Colouration marbled greyish, body short and densely pilose. – FMNH-INS 4089; 1 ♀; Madagascar, Province Antsiranana, Befingotra (9.2 km WSW), Rés. Anjanaharibe-Sud, 14.7500°S, 49.4667°E, 1280 m, montane rainforest; coll. B. L. Fisher, 05.xi.1994, Winkler extraction. Remarks: Colour similar to FMNH-INS 3978.

**Specimens from Madagascar Only Determined to Order Level**

The following specimens were regretfully only sorted to order level. A re-examination of the listed specimens was not possible during the course of this study.

Siphonorhinus sp., MHNG Mad 89/21, two males, A = smaller male specimen, B-D = largest male specimen, multi-layer photograph and SEM. (A) Habitus, lateral view. (B) First and second legs, anterior view. (C) Head, lateral view. (D) Posterior gonopods and leg pair 10, anterior view. Abbreviations: L1 = leg 1; L2 = leg 2; L10 = leg 10; pG = posterior gonopod (= leg 9); St = sternite fused to stigmatic plate.

Potentially Province Toamasina, Ambodihatafana, 16.21666°S, 49.4333°E, 795 m, rainforest, now degraded. – MNHN “99”; more than 5 specimens; Madagascar, 1957, Ambila Lemaitso; fin vii.1957, P.A. Remy. Remarks: Potentially Province Toamasina, Ambila-Lemaitso / Andevoranto, 18.8167°S, 49.1333°E, 16 m, coastal rainforest, now degraded. – CAS BLF 7385; 1 specimen; Madagascar, Province Fianarantsoa, Forêt d’Analalava, 29.6 km W Ranohira, 22°35'30''S, 045°07'42''E, 700 m, tropical dry forest; coll. Fisher, Griswold et al., 1.-5.i.2003, yellow pan trap. Remarks: 1 d., black. – CAS BLF 10501; 7 specimens; Madagascar, Province Toamasina, Ambatovy, 18°51'03''S, 48°19'17''E, 1075 m, montane rainforest; coll. Malagasy ant team, 21.iii.2004, sifted litter (leaf mold, rotten wood). – CAS BLF 10502; 9 specimens; Madagascar, Province Toamasina, Analamy, 18°48'22''S, 048°20'13''E, 1068 m, montane rainforest; coll. Malagasy ant team, 21.iii.2004, sifted litter (leaf mold, rotten wood). Remarks: Elongated, whitish, small. – CAS BLF 10627 MW; numerous specimens; Madagascar, Toamasina, Torotorofotsy, 18°52'15''S, 48°20'51''E, 1070 m, montane rainforest, marsh edge; coll. Malagasy ant team 24.iii.2004, sifted litter (leaf mold, rotten wood). – FMNH-INS 3990; 1 specimen; Madagascar, Province Fianarantsoa, 8.0 km NE Ivohibe, camp IV, 22.4217°S, 46.8983°E, 1200 m, montane rainforest; coll. B. L. Fisher, 03.-09.xi.1997, pitfall traps. – FMNH-INS 3997; 1 specimen; Madagascar, Province Toliara, S.F. Mandena, 8.4 km NNE Tolagnaro, 24.9522°S, 47.0017°E, 20 m, littoral rainforest; coll. B. L. Fisher, 20.xi.1998, Winkler extraction. – FMNH-INS 13727; 3 specimens; Madagascar, Province Fianarantsoa, 38

**SPECIMENS FROM MAURITIUS ONLY DETERMINED TO ORDER LEVEL**


**DISCUSSION**

Siphonophorida are apparently widespread in the lowland rainforests and montane rainforests of Madagascar, having been collected from 18 sites spanning most of the humid biome on the island (Fig. 2). The existence of both families, Siphonorhinidae and Siphonophoridae, is a further indication of the natural occurrence of the order on Madagascar. Surprisingly, most of the studied specimens of both families seem to be relatively small and much shorter than the large and multisegmented record holders currently redescribed from South Africa (Shelley & Hoffinan, 2004) and North America (Marek et al., 2012). Siphonophorida, however, seem to be relatively rare and elusive on Madagascar, with only few individuals, always five or less, discovered per site, often by means of Winkler and Berlese extractions.

Although millipede inventories have been conducted on Mauritius (Verhoeoff, 1939, 1941; MAurië & Geoffroy, 1999), previously referred to as “Ile de France”, I here record for the first time the occurrence of the order Siphonophorida on the island. The Mauritius specimens come from at least three sites, belong to at least two different species and were found stored among the Madagascar material collected by P.A. Remy (Remy, 1956) at the MNHN. Because a relatively high number of introduced millipede species inhabit Mauritius (Maurië & Geoffroy, 1999), the possibility exists that one or two siphonophoridan tramp species may also have been spread by humans. An analogous situation is found in the siphonotid polyzoniidan *Rhinotus purpureus* (Pocock, 1894), which now occurs on most (all?) continents (Shelley, 1998; Wesener, 2014). The possibility of widely introduced siphonophoridans constitutes a good reason why new species in the order should be described only with careful illustrations of the male gonopods and other potentially taxonomically important characters in order to avoid synonyms.

Currently, there is only one established system for the Siphonophorida, the family-level division into Siphonophoridae and Siphonorhinidae which dates back to the 19th century. Anything below that systematic level is in its infancy. A proper taxonomic foundation is lacking. In the near future I hope to provide a more detailed morphological description of the family Siphonorhinidae based on the Malagasy *Siphonorhinus* species pictured here. Hopefully, once large series of specimens become available for study, the taxonomic characters of species and genera can be resolved on the basis of molecular data. This process has begun for the only American represen-
Fig. 2
Distribution of Siphonophorida localities on Madagascar.
tative (Marek et al., 2012). After taxonomic characters have been established, especially in the Siphonophoridae, the backlog (Jeekel, 2001) of old types can be re-examined and assessed. This would enable the description and naming of new species without the risk of creating additional synonymies.

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Current status of the Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 in Vietnam with implications for conservation measures

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**Current status of the Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 in Vietnam with implications for conservation measures.** - The Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 is a monotypic species, with a distribution range restricted to small and isolated areas in southern China and northern Vietnam. Habitat destruction and illegal poaching are the main causes of alarming population declines and even extinction of some wild populations in China. While the Chinese population was estimated to comprise only 950 individuals in 2004, the existing status of the Vietnamese population remains unknown, since its discovery in 2002. Our work provides the first estimation of the population size of *S. crocodilurus* in Vietnam, which is essential baseline data for future conservation strategies. Our field research revealed a dramatically small population size of less than 100 mature individuals. This value falls substantially below published threshold sizes of several thousand individuals, required for the long-term persistence of a species. Our research highlights the urgent need to improve the conservation activities for this species in its natural habitats and suggests means for a translocation program to restore (minimum viable sizes of) the wild populations in northern Vietnam.

