

Two new species of the genus *Cricula* WALKER, 1855 from Myanmar and India, with synonymic notes (Lepidoptera: Saturniidae)

Stefan NAUMANN and Swen LÖFFLER

Dr. Stefan NAUMANN, Hochkirchstrasse 11, D-10829 Berlin, Germany; sn@saturniidae.com

Swen LÖFFLER, Hospitalgasse 7, D-09350 Lichtenstein/Sachsen, Germany; swen.loeffler@t-online.de

Abstract: Two new species of the South-East Asian genus *Cricula* Walker, 1855 are described as new: *C. tremula* sp. n. from western Myanmar (Chin), and *C. gandhii* sp. n. from northern India (Arunachal Pradesh). The male holotypes, male genitalia structures and females are figured in colour. Both holotype specimens will be presented to the entomological collections of the Museum für Naturkunde at Humboldt-University of Berlin, Germany. A short list of revised synonymies within the genus *Cricula* is given at the end of the paper.

Key words: Saturniidae, *Cricula*, new species, Myanmar, India, synonymies.

Zwei neue Arten der Gattung *Cricula* WALKER, 1855 aus Myanmar und Indien, mit Anmerkungen zur Synonymie (Lepidoptera: Saturniidae)

Zusammenfassung: Zwei neue Arten der südostasiatischen Gattung *Cricula* WALKER, 1855 werden als neu beschrieben: *C. tremula* sp. n. aus Westmyanmar (Chin) und *C. gandhii* sp. n. aus Nordindien (Arunachal Pradesh). Die männlichen Holotypen, die Genitalstrukturen und die zugehörigen Weibchen werden farbig abgebildet. Beide Holotypen gelangen in die entomologischen Sammlungen des Zoologischen Museums an der Humboldt-Universität zu Berlin. Am Ende der Arbeit wird eine kurze Liste mit aktualisierten Synonymien innerhalb der Gattung *Cricula* präsentiert.

Introduction

The genus *Cricula* was described by WALKER (1855); its type species (by monotypy) is *Saturnia trifenestrata* HELFER, 1837. Major works on the genus were those provided by JORDAN (1909), ROEPKE (1940) and NÄSSIG (1989); the latter author produced a revision of the genus in his [unpublished] PhD thesis (NÄSSIG 1995) on basis of the then existing knowledge of the genus. Since then, many more species and subspecies were introduced into science by PAUKSTADT & PAUKSTADT (2009, 2010), NAUMANN & LÖFFLER (2010), BRECHLIN (2010), NAUMANN & LANE (2010), NÄSSIG & TREADAWAY (2011) and others. The morphological aspects used for specific diagnoses were partly supported by results found in the BOLD project of the University of Guelph, Canada (see RATNASINGHAM & HEBERT 2007, BOLD 2013) by using our material sent there for mt-DNA COI barcode analysis. In the present paper two further species are described as new within the genus *Cricula*: One description is based mainly on morphological characters and, as a very important differential criterion, on adult behaviour of the ♂ moth in its habitat in Chin State, western Myanmar. The second species draw our attention when we received the results of the barcoding process. The Indian specimens were formerly included in the type series of another species,

C. aungsansuukyia NAUMANN & LÖFFLER, 2010, from northern Myanmar but now are dealt with as a separate species due to their placing within the Neighbor Joining and Minimum Evolution trees calculated from mtDNA base sequences plus some details in morphology.

The terms describing genitalic structures follow ROEPKE (1940) and NÄSSIG (1995).

Abbreviations and acronyms

BC [no.]	Barcode [with number].
BMNH	The Natural History Museum, London (formerly: British Museum [Natural History]).
CMWM	Collection Museum T. WITT, München.
CRBP	Collection R. BRECHLIN, Pasewalk.
CSLL	Collection Swen LÖFFLER, Lichtenstein/Sachsen, Germany.
CSNB	Collection Stefan NAUMANN, Berlin, Germany.
CULP	Collection U. + L. H. PAUKSTADT, Wilhelmshaven.
CWAN	Collection W. A. NÄSSIG, now in SMFL.
GP [no.]	Genitalia dissection [with number].
SMFL	Senckenberg-Museum, Frankfurt am Main, Lepidoptera collection.
ZMHU	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

Description of the new *Cricula* species

Cricula tremula sp. n.