**Keywords:** Population size - PIT tags - MVP - Conservation planning - Restoration - Southeast Asia - Yen Tu Mountain.

**INTRODUCTION**

The Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 (Fig. 1) is the only living representative of the monotypic family Shinisauridae and recognized as a true “living fossil” (Hu et al., 1984; Huang et al., 2008; Le & Ziegler, 2003; Zhao et al., 1999). The species has specific habitat requirements such as undisturbed rocky streams within the evergreen rainforests with a known geographic range restricted to few small and isolated areas in northern Vietnam and southern China (Huang et al., 2008; Le &
Fig. 1  

*Shinisaurus crocodilurus* in its natural habitat in Tay Yen Tu NR, Vietnam. Photo: M. van Schingen.

*Ziegler, 2003; van Schingen et al., 2014.* The Crocodile Lizard is threatened by extinction, with illegal poaching and habitat loss being recognized as the major threats to this species in China. Its resemblance to a crocodile makes it a desired target species on the international pet market and its reduced activity and low metabolism makes the species an easy prey of illegal poachers (Huang *et al.*, 2008; Le & Ziegler, 2003; Wang *et al.*, 2009). As a result *S. crocodilurus* is experiencing alarming population declines and even extirpation at some localities in China (Huang *et al.*, 2008). In 1990 the species was finally listed by the Committee on the International Trade in Endangered Species (CITES) on appendix II in an attempt to diminish the trade with the species and to minimize further population declines (Huang *et al.*, 2008). However, a study conducted in 2004 on the Chinese population concluded that only 950 individuals remained in the wild and revealed dramatic local declines of up to 90% in 25 years (Huang *et al.*, 2008). Today the populations of *S. crocodilurus* in China have likely declined even more, while the existing status of the Vietnamese subpopulation remains unknown since its discovery in 2002 (Le & Ziegler, 2003).

In Vietnam the species was reported from three different localities, all in areas with some degree of protection: Tay Yen Tu Nature Reserve (NR) in Bac Giang Province, and Yen Tu NR and Dong Son - Ky Thuong NR in Quang Ninh Province (Le & Ziegler, 2003; Hecht *et al.*, 2014; van Schingen *et al.*, 2014), being at least 10 km
apart from each other. All three sites are part of the last remaining contiguous lowland rainforest of Northeast Vietnam, which harbours a unique fauna not being found elsewhere in the country and which is zoogeographically related to southern China (Nguyen, 2011).

Appropriate estimations of the population size provide essential information for the classification of the threat level of a species and are crucial for wildlife management and management of the long-term survival of populations and species (Reed et al., 2003; Traill et al., 2007). Several studies support the notion that the size of the “minimum viable population” (MVP) is in reality much higher than the threshold sizes proposed by the IUCN and lie in the dimension of several thousand individuals (e.g., Reed et al., 2007; Traill et al., 2010).

This study includes a preliminary evaluation of the existing status of *S. crocodilurus* in Vietnam and provides information and evidence for the necessity of immediate conservation measures to protect this species in its natural habitat. Subsequently we provide recommendations for future conservation strategies of *S. crocodilurus*.

**METHODS**

*Study sites:* The surveyed sites were selected based on the previous discovery of three subpopulations of *S. crocodilurus* in Yen Tu NR, Uong Bi District, Quang Ninh Province (21°06’ - 21°11’N, 106°37’ - 106°43’E) in 2002; in Tay Yen Tu NR, Son Dong District, Bac Giang Province (21°09’ - 21°23’N, 106°38’ - 107°02’E) in 2010 and the recent discovery in Dong Son - Ky Thuong NR in Hoanh Bo District, Quang Ninh Province (21°05’ - 21°12’N, 106°56’ - 107°13’E) in 2013 (Le & Ziegler, 2003; Hecht et al., 2014; van Schingen et al., 2014), see Fig. 2. Tay Yen Tu and Yen Tu NRs are contiguous forest areas with Mount Yen Tu forming the highest peak (1068 m a.s.l.) and are linked in the East to the Dong Son - Ky Thuong NR by a forest corridor. The vegetation is dominated by evergreen broadleaf forest and intermixed with bamboo forest within the Dong Son - Ky Thuong NR. The study sites are part of the last remaining evergreen forest in Northeast Vietnam, which has been substantially cleared off from the eastern side of the Red River.

*Field survey:* Field surveys were conducted in June and July 2013, during the non-hibernation season of the Crocodile Lizard. Due to its strong association with lentic habitats and a diurnal life-mode, the riverine vegetation of selected rocky streams was sampled upstream during repeated night excursions between 6:45 and 10:30 pm, when animals were expected to rest on perches above the water. Captured animals were tagged and released on the exact same place on the following day between 12:00 am and 7:00 pm.

A total of 14 different stream transects were sampled, ranging from 515 to 3500 m in length. In the western side of the Yen Tu mountain range located within the Tay Yen Tu NR, six streams between elevations of 350-500 m a.s.l. were surveyed. On the eastern side of the Yen Tu range, four stream transects within the Yen Tu NR at elevations between 700-850 m a.s.l. and four streams in Dong Son - Ky Thuong NR at elevation between 200-350 m a.s.l. were surveyed. Coordinates and elevations of each captured individual were recorded with a GPS.
Map of the current distribution of Shinisaurus crocodilurus. Red dots represent occurrence records.

Based on snout vent-length (SVL), individuals were classified into three different age groups, viz. juvenile (SVL < 100 mm), subadult (100 mm ≤ SVL < 140 mm) and adult (SVL ≥ 140 mm). Injuries were recorded, with special attention to the caudal region that was used as a measure of multivariate stressors.

Tagging: For the long-term monitoring of population dynamics of the species, individuals were tagged with passive integrated transponder (PIT) tags. PIT tags are commonly applied both in studies of vertebrates and invertebrates (Smyth & Nebel, 2013). Its use has established as a safe and reliable method, with low mortality rates and virtually no implications on moving speed, growth rate and health of the animal (Keck, 1994; Smyth & Nebel, 2013). It is also recommended by CITES to identify captive-bred animals, and to monitor illegal harvests as well as the international trade of species at risk (Gibbons & Andrews, 2004).