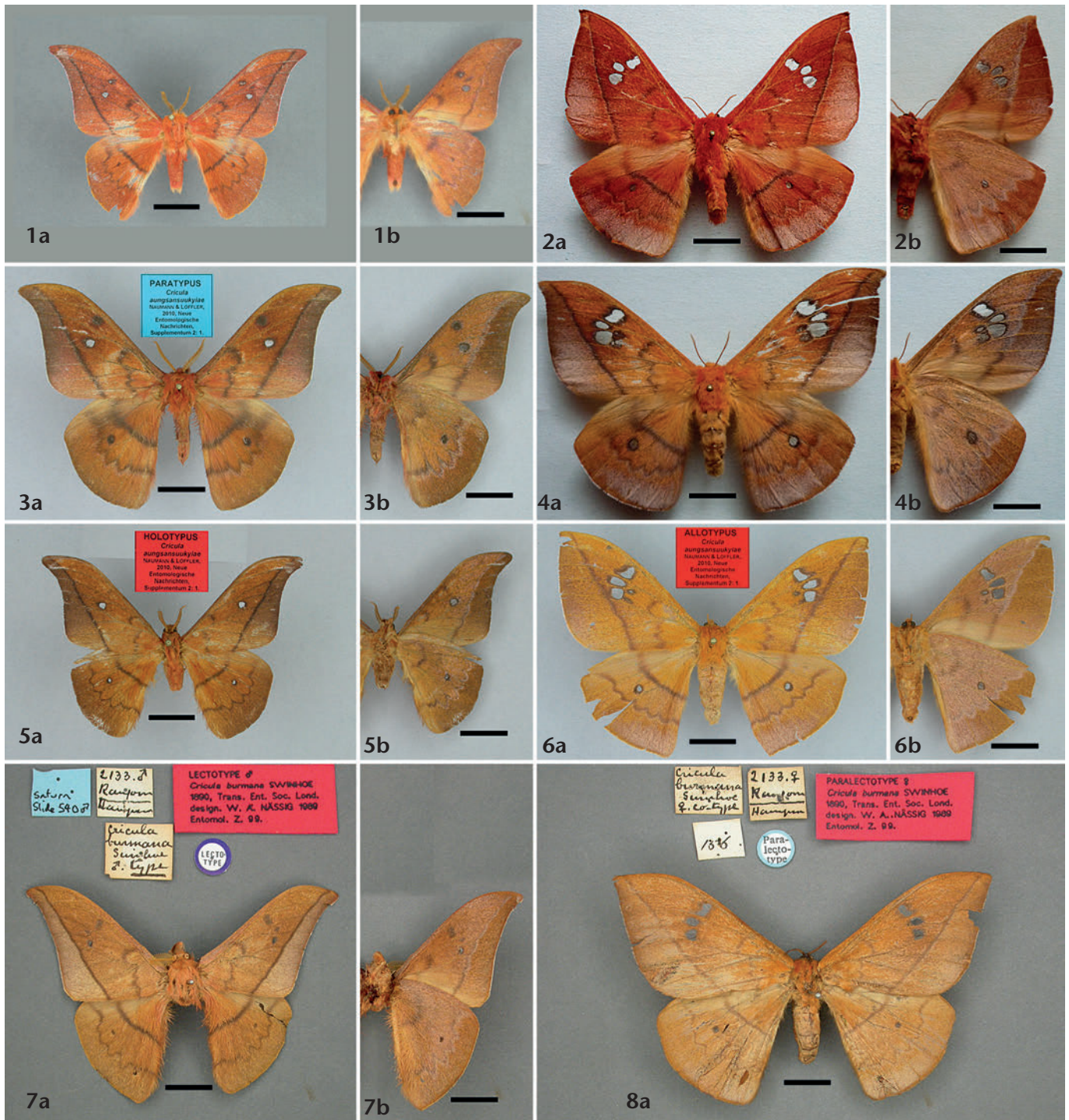
Holotype ♂ (Figs. 1a–b, 9–10): Myanmar (West), Chin State, Mindat town guesthouse, near police station, 21° 22.315' N, 93° 58.601' E, 1453 m, 22. v. 2012, 0.30 h, leg. S. NAUMANN & S. LÖFFLER, GP 2305/12 NAUMANN, BC SNB 4883; CSNB. A red holotype label will be fixed accordingly. The holotype will be deposited in the collections of Museum für Naturkunde der Humboldt-Universität Berlin, Germany.

Paratypes (in total 3 ♂♂, 1 ♀; all Myanmar): 2 ♂♂, same data as holotype, CSLL. 1 ♀, Chin State, Natma Taung N.P., Mindat, Kall Nue, 21° 22.314' N, 93° 58.611' E., 1457 m, 13. VIII. 2007, leg. P. SPONA, S. LÖFFLER & T. IHLE, BC SNB 1209; CSLL. 1 ♂, Magway [Magwe] State, rd. Padaukaing-Ngabyin, Kyetyo Pass, 21° 88.911' N [sic!], 94° 41.589' E, secondary forest, 850 m, 30. VI. 2005, leg. M. HOFFMANN, GP 1285/05 NAUMANN, BC SNB 1210; CSLL.

Etymology: The species is named after its unusual flight behaviour and wing movements which are very slowly fluttering and almost geometrid-like: TREMULUS, -A, -UM [LATIN] = trembling or quivering.

Diagnosis

A relatively small species, ♂♂ dark reddish brown, with falcate, very elongate forewing apex, white outer margin of the forewing and two or three forewing fenestra. The



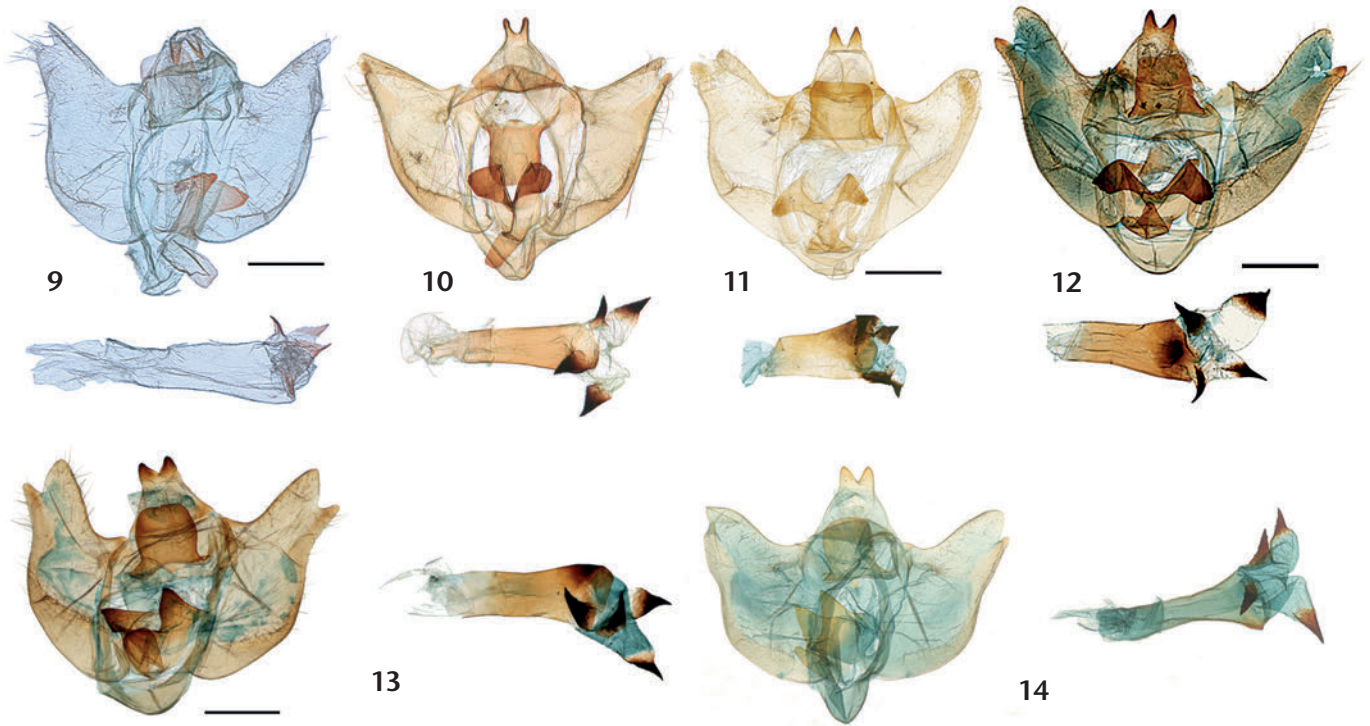
Figs. 1–8: Specimens of *Cricula*. a = upperside [dorsal view], b = underside [ventral view]. — **Figs. 1a/b:** *C. tremula* sp. n., Myanmar, Chin State, ♂ holotype, CSNB, to be deposited in ZMHU. **Figs. 2a/b:** *C. tremula* sp. n., Myanmar, Chin State, ♀ paratype, CSLL. — **Figs. 3a/b:** *C. gandhii* sp. n., ♂ holotype, India, Arunachal Pradesh, CSNB, to be deposited in ZMHU. **Figs. 4a/b:** *C. gandhii* sp. n., ♀ paratype, India, Arunachal Pradesh, CSLL. — **Figs. 5a/b:** *C. aungsansuukyiae*, ♂ holotype, Myanmar, Sagaing State, dorsal view, CSNB, to be deposited in ZMHU. **Figs. 6a/b:** *C. aungsansuukyiae*, ♀ paratype (“allotype”), Myanmar, Kachin State. — **Figs. 7a/b:** *C. trifenestrata burmana*, ♂ lectotype, Myanmar, Yangon, BMNH. **Fig. 8a:** *C. trifenestrata burmana*, ♀ paralectotype, Myanmar, Yangon, BMNH. — All specimens approximately to the same scale, scale bar = 1 cm. — Photos Figs. 1, 3, 5–8: S. NAUMANN; Figs. 2, 4: S. LÖFFLER.

single known ♀ intensive dark reddish brown, lower parts of postmedian area with light violet shadow, forewing, as far as known from only one specimen, with three large fenestra, and a little black spot in the apex.

Description

♂♂ (Figs. 1a–b): Forewing length, measured from basis to apex, 29–32 mm (holotype 29 mm). The forewings are quite elongated, with an apical tip bent outward.

Antennae 7 mm long, longest rami 1.3 mm, with 19 segments in total, quadripectinate up to the last 4 segments; of ochreous brown colour. The dorsal side including head, thorax and abdomen of homogenous dark reddish brown ground colour with following dark greyish markings: the forewing has a zigzag-shaped antemedian line and an almost straight postmedian line, ending in the costal margin about 2 mm in front of the apical tip. The hindwing has an almost straight antemedian line and a



Figs. 9–14: ♂ genitalia structures of *Cricula*. Fig. 9: *C. tremula* sp. n., holotype, GP 2305/12 SNB. Fig. 10: *C. tremula* sp. n., paratype, GP 1285/05 SNB. — Fig. 11: *C. gandhii* sp. n., paratype, GP 2051/09 SNB. — Fig. 12: *C. aungsansuukyiae*, holotype, GP 2108/09 SNB. Fig. 13: *C. aungsansuukyiae*, paratype, GP 2109/09 SNB. — Fig. 14: *C. trifenestrata burmana*, lectotype, GP B.M. Sat. no. 540. — Genitalia approximately to the same scale; scalebar (where present) = 1 mm. — Scans: Fig. 9: W. ECKWEILER; Fig. 10: U. BROSCHE; Figs. 11–13: J. RUDLOFF; Fig. 14: A. GIUSTI (BMNH).

zigzag postmedian line. There are two or three fenestra on each forewing, a larger lower one, a small costal one which is surrounded by a grey patch, and in some specimens a very tiny one in between the two others. The hindwing has one very small fenestrum circled with a wide grey ring. Both fore- and hindwings have a row of marginal white fringes. The ventral side of same colour, the antemedian lines less indicated, and the postmedian lines followed by a violet shadow of scales.

♂ genitalia (Figs. 9–10): Uncus strongly sclerotised, with two slender lateral processes and deeply rounded furcation. Gnathos almost rectangular. Juxta with two lateral lobe-like, rounded processes and a ventral tongue-like sella. There are two slender and acute dorsal processes of the valves, the sacculus is broad, the saccus short and rounded. The phallus is relatively long, the vesica is short and has four bulbs with one sclerotised acute spine each on their tops, the two ventral ones being the longest.

♀ (Figs. 2a–b): Generally, there are mainly sexually dimorphic characters by which the ♀ differs from the ♂♂; but in general, it is also more colourful. Forewing length, measured from basis to apex, 34 mm, the forewings are rounded, with a short apical tip bent outward, with a tiny black dot. Antennae 5.8 mm long, bipectinate, of orange brown colour. The dorsal side including head, thorax and abdomen similar to males in dark reddish brown ground colour, but suffused with whitish-violet scales in the fore- and hindwing postmedian areas and the lower median area of the hindwing, and again with the typical dark greyish markings as in ♂♂. The forewing with three larger fenestra, the hindwing with one small fenestrum

circled with a narrow grey ring. The ventral side widely suffused with whitish scales, the only portions in ground colour are the costal forewing antemedian area and the apical fore- and hindwing postmedian areas. The lower hindwing postmedian area is almost completely coloured in light whitish violet colour.

Cricula gandhii sp. n.

Holotype ♂ (Figs. 3a–b): India (NE), Arunachal Pradesh, Dist. Along, near Rapum, 2000 m, 28.53176° N, 94.24941° E, 9.–11. v. 2009, leg. G. BRETSCHNEIDER, material received in exchange from Swen LÖFFLER III. 2010; Paratypus *Cricula aungsansuukyiae* NAUMANN & LÖFFLER, 2010, Neue Entomologische Nachrichten, Supplementum 2: 1 [blue]; CSNB. A red holotype label will be fixed accordingly. The holotype will be deposited in the collections of Museum für Naturkunde der Humboldt-Universität Berlin, Germany.