A unique PIT tag (ISO FDX-B, 9 x 1.4 mm) was inserted under the skin on the left body side behind the shoulder of each captured individual. The puncture was closed with petrolatum. The functioning of all microchips had been tested earlier with a reader (Breeder Reader LC, Planet ID GmbH). Tagged individuals did not show any signs of injury resulting from the injection and were released within 24 hours of capture. Recaptures were identified and released immediately.

Calculation: The population size was estimated by applying a capture-recapture method modified for S. crocodilurus by Huang et al. (2008). Accordingly, we calcu-
lated an “invisibility rate” which was adopted for *S. crocodilurus* to compensate for animals present but not seen during the surveys. This method was selected to obtain comparable data to the estimates on the Chinese population. The calculation of the “invisibility rate” was based on three consecutive time surveys in intervals of 1-12 days within the Tay Yen Tu NR: \( N = \sum [n (1 + i)] \), where \( N \) is the total population size, \( n \) is the number of observed individuals along a stream transect and \( i \) is the “invisible rate” index: \( i = [\sum (b_n - a_n)] / \sum a_n \), where \( a_n \) is the number of observed individuals in the transect \( n \) during the first survey and \( b_n \) is the total number of observed individuals in transect \( n \). The transect \( n \) equals the surveyed stream.

**Statistical analyses:** Statistical analysis was performed with the program PAST (Hammer *et al.*, 2001). A \( \text{Chi}^2 \)-Test was applied to test for differences among age classes and the occurrence of injuries between different localities. Significant difference was declared for \( p < 0.05 \) (\( p < 0.05 = * \), \( p < 0.01 = ** \) and \( p < 0.001 = *** \)).

**RESULTS**

**Population size:** During the field research *S. crocodilurus* was found in seven different streams of three nature reserves. A total of 62 individuals were captured and 32 recapture events took place during the survey. Based on a calculated invisibility rate index of 1.35 the total population in Vietnam was estimated to comprise about 98 individuals, from which only 59 were considered to be mature (Tab. 1). The highest density of *S. crocodilurus* was found in Tay Yen Tu NR (28 individuals per km transect stream), while densities were lowest in Dong Son - Ky Thuong NR, ranging from 1 to 6 individuals per km transect stream (Tab. 2).

**Population structure:** The number of individuals capable of reproduction is crucial for the survival of the population and thus serves as measure to evaluate the endangerment of species (IUCN, 2013). *S. crocodilurus* reaches maturity at about three years (Yu *et al.*, 2009). The age is highly related to the animals size, whereby the snout-vent length proved to be the most appropriate measure corresponding to body size in lizards, as tails are prone to be injured (Meiri, 2010). A frequency histogram of the snout-vent length of captured *S. crocodilurus* revealed two maxima at 85 and 150 mm (Fig. 3A). This pattern shows that the wild population investigated in our study consisted of relatively high numbers of juveniles and young adults, but only of few subadults and big adults. A conspicuous reproduction success was observed in the Tay Yen Tu NR, related to the high proportions of juveniles, which represented 57.5% of this subpopulation (Fig. 4A). A significantly smaller success was reported in Yen Tu (8.3%) and in Dong Son - Ky Thuong (9.1%) NRs (\( \text{Chi}^2 = 19.31, \text{df} = 4, p = 0.0007; \) Fig. 4A). Taking into account the whole Vietnamese population, the number of adults and juveniles was represented with high percentages of about 47.6% and 39.7%, respectively, while subadults only contribute with about 12.7% (Fig. 4A).

Besides spatial differences in the population structure, high temporal fluctuations were also observed. In comparison to a previous field survey conducted by our team in June and July 2010 in Tay Yen Tu NR, the recent survey revealed: a more than tenfold increase in the number of juveniles; while the frequency of observed adults had almost doubled (\( \text{Chi}^2 = 8.591, \text{df} = 2, p = 0.0136; \) Fig. 4B).
A comparison of tail conditions among the three nature reserves showed that 25, 58 and 70% of the observed individuals from Tay Yen Tu NR, Yen Tu NR and Dong Son - Ky Thuong NR, had regenerated tails, respectively (Chi² = 8.036, df = 2, p = 0.018; Fig. 3B). The habitats within Dong Son - Ky Thuong NR were the closest to local villages, had the lowest elevations (200-350 m a.s.l.) and thus were more easy to access, in comparison to the other locations. Furthermore in this area the streams were broader, less vegetated and did not comprise as many waterfalls, backwater pools and shelters like in the other two reserves. The highest visual encounters of sympatric occurring reptiles such as the Waterdragon Physignathus cocincinus were also found within the habitat of S. crocodilurus in Dong Son - Ky Thuong NR.

CONSERVATION STATUS

Threats: The major threats to the population of S. crocodilurus in Vietnam are habitat loss and habitat alterations caused by intensive coal mining and illegal timber logging (Ziegler et al., 2008; pers. obs.). Coal-mining leads not only to fragmentation but also results in the contamination of the forest floor and forest streams, threatening the water-associated organisms (Fig. 6A). In Tay Yen Tu NR, the species’ habitat was seriously disturbed. The forest has been opened throughout the nature reserve in order to build roads and facilitate coal-mining (Fig. 6B). The mining area has been steadily expanding and meanwhile almost touched a stream habitat of S. crocodilurus. During one night survey in 2013, a huge hydraulic excavator was observed working in a distance of less than 50 m to a habitat stream of S. crocodilurus. In addition, huge parts of the forest have been cleared by slash and burn agriculture or have been harvested for the paper industry (Fig. 5). Habitat destruction was also hazardous in the Dong Son - Ky Thuong NR, caused in main parts by the activities of Hoanh Bo Forest Enterprise.

### Tab. 1. Estimated wild population size of Shinisaurus crocodilurus in Vietnam.

<table>
<thead>
<tr>
<th>Nature Reserve</th>
<th>Tay Yen Tu</th>
<th>Yen Tu</th>
<th>Dong Son - Ky Thuong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtotal mature (all)</td>
<td>20 (51)</td>
<td>17 (21)</td>
<td>22 (26)</td>
</tr>
<tr>
<td>Total mature (all)</td>
<td>59 (98)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Tab. 2. Abundances of observed Shinisaurus crocodilurus in Vietnam: Ad = adults, Sub = sub-adults, Juv = juveniles.