Paratypes (Figs. 4a–b) (in total 8 ♂♂, 1 ♀; all India, Arunachal Pradesh; all paratypes of *Cricula aungsansuukyiae* with blue paratype labels: Paratypus *Cricula aungsansuukyiae* NAUMANN & LÖFFLER, 2010, Neue Entomologische Nachrichten, Supplementum 2: 1; all specimens will receive additional blue paratype labels for the taxon *gandhii*): 8 ♂♂, same data as holotype, one of them with GP 2051/09 NAUMANN, BC SNB 1564; CSLL. 1 ♀, Dist. Monigong, near Pidi, 1650 m, 28.37601° N, 94.21316° E, 13. v. 2009, leg. G. BRETSCHNEIDER; CSLL.

Etymology: The type series of *C. gandhii* sp. n. was part of the type series of the earlier described *C. aungsansuukyiae*, dedicated to AUNG SAN SUU KYI, human rights activist in Myanmar, receiving the Nobel Peace Prize of 1991, and meanwhile member of the new Myanmar parliament. As the Indian specimens are now described as separate species we choose in “good tradition” as name patron for the here described similar taxon the famous Indian pacifist Mohandas Karamchand GHANDI, known as Mahatma GANDHI.

Diagnosis

Medium-sized species, ♂♂ chocolate brown, with falcate forewing apex, white outer margin of the forewing, blurred dark grey ornamentation, and one forewing fenestrum. The only known ♀ is orange brown, lower parts of postmedian area with light violet shadow, forewing, as far as known from the singleton, with three large fenestra and two additional small grey patches.

Description

♂ (Figs. 3a–b): Forewing length, measured from basis to apex, 33–37 mm (holotype 35 mm), the forewings almost rectangular with apical tip slightly bent outward. Antennae around 8.5 mm long, longest rami 1.6 mm, with 19 segments in total, quadripectinate up to the last 5 segments; of dark ochreous brown colour. The ground colour on both dorsal and ventral sides chocolate brown; head, thorax, abdomen, and wings in their dorsal antemedian and median area in ground colour, the forewing antemedian zigzag line and straight postmedian line respectively the straight hindwing antemedian line and postmedian zigzag line of dark grey colour, a little blurred, the postmedian area is a little darker than ground colour, suffused with dark greyish scales. There is one forewing fenestrum plus a costal grey patch, the hindwing with one central fenestrum, bordered broadly with dark grey margin. The ante- and postmedian line of the hindwing do not touch each other. Both fore- and hindwing bear an outer margin with short white fringes. Ventral side of same colour and with same markings, but in antemedian and median area suffused with pinkish scales along the markings.

♂ **genitalia** (Fig. 11): Uncus strongly sclerotised, with two short lateral acute processes and deep furcation. Gnathos almost rectangular. Juxta with two lateral lobe-like, triangular processes and a ventral triangular sella. There are two short, little rounded dorsal tips of the valves, the sacculus is quite broad, the saccus short, broad and rounded. The very short phallus has a sclerotised portion on dorsal side, the vesica is short and has four very short bulbs with one small sclerotised spine each on their tops, the longest one positioned in right ventrolateral direction.

♀ (Figs. 4a–b): In addition to sexually dimorphic characters such as larger wings, broader abdomen and bipectinate antennae, the single known ♀ is of much lighter, orange brown colour and generally more colourful. Forewing length, measured from basis to apex, 38 mm. The forewings are rounded, with an apical tip bent outward. Antennae 8 mm long, bipectinate, orange brown. The dorsal side including head, thorax and abdomen in ground colour, but suffused with whitish-violet scales in the fore- and hindwing postmedian areas and a little in the lower median area of the hindwing, and again with the typical dark greyish, blurred markings as in ♂♂. The forewing with three larger fenestra plus two smaller grey patches, the hindwing one small fenestrum circled

with a grey ring. The ventral side widely suffused with whitish scales, the costal forewing antemedian area and the apical fore- and hindwing postmedian areas are the only parts of pure ground colour. The lower hindwing postmedian area is almost completely coloured in light whitish violet colour. The two grey patches of the dorsal side are here also unscaled fenestra.

Discussion

Generally, as already shown by NAUMANN & LÖFFLER (2010) and NÄSSIG et al. (2010), the structure and species arrangement of the genus *Cricula* is quite easily understandable for most species groups when the barcoding results are used as “sorting basis”. This helped very much to classify several taxa in 2010. Nevertheless, there are generally only small (and often insignificant) differences in barcodes especially within the species-group of *C. trifenestrata* and its subspecies and closely related species, such as *C. cameronensis* PAUKSTADT & PAUKSTADT, 1998 and others.