<table>
<thead>
<tr>
<th>Nature Reserve</th>
<th>Transect [m]</th>
<th>Ad_{obs}</th>
<th>Sub_{obs}</th>
<th>Juw_{obs}</th>
<th>Total_{obs}</th>
<th>Density_{obs} [Ind_{obs}/km]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tay Yen Tu</td>
<td>1</td>
<td>842</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1200</td>
<td>11</td>
<td>1</td>
<td>21</td>
<td>27.5</td>
</tr>
<tr>
<td>Yen Tu</td>
<td>1</td>
<td>514</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>8.036</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1600</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Dong Son - Ky Thuong</td>
<td>1</td>
<td>650</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3500</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>830</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Population structure of *Shinisaurus crocodilurus* in Vietnam. (A) Frequency histogram of snout-vent length of all encountered animals; (B) Frequency of individuals with original or regenerated tails for each nature reserve, $p < 0.05$. 

**Fig. 3**
Fig. 4
Distribution of different age classes of *S. crocodilurus* in Vietnam. (A) Frequency of observed juveniles, subadults and adults from three nature reserves, *p* < 0.001; (B) Frequency shift (of juveniles, subadults and adults) in Tay Yen Tu NR between 2010 and 2013, *p* < 0.05.
Fig. 5
Slash and burn practices in Tay Yen Tu NR, Vietnam. (A) example of forest fire; (B) burned area cleared for agricultural purposes or exploration by the paper industry. Photos: M. Bernardes & M. van Schingen.
(see also Birdlife International, 2004). The construction of logging roads throughout the Dong Son - Ky Thuong NR has facilitated illegal logging and increases the accessibility of almost all areas within the nature reserve (Tordoff et al., 2000). We could prove the observation of Tordoff et al. (2000) that hunting posed a severe threat to the biodiversity in Dong Son - Ky Thuong, as our interviews with local people showed that they indeed randomly collect amphibians and reptiles within the nature reserve as food source, and that Crocodile Lizards were collected for traditional medicine (Fig. 6C). Le & Ziegler (2003) already reported that illegal poaching for the pet trade threatens the Vietnamese population. Sold as “baby crocodile” for 100,000 to 200,000 Vietnam Dong (about 7-15 US Dollars), the Crocodile Lizard is a big seller especially among tourists. This observation agreed with our findings that Vietnamese specimens apparently also ended up in the international pet trade, as they are being offered already for sale in the internet (e.g., Doelle in lit., 2013; pers. obs.). The high demand for the species, especially in European countries immensely increases the hunting pressure on the wild populations.

DISCUSSION

The persistence of populations in the wild depends on the size of viable sub-populations and the exchange and speed of recolonization from nearby habitats, with particularly small and range-restricted populations being highly prone to extinction in various animal species (Hanski, 1991; Reed et al., 2003; Traill et al., 2007). In terms of the ongoing alarming global loss of biodiversity, guidelines to link extinction risk to population size have high priority in conservation biology (Lawton & May, 1995; Reed et al., 2003; Shaffer et al., 2002). The concept of a ‘minimum viable population’ (MVP; Shaffer, 1981) has been frequently applied in terms of species recovery and conservation management programs, with relevance to the IUCN Red List’s criteria concerning small and range-restricted populations (e.g., Clark et al., 2002; Reed et al., 2003; Traill et al., 2007, 2010). The MVP is defined as the smallest threshold size, which is required for a population or a species to have a predetermined probability of persistence for a given length of time (Reed et al., 2003; Shaffer, 1981). Experiments on isolated subpopulations revealed a local extinction of subpopulations with n < 50 and persistence with n > 50 individuals (Berger, 1990). With respect to reptiles and amphibians Traill et al. (2007) summarized MVPs ranging from 3611 to 6779 individuals and stated that MVPs generally lie in the range of several thousand individuals. Reed et al. (2003) concluded that a population size of at least 7000 adults in any vertebrate is required to cope with evolutionary and demographic constraints in the long-term. The population size of S. crocodilurus in Vietnam was preliminary estimated to comprise about 59 mature individuals and thus being dramatically smaller than the Chinese population with 950 estimated individuals in 2004 (Huang et al., 2008). The high incidence of juveniles, most concise within the Tay Yen Tu NR implies that the reproduction capability of the population is not entirely constrained by certain stressors, but rather secondary hazards as habitat degradation and poaching are assumed to limit the population persistence in the long-term, comparable to the Chinese population (Huang et al., 2008).
Main threats to *S. crocodilurus* in Vietnam. (A) Coal-mining exploration close to the species' habitat; (B) Opening of the forest with roads to facilitate coal-mining throughout the nature reserves; (C) Preserved *S. crocodilurus* in alcohol, used for traditional medicine in Quang Ninh Province. Photos: M. Bernardes & M. van Schingen.
The order of injuries in specimens differed among the three sites and was highest within the Dong Son - Ky Thuong NR. An unfavourable habitat structure, the occurrence of predators or competitors and human impacts might be potential reasons for higher rates of violated specimens in this reserve.

Furthermore, our study revealed that S. crocodilurus is strongly sedentary, as no migration between habitat streams in striking distance was proved within three years. In long-term view the restricted migration ability might reduce the gene flow and thus endanger the continuance of the species. The extremely small subpopulation sizes of about 20 mature individuals within each nature reserve make the species prone to fall into an extinction vortex (Gilpin & Soulé, 1986). Strong fluctuations within populations make them especially prone to extinction, even though populations generally underlie some level of fluctuations (e.g., Bjørnstad & Grenfell, 2002; Ranta et al., 2006). In this context our study revealed that the subpopulation from Tay Yen Tu NR had more than doubled from 2010-2013, including a more than 11-fold increase in the proportion of juveniles. This high incidence of juveniles was observed nowhere else in Vietnam. However, the duration of survival appeared strongly restricted as only one of 13 individuals, marked in 2010 was recaptured in 2013. Since S. crocodilurus reaches sexual maturity only after three years, the survival during this period is crucial for the maintenance of its populations (Zhang, 2006; Yu et al., 2009).

CONSERVATION MEASURES

**Habitat protection:** Based on the observation of various threats to the habitat of S. crocodilurus in Vietnam (e.g., continuously expanding coal-mining area in the direction of the habitat streams, habitat fragmentation from roads made for coal exploration and logging companies, forest clearance and natural forest fires), we strongly recommend a protection status elevation of the nature reserves in close collaboration with the authorities of the reserves. As many Crocodile Lizard populations are distributed outside or within the buffer regions of the NRs (van Schingen et al., 2014), an extension of the protected area network should be further considered. Apart from the protection of the macrohabitat, we recommend that at least the habitat streams need higher protection to enable the long-term persistence of the species. An agreement with the operators of local coal-mining companies is necessary to protect the minimum area required for the survival of the population, which would be feasible as the species is strongly sedentary and restricted to few specific streams (Ning et al., 2006; van Schingen et al., 2014). Roads, which are increasingly created throughout Tay Yen Tu and Dong Son - Ky Thuong NRs to facilitate coal-mining and timber logging (Tordoff et al., 2000; pers. obs.), should be directed around the habitat streams.

**Wildlife trade control:** To control the trade, an enhancement of the conservation status of S. crocodilurus by the assessment of the species for the IUCN Red List is recommended just as an upgrade of the CITES appendix. We also propose to include S. crocodilurus in the list of protected species in Vietnam. Illegal collections for the pet trade should be controlled by forest ranger stations through patrols at touristic sites like Tay Yen Tu and Yen Tu NRs. As S. crocodilurus is a habitat specialist (Ning et al., 2006; van Schingen et al., 2014; Wu et al., 2007), only occurring along specific streams, this measure would be feasible and effective. A public awareness campaign
(e.g., brochure, poster, signboard) should be conducted for local communities inside protected areas and within their buffer zones.

**Population restoration:** First molecular analysis of the extant subpopulations revealed no significant genetic difference (Ziegler *et al.*, 2008). However, a broader genetic analysis to evaluate the closer taxonomic relationships of the extant subpopulations is recommended, as discrepancies would have a strong impact on the risk of extinction of subpopulations or even different taxa and would require a drastic enhancement of the conservation status of *S. crocodilurus* in Vietnam. However, the estimated total population size (China: 950 + Vietnam: 59) already falls below reported threshold sizes in the magnitude of several thousand individuals, which is required for the persistence of a species over a longer period (Traill *et al.*, 2010). Based on our findings a translocation program of the species to restore the wild population, particularly in Vietnam, is urgently recommended. Translocation, defined as movement of living organisms from one area to another (IUCN), forms an important tool in wildlife conservation (Germano & Bishop, 2008). Repatriations of animals into their natural habitats were frequently combined with captive-breeding programs at zoological parks (Scott & Carpenter, 1987). A restoration program of a subpopulation of *S. crocodilurus* in China (Luokeng NR, Guangdong Province) was already initiated in 2004 (Zhang, 2006). In addition, Vietnamese specimens originating from Yen Tu NR were already successfully bred in captivity at the Me Linh Biodiversity Station in Vinh Phuc Province, which was established in cooperation of the Institute of Ecology and Biological Resources, Hanoi and the Cologne Zoo, Germany (e.g., Ziegler *et al.*, 2013). Those individuals would be suitable for restocking the wild population. A reintroduction should proceed after IUCN standards and based on studies on the species’ specific requirements. In addition, all captive bred specimens should be marked with PIT tags in order to monitor the development of introduced specimens and long-term population dynamics after the release to evaluate the restoration success. Moreover, tagging of wild individuals during the present study already provides a base for future long-term investigations of *S. crocodilurus* in Vietnam.

**ACKNOWLEDGEMENTS**

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NOTE ADDED IN PROOF
While the present paper was in press, the inclusion of the species into the IUCN Red List and the list of protected species of Vietnam took place.

Observations on *Hydractinia aculeata* (Hydrozoa, Cnidaria)

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**Observations on *Hydractinia aculeata* (Hydrozoa, Cnidaria).** - Two living colonies of the uncommon hydroid *Hydractinia aculeata* (Wagner, 1833) found in the Balearic Islands are described and depicted. The relationships to other similar hydactiniids producing medusoids are discussed. Partial sequences of the mitochondrial 16S RNA gene were determined in order to allocate the species to its correct genus within a recent classification scheme based on a molecular phylogeny of the family. The 16S sequences did not permit to associate the species to a known genus of this new classification because the lineage was rather distinct from all other genus-level clades. The species was thus left temporarily in the genus *Hydractinia*.

**Keywords:** Mediterranean - Hydractiniidae - hermit crabs - morphology - medusoid.

**INTRODUCTION**

*Hydractinia aculeata* (Wagner, 1833) is an endemic, uncommon Mediterranean hydroid living on shells of gastropods and hermit crabs. In spite of its well characterized morphology and recent re-description (Schuchert, 2008), modern illustrations are lacking. The present contribution therefore aims at illustrating the species based on living specimens, as well as discussing its relationships and taxonomy.

The generic subdivision of the family Hydractiniidae was traditionally based on the presence or absence of a medusa stage and the nature of the hydorhiza in the polyp stage (e. g. Bouillon, 1985). Species with free medusae were placed in the genus *Podocoryna*. Polyp colonies with normal, reticulate hydorhiza were assigned to the genus *Stylactaria*, while for those species in which the stolons coalesced into a crust-like hydorhiza the genus *Hydractinia* was used. This classification scheme was then abandoned after the studies of Bouillon *et al.* (1997) and Boero *et al.* (1998) showed that these characters are unsuitable to distinguish genera because it is not possible to draw unambiguous separation lines between the genera. The three genera were thus united in the single genus *Hydractinia*. Recently, the family Hydractiniidae has again been revised, this time based on extensive molecular phylogenies (Miglietta *et al.*, 2009, 2010, 2012). In these studies, the genus *Hydractinia*, as defined by Boero *et al.* (1998) or Bouillon *et al.* (2006), was split again into several genera. Notably, the previously well-established genus *Podocoryna* was re-validated and comprises hydractiniids producing medusae or medusoids. Also the genus *Stylactaria* was re-validated,

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Manuscript accepted 21.05.2014
but not based on the structure of the hydrorhiza, which was shown to be unsuitable for generic separations (but it may remain useful at the species level). The new classification is based entirely on DNA sequence data and many genera can in fact not be diagnosed using morphological characters alone. A similar situation is met with in at least another family of Anthoathecata, the Corynidae (Nawrocki et al., 2010), suggesting that the problem is not unique to the Hydractiniidae. Such molecular based genus diagnoses may pose problems for allocating new species to their correct genus. Likewise, for species like *H. aculeata* that were not included in the original molecular analyses, it may be not evident to what genus they actually belong. Therefore, partial mitochondrial 16S RNA gene sequences obtained from the present material were compared to all known hydractiniid sequences in order to clarify its position within the new classification of the Hydractiniidae.

**MATERIAL AND METHODS**

Two colonies on hermit crabs were collected near Cala Murada, Mallorca, Balearic Islands (39.4521°N 3.2782°E) on 1st and 2nd July 2010, in a depth of 2 to 3 m. The shells were obtained by combing with an open hand through *Peyssonnelia* algae. The specimen MHNG:INVE:71904 is a male colony on a 12 mm long nassariid shell inhabited by a hermit crab. The specimen MHNG:INVE:71907 is a female colony growing on a 14 mm long shell of *Pisania striata* (Gmelin) inhabited by a hermit crab tentatively identified as *Cestopagurus timidus* (Roux) using Ingle (1993). Both colonies were kept alive for observation, then preserved in formalin, and subsequently deposited in the invertebrate collection of the Natural History Museum of Geneva.