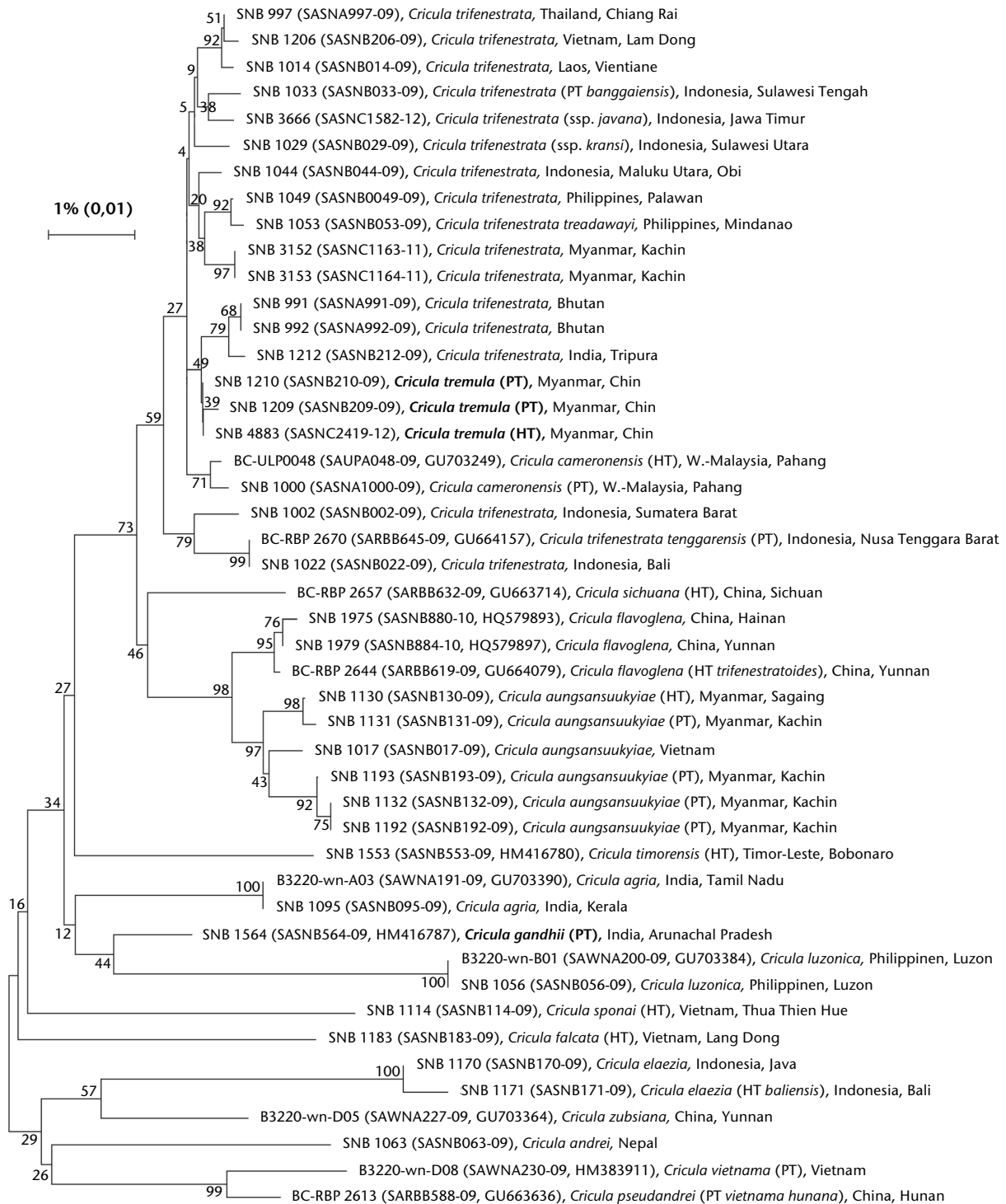
1) *Cricula tremula* sp. n.

The here described species *C. tremula* is found nesting just within this group, showing up as sistergroup of a small group of analyzed specimens from the southern slopes of the Himalaya in Bhutan and from the mountains south of the Brahmaputra valley in India: Tripura. We nevertheless decided to describe this taxon on species level, although differences in the barcode tree (Fig. 15) are only very small (far below 1%, and even the bootstrap result clearly below 50), due to other characters: besides the much smaller size and morphological differences, ♂♂ of *C. tremula* (see etymology of name!) show, for the genus *Cricula*, a very unusual wingbeat and flight pattern, resulting in a very slow and fluttering flight similar to many geometrid moths and completely different from any specimen of *C. trifenestrata* which we ever observed across the entire range of that taxon *sensu lato*.

Cricula tremula has clearly different ♂ genitalic structures, compared to *C. trifenestrata*, here especially to *C. trifenestrata burmana* SWINHOE, 1890, of which we figure the ♂ genitalia of the lectotype from BMNH (Fig. 14); this latter taxon has more rounded processi of the uncus, a broad, rounded dorsal process of the valves, and a much broader sella. Also the imagos of *C. t. burmana* (Figs. 7a–b: ♂ lectotype, Fig. 8: ♀ paralectotype; both in BMNH) differ by their larger size, lighter, more ochreous ground colour, details in ornamentation, and in the ♀ the missing apical tip of the forewing.

We, therefore, decided not to adhere to the barcode results alone, but accept that species might just as well differ in “classical” characters like morphology and behaviour while not showing strong (or even any at all) differences in the barcode.

In the Neighbor Joining tree delivered automatically by the Bold website (BOLD 2013), based on all *Cricula*



15

Fig. 15: "Barcode similarity tree" showing statistically inferred evolutionary relationships of taxa. Extract of 46 specimens, mostly of the *trifenestrata* species-group, but also a few members of other species-groups of the genus *Cricula*. Details of specimens see in Table 1; the new taxa are printed in bold types. The evolutionary history was inferred using the **Minimum Evolution** method (RZHETSKY & NEI 1992). The ME tree was searched using the Close-Neighbor-Interchange (CNI) algorithm (NEI & KUMAR 2000) at a search level of 0. The Neighbor-joining algorithm (SAITOU & NEI 1987) was used to generate the initial tree. The bootstrap consensus tree inferred from 1000 replicates is taken to represent the evolutionary history of the taxa analyzed (FELSENSTEIN 1985). Branches corresponding to partitions reproduced in less than 50% bootstrap replicates are collapsed, and the percentage of replicate trees in which the associated taxa clustered together in the bootstrap test are shown next to the branches. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree. The evolutionary distances were computed using the Maximum Composite Likelihood method (TAMURA et al. 2004) and are in the units of the number of base substitutions per site. The rate variation among sites was modeled with a gamma distribution (shape parameter = 3). The differences in the composition bias among sequences were considered in evolutionary comparisons (TAMURA & KUMAR 2002). The analysis involved 46 nucleotide sequences (= specimens analysed). Codon positions included were 1st+2nd+3rd+Noncoding. All positions containing gaps and missing data were eliminated; there was a total of 447 positions (= bp) in the final dataset. Evolutionary analyses were conducted in MEGA5 (TAMURA et al. 2011).

Tab. 1: Specimen and barcode data, locality of collecting and depository for the specimens used here in the publication (in the order of appearance in Fig. 15). — For general abbreviations see NÄSSIG & TREADAWAY (2009) and above. Further abbreviations: BC = barcode no.; GBAC = GenBank Access Code; GP = genitalia dissection no.; HT = holotype; PT = paratype; SL = COI-5P sequence length in base pairs (data from BOLD 2013); — = data presently not available or not existent.

Taxon	BC	BOLD Process ID	GBAC	Sex	SL	Locality	GP	Coll.
<i>Cricula trifenestrata</i>	SNB 997	SASNA997-09	—	♂	658 [0n]	Thailand, Chiang Rai	—	CSNB
<i>Cricula trifenestrata</i>	SNB 1206	SASNB206-09	—	♂	658 [0n]	Vietnam, Lam Dong	—	CSLL
<i>Cricula trifenestrata</i>	SNB 1014	SASNB014-09	—	♂	658 [0n]	Laos, Vientiane	—	CSNB
<i>Cricula trifenestrata</i> (PT banggaiensis)	SNB 1033	SASNB033-09	—	♂	658 [0n]	Indonesia, Sulawesi Tengah, Peleng	—	CSNB
<i>Cricula trifenestrata</i> (ssp. javana)	SNB 3666	SASNC1582-12	—	♀	658 [0n]	Indonesia, Jawa Timur, Bawean	—	CSNB
<i>Cricula trifenestrata</i> (ssp. kranzi)	SNB 1029	SASNB029-09	—	♂	658 [0n]	Indonesia, Sulawesi Utara	—	CSNB
<i>Cricula trifenestrata</i>	SNB 1044	SASNB044-09	—	♂	658 [0n]	Indonesia, Maluku Utara, Obi	—	CSNB
<i>Cricula trifenestrata</i>	SNB 1049	SASNB049-09	—	♂	658 [0n]	Philippines, Palawan	—	CSNB
<i>Cricula trifenestrata treadawayi</i>	SNB 1053	SASNB053-09	—	♂	658 [0n]	Philippines, Mindanao	—	CSNB
<i>Cricula trifenestrata</i>	SNB 3152	SASNC1163-11	—	♂	658 [0n]	Myanmar, Kachin	—	CSNB
<i>Cricula trifenestrata</i>	SNB 3153	SASNC1164-11	—	♀	658 [0n]	Myanmar, Kachin	—	CSNB
<i>Cricula trifenestrata</i>	SNB 991	SASNA991-09	—	♂	658 [0n]	Bhutan	—	CSNB
<i>Cricula trifenestrata</i>	SNB 992	SASNA992-09	—	♂	642 [0n]	Bhutan	981/04 SNB	CSNB
<i>Cricula trifenestrata</i>	SNB 1212	SASNB212-09	—	♂	658 [0n]	India, Tripura	—	CSNB
<i>Cricula tremula</i> (PT)	SNB 1210	SASNB210-09	—	♂	658 [0n]	Myanmar, Chin	1285/05 SNB	CSLL
<i>Cricula tremula</i> (PT)	SNB 1209	SASNB209-09	—	♀	658 [0n]	Myanmar, Chin	—	CSLL
<i>Cricula tremula</i> (HT)	SNB 4883	SASNC2419-12	—	♂	658 [0n]	Myanmar, Chin	2305/12 SNB	CSNB (ZMHU)
<i>Cricula cameronensis</i> (HT)	BC-ULP0048	SAUPA048-09	GU703249	♂	658 [0n]	W.-Malaysia, Pahang	—	CULP
<i>Cricula cameronensis</i> (PT)	SNB 1000	SASNA1000-09	—	♀	658 [0n]	W.-Malaysia, Pahang	—	CSNB
<i>Cricula trifenestrata</i>	SNB 1002	SASNB002-09	—	♂	658 [0n]	Indonesia, Sumatera Barat	—	CSNB
<i>Cricula trifenestrata tenggarensis</i> (PT)	BC-RBP 2670	SARBB645-09	GU664157	♂	651 [0n]	Indonesia, Nusa Tenggara Barat, Sumba	—	CRBP (CMWM?)
<i>Cricula trifenestrata</i>	SNB 1022	SASNB022-09	—	♀	658 [0n]	Indonesia, Bali	—	CSNB
<i>Cricula sichuana</i> (HT)	BC-RBP 2657	SARBB632-09	GU663714	♂	658 [0n]	China, Sichuan	602-2005 RBP	CRBP (CMWM?)
<i>Cricula flavoglana</i>	SNB 1975	SASNB880-10	HQ579893	♂	658 [0n]	China, Hainan	—	CSLL
<i>Cricula flavoglana</i>	SNB 1979	SASNB884-10	HQ579897	♂	658 [0n]	China, Yunnan	—	CSLL
<i>Cricula flavoglana</i> (HT trifenestratoides)	BC-RBP 2644	SARBB619-09	GU664079	♂	658 [0n]	China, Yunnan	—	CRBP (CMWM?)
<i>Cricula aungsansuukyi</i> (HT)	SNB 1130	SASNB130-09	—	♂	658 [0n]	Myanmar, Sagaing	2108/09 SNB	CSNB (ZMHU)
<i>Cricula aungsansuukyi</i> (PT)	SNB 1131	SASNB131-09	—	♂	658 [0n]	Myanmar, Kachin	—	CSNB
<i>Cricula aungsansuukyi</i>	SNB 1017	SASNB017-09	—	♂	658 [0n]	Vietnam, Lao Cai	2120/10 SNB	CSNB
<i>Cricula aungsansuukyi</i> (PT)	SNB 1193	SASNB193-09	—	♂	658 [0n]	Myanmar, Kachin	—	CSNB
<i>Cricula aungsansuukyi</i> (PT)	SNB 1132	SASNB132-09	—	♂	658 [0n]	Myanmar, Kachin	—	CSNB
<i>Cricula aungsansuukyi</i> (PT)	SNB 1192	SASNB192-09	—	♂	658 [0n]	Myanmar, Kachin	2107/09 SNB	CSNB
<i>Cricula timorensis</i> (HT)	SNB 1553	SASNB553-09	HM416780	♂	658 [0n]	Timor-Leste, Bobonaro	2180/10 SNB	CSNB (ZMHU)
<i>Cricula agria</i>	B3220-wn-A03	SAWNA191-09	GU703390	♀	658 [0n]	India, Tamil Nadu	—	CWAN (SMFL)
<i>Cricula agria</i>	SNB 1095	SASNB095-09	—	♂	658 [0n]	India, Kerala	—	CSNB
<i>Cricula gandhii</i> (PT)	SNB 1564	SASNB564-09	HM416787	♂	658 [0n]	India, Arunachal Pradesh	2051/09 SNB	CSLL
<i>Cricula luzonica</i>	B3220-wn-B01	SAWNA200-09	GU703384	♂	658 [0n]	Philippinen, Luzon	—	CWAN (SMFL)
<i>Cricula luzonica</i>	SNB 1056	SASNB056-09	—	♂	658 [0n]	Philippinen, Luzon	—	CSNB
<i>Cricula sponai</i> (HT)	SNB 1114	SASNB114-09	—	♂	658 [0n]	Vietnam, Thua Thien Hue	1134/05 SNB	CSLL (ZMHU)
<i>Cricula falcata</i> (HT)	SNB 1183	SASNB183-09	—	♂	658 [0n]	Vietnam, Lam Dong	989/04 SNB	CSLL (ZMHU)
<i>Cricula elaezia</i>	SNB 1170	SASNB170-09	—	♂	658 [0n]	Indonesia, Java Barat	—	CSNB
<i>Cricula elaezia</i> (HT baliensis)	SNB 1171	SASNB171-09	—	♂	658 [0n]	Indonesia, Bali	2096/09 SNB	CSNB (ZMHU)
<i>Cricula zubsiana</i>	B3220-wn-D05	SAWNA227-09	GU703364	♂	658 [0n]	China, Yunnan	—	CWAN (SMFL)
<i>Cricula andrei</i>	SNB 1063	SASNB063-09	—	♂	658 [192n]	Nepal	—	CSNB
<i>Cricula vietnana</i> (PT)	B3220-wn-D08	SAWNA230-09	HM383911	♂	658 [0n]	Vietnam, Lao Cai	—	CWAN (SMFL)
<i>Cricula pseudandrei</i> (PT vietnana hunana)	BC-RBP 2613	SARBB588-09	GU663636	♂	658 [0n]	China, Hunan	2009-853 RBP	CRBP (CMWM?)