DNA from a few polyps was extracted from both colonies and a fragment of the mitochondrial 16S RNA gene was amplified and sequenced as described in Schuchert (2005). The new sequences have been deposited in the EMBL database under the registration numbers H9766224 and HG976625. They were compared to the complete set of hydractiniid 16S sequences (GenBank PopSet 188474499) provided by Miglietta & Cunningham (2012) using maximum likelihood trees as described in Schuchert (2014). A subset of these 16S data, comprising only European species, was used similarly to examine whether *H. aculeata* is genetically distinct from the other European hydractiniids for which 16S sequences are known.

**TAXONOMY AND RESULTS**

*Hydractinia aculeata* (Wagner, 1833)  
*Hydra ovipara s. aculeata* Wagner, 1833: 256, pl. 11 figs 1-10.  
*Stylactis aculeata*. – Bavestrello, 1985: 351, fig. 2.

**DIAGNOSIS:** Colonies growing on gastropod shells, hydrorhiza encrusting or stolonal, gastrozoooids 1.5-2 mm high, 12-14 tentacles in two close-set whorls, gonozooids smaller, 3-10 short tentacles, with mouth. Gonophores short-lived medusoids
Hydractinia aculeata, living colony from Mallorca. (A) Dorsal view of a hermit crab inhabited gastropod shell invested by hydroid colony (B) Portion of colony near shell aperture, showing gastro-, gono-, and tentaculozooids. The size of the shell is 14 mm.
with mature gonads, released or not, 20-36 eggs, no distinct tentacle bulbs, without or with 7-8 tentacle stumps.

**Description of Examined Material:** Colonies growing on different gastropod shells inhabited by the hermit crab *Cestopagurus timidus* (Roux) (Fig. 1). Hydrorhiza with varied structure, either stolonal (on the rugose nassarid shell) or forming a crust (on the smooth-walled shell); small spines present, smooth. Polyps polymorphic, comprising gastro-, gono-, and tentaculozooids. Colour of polyps yellow, female gonophores deep orange, male ones beige. All polyps without basal perisarc cup.

Gastrozooids 1.5-2 mm high when extended (Fig. 2B), with dome-shaped to slightly necked hypostome, covered by a dense band of contiguous nematocysts; 12-14 (rarely 18) tentacles in two close-set whorls. All tentacles held upwards, length differences less marked than in other hydactiniids.

Gonozooids resembling the gastrozooids and derived from them (Fig. 2D), comparatively smaller (ca. 1/3 their height), with mouth, and up to 10 shortened tentacles; in upper third of body one whorl of 1-3 medusa buds, buds globular to oblong, filled with gametes, radial canals and bulbs well visible. Mature, but still attached gonophores 0.8 mm long.

Tentaculozooids occur along the rim of the shell opening, slightly tapering, smaller than gastrozooids, coiling synchronously.

Gonophores short-lived medusoids that can be released (Fig. 2E) or that remain attached (Fig. 3). Liberated medusoids rather inactive, spherical to oblong, jelly moderately thick and even, exumbrella without nematocysts, velum present, no distinct perradial bulbs, with 7-8 tentacle stumps. Manubrium spanning about half the sub-umbrellar height, without mouth, surrounded by a very thick gonad without perralial interruptions, females with 30-36 eggs. Colonies dioecious.

Nematocysts:
- large microbasic heteronemes (Fig 4C-D) on hypostome, with faint swelling of shaft, size of native capsules (3.5-4.5)x(10-10.5)μm; the shaft in discharged capsules is variable and may appear either as characteristic for euryteles or for mastigophores;
- smaller microbasic euryteles on tentacles and body (Fig. 4B), size of native capsules (3-3.5)x(7-8)μm;
- desmonemes on tentacles and body (Fig. 4A), size of native capsules (3.5-4)x(6-7)μm.

**Biology:** Grows on various gastropod shells, inhabited either by molluscs or hermit crabs. For more details see Schuchert (2008).

**Distribution:** Mediterranean. Type locality: Trieste, Adriatic Sea.

**Phylogeny:** The two 16S sequences (583 base pairs long) obtained from the present material differ in only two positions. They were compared to the 16S sequences published by Miglietta & Cunningham (2012). A phylogenetic tree based on maximum likelihood analysis (HKY model, 100 bootstrap pseudoreplicates, not shown) did not associate *H. aculeata* with sufficient bootstrap support to any other species or clade. It is, however, well delimited from all other European species (Fig. 5).
DISCUSSION

The morphological and molecular data provided herein are intended to allow an easier, more reliable identification of *H. aculeata*. Although the description of Wagner (1833) is surprisingly precise and complete for its time (see reproduction of his figures in Schuchert, 2008), the species remains rather difficult to separate from a number of nominal taxa occurring in the Mediterranean and along the European Atlantic coast. Other medusoids producing *Hydractinia* species which have been reported in European waters are: *H. allmani, H. calderi, H. hooperii, H. inermis, H. pruvoti*, and *H. proboscidea* (comp. Schuchert, 2008). The most important distinguishing characters are the distribution and the type of substrate (Table 1).
<table>
<thead>
<tr>
<th>Species character</th>
<th>allmani</th>
<th>calderi (not alger)</th>
<th>hooperi</th>
<th>inermis</th>
<th>proboscidea (not calderi)</th>
<th>pruvoti</th>
<th>aculeata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Arctic Sea, northern Norway</td>
<td>western Mediterranean</td>
<td>western Atlantic</td>
<td>Mediterranean</td>
<td>north-eastern Atlantic</td>
<td>Mediterranean</td>
<td>Mediterranean</td>
</tr>
<tr>
<td>Hydorhiza</td>
<td>coalesced into crust, naked coenosarc on top</td>
<td>reticulate stolons</td>
<td>reticulate stolons</td>
<td>reticulate stolons</td>
<td>reticulate stolons or coalesced into crust</td>
<td>reticulate stolons or coalesced into crust</td>
<td></td>
</tr>
<tr>
<td>Substrate</td>
<td>gastropods</td>
<td>gastropods</td>
<td>gastropods</td>
<td>algae and other fixed substrates</td>
<td>rock, laminarian holdfasts</td>
<td>gastropod shells inhabited by molluscs or hermit crabs</td>
<td>gastropod shells inhabited by molluscs or hermit crabs</td>
</tr>
<tr>
<td>Spines</td>
<td>present</td>
<td>present</td>
<td>present</td>
<td>absent</td>
<td>absent</td>
<td>small or absent</td>
<td>present</td>
</tr>
<tr>
<td>Gastrozooid size [mm]</td>
<td>5-15</td>
<td>1-5</td>
<td>up to 25</td>
<td>1.5-6</td>
<td>up to 16</td>
<td>1-6</td>
<td>1.5-5</td>
</tr>
<tr>
<td>Tentacles of gastrozooids</td>
<td>10-16</td>
<td>20-40 in up to 3 whorls</td>
<td>up to 20 in one whorl</td>
<td>16-18 (max. range 12-22)</td>
<td>14-22 (max. range 10-32)</td>
<td>8-14 in 2 whorls</td>
<td>8-12 (max. range 5-18)</td>
</tr>
<tr>
<td>Tentacles of gonozooids</td>
<td>usually 4, range 0-6</td>
<td>2-14</td>
<td>6-8</td>
<td>6-16</td>
<td>6-12</td>
<td>1-2</td>
<td>3-7</td>
</tr>
<tr>
<td>Band of nematocysts on hypostome</td>
<td>yes</td>
<td>yes</td>
<td>?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Egg number per gonophore</td>
<td>up to 100</td>
<td>&gt;20</td>
<td>&gt;30</td>
<td>10-20</td>
<td>16-70</td>
<td>&gt;100</td>
<td>30-36</td>
</tr>
</tbody>
</table>
HYDRACTINIA ACULEATA

Fig. 3

_Hydractinia aculeata_, photo of an isolated gonozoid with attached medusoid after spawning (left), and incipient gonophore (right).

_Hydractinia almani_ Bonnevie, 1898 (now _Schuchertinia almani_) is an arctic to northern boreal species with much larger hydranths than _H. aculeata_. The 16S sequence data show that it is distinct from _H. aculeata_ (Fig. 5).

_Hydractinia calderi_ Bouillon, Medel, & Peña Cantero, 1997 (now _Bouillonactinia calderi_) was regarded as conspecific with _H. proboscidea_ in my earlier (2008) publication. However, _H. proboscidea_ is only known to occur on immobile substrata (see below), this in contradistinction to _B. calderi_ which grows on gastropod shells only. _Bouillonactinia calderi_ has large (5 mm) polyps with numerous tentacles (up to 40), which is significantly higher than noted for _H. aculeata_. Mediterranean material tentatively identified as _B. cf. calderi_ in the study of Miglietta & Cunningham (2012) proved to be distinct from _H. aculeata_ at the molecular level (Fig. 5). New, living animals and 16S data must be obtained of topotypical _B. calderi_ material for a more conclusive evaluation of its identity.

_Hydractinia hooperii_ (Siegerfoos, 1899) (now _Bouillonactinia hooperii_) was recorded once from the Mediterranean by Peña Cantero & García Carrascosa (2002). This is an American species and Schuchert (2008) assigned, with some reservation, the
Hydractinia aculeata from Mallorca, cnidome. (A) Desmonemes and small microbasic euryteles from tentacles. (B) Small microbasic euryteles; left undischarged, right discharged. (C) Large microbasic heteroneme from hypostome; left undischarged, right discharged. (D) Large microbasic heteronemes from hypostome.

Mediterranean record to H. proboscidea. According to the new data obtained here, it seems more likely that the Mediterranean records of B. hooperi belong actually to H. aculeata. The 16S sequences of the American H. hooperi were clearly distinct from the ones of H. aculeata (Fig. 5).
**HYDRACTINIA ACULEATA**

Molecular phylogeny of NE Atlantic and Mediterranean hydractiniids based on partial 16S sequences: maximum likelihood tree obtained with PhyML (HKY model), 100 bootstrap pseudo-replicates, node support values only given if >70%. The tree was rooted using an outgroup, but the outgroup branch is shown shortened for clarity reasons. The numbers preceding the species names are the EMBL/Genbank accession numbers of the corresponding sequences.

*Hydractinia inermis* (Allman, 1872) (now *Stylactaria inermis*) can release medusoids with eight rudimentary tentacles, although the medusoids are sometimes retained on the gonozooids (pers. comm. Ivona Onofri, Dubrovnik). The species differs from *H. aculeata* in its substrate specificity, as it occurs only on non-mobile substrates like algae, sponges, rocks, barnacles etc. It also lacks spines and the hydrorhiza is never encrusting. The 16S data confirmed that it is distinct from *H. aculeata* (Fig. 5).

*Hydractinia proboscidea* (Hincks, 1868) is a very rare species only known from the Atlantic coast of Europe. It resembles closely *H. aculeata* but occurs on non-mobile substrates, like rocks and laminarian holdfasts. It differs additionally in having a stolonal hydrorhiza and the lack of spines. As for *H. calderi*, new, living material and 16S data must be obtained for a more conclusive taxonomic evaluation of this species.
*Hydractinia pruvoti* Motz-Kossowska, 1905 (now *Podocoryna pruvoti*) is easily separable as its gonozooids have one, occasionally two, tentacles only. The 16S data confirmed that it is distinct from *H. aculeata* (Fig. 5).

The 16S sequence data did not permit to assign *H. aculeata* reliably to a genus of the new classification introduced by Miglietta & Cunningham (2012). The 16S sequence alone is insufficient to resolve the genus clades (see Miglietta *et al.*, 2009). *Hydractinia aculeata* did also not cluster with convincing support with any of the other analyzed species, which would have allowed assigning it to the same genus. Additional, nuclear gene sequences are thus necessary to solve this issue. However, determining complete 18S and 28S gene sequences is much more costly than 16S sequences and may be beyond the capabilities of many institutions. This makes the new system rather cumbersome for all species which were not included in the original analyses. Likewise, it may prove to be difficult for some newly discovered hydractiniid species to assign them to the correct genus in the absence of 18S and 28S sequence information.

For the time being, *Hydractinia aculeata* is therefore left in the genus *Hydractinia*, a taxon which should be used as the default genus for all hydractiniids with unresolved genus affiliation.

The sequence data can also be used to examine if they permit to delimit *H. aculeata* from other European hydractiniids using a barcoding approach (Hebert *et al.*, 2003). The resulting tree (Fig. 5) confirms that the present samples of *H. aculeata* are easily separable from *Sch. allmani*, *B. calderi*, *B. hooperi*, *P. pruvoti* and *St. inermis*.