available to our research (a total of almost 350 sequences [= specimens] as of mid-January 2013, with filter “over 600 bp”), *C. tremula* sp. n. is found exactly at the same place within the large tree as in the ME-tree in Fig. 15 (based on an extract of only 46 specimens); compare below for *C. gandhii*.

Interestingly, there was not a single specimen of the true *C. trifenestrata* collected by us in Myanmar, Chin State, within seven expeditions to that area so far. *C. tremula* is already the fifth known Saturniidae species endemic to the Chin Hills of western Myanmar, and together with, for example, *Salassa inversa* NAUMANN, LÖFFLER & KOHLL, 2010 and *Saturnia (Cachosaturnia) victoria* NAUMANN, LÖFFLER & NÄSSIG, 2012, another new recent discovery from this hardly accessible region.

2) *Cricula gandhii* sp. n.

When describing *C. aungsansuukyia* in 2010, we included some Indian specimens from Arunachal Pradesh within the type series because the ♂♂ looked very similar to some of the Myanmar specimens of the type series and just differed by their slightly larger size, somewhat darker chocolate brown colour and some details in ♂ genitalia. At that time, no results of DNA barcode analysis existed yet for the Indian population. Meanwhile, with the results shown in the ME tree (Fig. 15) plus more intensive morphological studies of this Indian material, we came to the conclusion that we have here another well-distinguished species in our hands. Therefore, we here described this as a new species *C. gandhii* above.

C. aungsansuukyia shows small differences in its ♂ genitalic structures (Figs. 12–13), such as more slender gnathos, flattened processes of the juxta, a more elongated dorsal process of the valves, and longer bulbs and spines on the vesica; the ♂ specimens (Figs. 5a–b, holotype) are generally smaller than those of *C. gandhii*, and most of them are of more orange colour (although few chocolate brown exist as well); the ♀ (Figs. 6a–b) lacks the apical tip of the forewing and is coloured more homogeneously. (It must also be stated that the morphology of ♂ genitalia obviously is rather variable especially within the *trifenestrata*-group – but not only there –, as can easily be seen in the two specimens of *C. aungsansuukyia* in Figs. 12–13 just as well as in the two genitalia of *C. tremula* illustrated in Figs. 9–10; compare especially the shape of the gnathos or shape and size of sella etc.)

However, the position of *C. gandhii* within the large NJ-tree delivered by BOLD (2013) [see above] is different from the one described here for the much smaller ME-tree: In the BOLD-tree it is the sistergroup to the entire *trifenestrata* species-group, while in the ME-tree it is placed outside of the *trifenestrata* species-group and keys out between the South Indian *Cricula agria* JORDAN, 1909 and the species-group of *luzonica* JORDAN, 1909. These differences are probably caused by the reduced number of specimens and species used for the ME-tree and the result of more or less accidental effects caused

by this choice of sequence data analysed. In both cases, *C. gandhii* has a well-developed difference in barcode sequences of around 4–5% to all related taxa.