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Editorial Announcement: New format and reduction of subscription prices for 2015

ERNST, Nicole, SCHMITZ, Andreas, CHAI, Norin, RIGOULET, Jacques, BURGEOS, Aude, KOHL, Muriel, HANO, Christelle & INEICH, Ivan. An unexpected occurrence - a case study on an intergeneric hybrid in giant snakes

MAKRANCZY, György. The Far Eastern species of Thinobius Kiesenwetter, 1844 (Coleoptera: Staphylinidae, Oxytelinae) lacking female modified genital appendage

PUTHZ, Volker. Edaphus von Japan (Coleoptera: Staphylinidae) 118. Beitrag zur Kenntnis der Euaesthetinen

DUTTO, Moreno & SABATINELLI, Guido. Nouvelles indications de Cetoniiinae (Coleoptera: Scarabaeidae)

DANKITTIPAKUL, Pakawin & SINGTRIPOP, Tippawan. New species and new records of the spider genus Otacilia Thorell, 1897 (Araneae, Corinnidae) from Southeast Asia

de ROUGEMONT, Guillaume. Two new species of Pseudolathra Casey from Borneo (Coleoptera, Staphylinidae, Paederinae)

HOLLIER, John. An annotated list of the Orthoptera (Insecta) species described by Adolf Nadig with an account of the type material housed in the Muséum d’histoire naturelle de Genève

WESENER, Thomas. First records of the order Siphonophorida from Madagascar and Mauritius (Diplopoda)

van SCHINGEN, Mona, THE PHAM, Guong, AN THi, Hang, BERNARDES, Maria, HECHT, Vera, NGUYEN, Truong Quang, BONKOWSKI, Michael & ZIEGLER, Thomas. Current status of the Crocodile Lizard Shinisaurus crocodilurus Ahi, 1930 in Vietnam with implications for conservation measures

SCHUCHERT, Peter. Observations on Hydractinia aculeata (Hydrozoa, Cnidaria)
Editorial Announcement: New format and reduction of subscription prices for 2015 ................................................................. 291

ERNST, Nicole, SCHMITZ, Andreas, CHAI, Norin, RIGOLET, Jacques, BURGEOIS, Aude, KOHL, Muriel, HANO, Christelle & INEICH, Ivan. An unexpected occurrence - a case study on an intergeneric hybrid in giant snakes ................................................................. 293-317

MAKRANCZY, György. The Far Eastern species of Thinobius Kiesenwetter, 1844 (Coleoptera: Staphylinidae, Oxytelinae) lacking female modified genital appendage ................................................................. 319-347

PUTHZ, Volker. Edaphus von Japan (Coleoptera: Staphylinidae) 118. Beitrag zur Kenntnis der Euaesthetinen ................................................................. 349-378

DUTTO, Moreno & SABATINELLI, Guido. New findings of Cetoniinae (Coleoptera: Scarabaeidae) for Arabian Peninsula ................................................................. 379-381

DANKITIPAKUL, Pakawin & SINGTRIPOP, Tippawan. New species and new records of the spider genus Otacilia Thorell, 1897 (Araneae, Corinnidae) from Southeast Asia ................................................................. 383-394

de ROUGEMONT, Guillaume. Two new species of Pseudolathra Casey from Borneo (Coleoptera, Staphylinidae, Paederinae) ................................................................. 395-399

HOLLIER, John. An annotated list of the Orthoptera (Insecta) species described by Adolf Nadig with an account of the type material housed in the Muséum d’histoire naturelle de Genève ................................................................. 401-414

WESENER, Thomas. First records of the order Siphonophorida from Madagascar and Mauritis (Diplopoda) ................................................................. 415-423


SCHUCHERT, Peter. Observations on Hydractinia aculeata (Hydrozoa, Cnidaria) ................................................................. 441-451

Indexed in CURRENT CONTENTS, SCIENCE CITATION INDEX
PUBLICATIONS DU MUSEUM D'HISTOIRE NATURELLE DE GENÈVE

CATALOGUE DES INVERTEBRES DE LA SUISSE, NOS 1-17 (1908-1926) ....... série Fr. 285.—
(prix des fascicules sur demande)

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R. L. Hoffm an, 237 p., 1979 ............................................ Fr. 30.—

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P. Géroudet, C. Guex & M. Maire
351 p., nombreuses cartes et figures, 1983 ................................................. Fr. 45.—

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M. Jangoux, 67 p., 1985 .................................................. Fr. 15.—

RADULAS DE GASTÉROPODES LITTORAUX DE LA MANCHE (COTENTIN-BAIE DE SEINE, FRANCE)
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O. SCHMIDT SPONGE CATALOGUE
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A DOCUMENTED FAUNAL LIST
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Editorial Announcement: New format and reduction of subscription prices for 2015.......................................................... 291

ERNST, Nicole, SCHMITZ, Andreas, CHAI, Norin, RIGOULET, Jacques, BURGEOIS, Aude, KOHL, Muriel, HANO, Christelle & INECH, Ivan. An unexpected occurrence - a case study on an intergeneric hybrid in giant snakes .......................................................... 293-317

MAKRANCZY, György. The Far Eastern species of Thinobius Kiesenwetter, 1844 (Coleoptera: Staphylinidae, Oxytelinae) lacking female modified genital appendage .................................................................................... 319-347

PUTHZ, Volker. Edaphus von Japan (Coleoptera: Staphylinidae) 118. Beitrag zur Kenntnis der Euaesthetinen .......................................................... 349-378

DUTTO, Moreno & SABATINELLI, Guido. New findings of Çetoniinae (Coleoptera: Scarabaeidae) for Arabian Peninsula .......................................................... 379-381

DANKITTIPAKIJ, Pakawin & SINGTRIPOP, Tippawan. New species and new records of the spider genus Otacilia Thorell, 1897 (Araneae, Corinnidae) from Southeast Asia .................................................................................... 383-394

de ROUGEMONT, Guillaume. Two new species of Pseudolathra Casey from Borneo (Coleoptera, Staphylinidae, Paederinae) .......................................................... 395-399

HOLLIER, John. An annotated list of the Orthoptera (Insecta) species described by Adolf Nadig with an account of the type material housed in the Muséum d’histoire naturelle de Genève .................................................................................... 401-414

WESENER, Thomas. First records of the order Siphonophorida from Madagascar and Mauritius (Diplopoda) .......................................................... 415-423


SCHUCHERT, Peter. Observations on Hydractinia aculeata (Hydrozoa, Cnidaria) .......................................................... 441-451

Indexed in CURRENT CONTENTS, SCIENCE CITATION INDEX