Revised and new synonymies in the genus *Cricula*

The almost simultaneously published descriptions of new *Cricula* species by NAUMANN & LÖFFLER (2010 [19. I.]) and BRECHLIN (2010 [26. I.]) resulted in several synonymies within the genus. In a subsequent short paper by NAUMANN (2010) the reasons for priority of the descriptions by NAUMANN & LÖFFLER (2010) over those of BRECHLIN (2010) were given, and a first synonymic list was published, based then only on the morphological characters mentioned in BRECHLIN’s paper as shown in the few figures. NÄSSIG et al. (2010) revised the group of *C. elaezia* JORDAN, 1909 which then also showed up with several synonymic descriptions. We will not list the actualized entire checklist of the genus here again, but for some of the involved taxa we can provide a short update of the synonymies, as by now barcode results for the primary types are publically available in the BOLD website (BOLD 2013). In correction to NAUMANN (2010) there is one taxon removed from synonymy and one revised and new synonymy:

- *C. tonkintrifenestratoidea* BRECHLIN, 2010, **stat. rev.**, from Vietnam, Lai Chau, is no synonym of *C. aungsansuukyia*. Together with *C. sichuana* BRECHLIN, 2010 from PR China, Sichuan, both taxa are to be accepted on full species rank. *C. aungsansuukyia* is rather closely related to the Chinese *C. flavoglana* ZHU & WANG, 1993.
- *C. australovietnama* BRECHLIN, 2010 is no synonym of *C. falcata* LÖFFLER & NAUMANN in NAUMANN & LÖFFLER, 2010, as proposed by NAUMANN (2010), but in fact a **new synonym** of *C. frederkingi* LÖFFLER & NAUMANN in NAUMANN & LÖFFLER, 2010.

Based on the barcode results of the types, *C. vietnama hunana* BRECHLIN 2010 is confirmed as a synonym of *C. pseudandrei* NAUMANN & LÖFFLER, 2010, and *C. trifenestratoidea* BRECHLIN, 2010 is confirmed as synonym of *C. flavoglana*.

Acknowledgements

We would like to thank the following persons who assisted in various ways with presenting important material or during expeditions, with literature, information, preparation of figures and notes on the manuscript: Gil BRETSCHNEIDER (Lichtenstein), Ulrich BROSCHE (Hille), Dr. Ulf EITSCHBERGER (Marktleuthen), Alessandro GIUSTI (London), Mathias HOFFMANN (Leipzig), HTAY AUNG (Yangon), Stanley JAKL (Prague), Dr. Wolfram MEY (Berlin), Dr. Wolfgang A. NÄSSIG (Frankfurt am Main) and the late Peter SPONA (Zwickau). Special thanks to Dr. Rodolphe ROUGERIE (Rouen). The molecular work (COI barcoding) was funded by NSERC and Genome Canada through grants to Paul D. N. HEBERT at the Canadian

Centre for DNA Barcoding based at the Biodiversity Institute of Ontario at the University of Guelph, Ontario, Canada.

References

- BARCODE OF LIFE [or BOLD or BOLDSYSTEMS] (2013): Advancing species identification and discovery by providing an integrated environment for the assembly and application of DNA barcodes. Barcode of life data systems. — URL: www.barcodinglife.org or www.boldsystems.org. — Last accessed: 5. II. 2013.
- BRECHLIN, R. (2010 [26. I.]): Neue Taxa der Gattung *Cricula* WALKER, 1855 (Lepidoptera: Saturniidae). — Entomo-Satsphingia, Pasewalk, 3 (1): 36–44.
- FELSENSTEIN J. (1985): Confidence limits on phylogenies: An approach using the bootstrap. — Evolution, New York, 39 (4): 783–791.
- JORDAN, K. (1909): On the species of *Cricula*, a genus of Saturniidae. — Novitates zoologicae, Tring, 16: 300–306.
- NÄSSIG, W. A. (1989): Systematisches Verzeichnis der Gattung *Cricula* WALKER, 1855 (Lepidoptera, Saturniidae). — Entomologische Zeitschrift, Essen, 99 (13): 181–192, (14): 193–198.
- (1995 [unpubl.]): Eine Revision der Gattung *Cricula* WALKER 1855 sowie ein Versuch einer phylogenetischen Analyse der Tribus Saturniini (Lepidoptera: Saturniidae). — PhD thesis, J. W. Goethe University (Fachbereich Biologie), Frankfurt am Main, 113 pp.
- , KITCHING, I. J., PEIGLER, R. S., & TREADAWAY, C. G. (2010): The group of *Cricula elaezia*: Comments on synonyms and priority questions, with illustrations of barcode similarity trees, distribution maps, a revised checklist and a formerly unknown female (Lepidoptera: Saturniidae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 31 (3): 145–165.
- , & TREADAWAY, C. G. (2011): Revisional notes on the *luzonica*-group of the genus *Cricula*, with the description of new taxa from Panay and Mindoro (Philippines; Lepidoptera: Saturniidae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 31 (4): 187–196.
- NAUMANN, S. (2010): Kritische Anmerkungen zu kürzlich publizierten Originalbeschreibungen innerhalb der Familie Saturniidae (Lepidoptera, Saturniidae). — Neue Entomologische Nachrichten 64: 143–144.
- , & LANE, D. (2010): A new species of the genus *Cricula* WALKER, 1855 from East Timor (Lepidoptera: Saturniidae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 31 (1/2): 17–19.
- , & LÖFFLER, S. (2010 [19. I.]): Notes on the Asian genus *Cricula* WALKER, 1855, with description of new species (Lepidoptera, Saturniidae). — Neue Entomologische Nachrichten, Markt-leuthen, Supplement 2: 1–24.
- , —, & KOHLL, S. (2010): Bemerkungen zur Gattung *Salassa* MOORE, 1859, mit Beschreibung einiger neuer Arten (Lepidoptera, Saturniidae). — The European Entomologist, Příbram, 2 (3/4): 93–123.
- , —, & NÄSSIG, W. A. (2012): Revisional notes on the species-group of *Saturnia cachara*, with description of a new subgenus and a new species (Lepidoptera: Saturniidae). Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 33 (2/3): 107–128.
- NEI, M., & KUMAR, S. (2000): Molecular evolution and phylogenetics. — New York (Oxford Univ. Pr.), 348 pp.
- PAUKSTADT, U., & PAUKSTADT, L. H. (1998): *Cricula trifenestrata cameronensis* n. subsp., eine neue Unterart der Gattung *Cricula* WALKER 1855 aus West Malaysia (Lepidoptera: Saturniidae). — Entomologische Zeitschrift, Essen, 108 (4): 129–141.
- , & — (2009): *Cricula pelengensis* sp. nov., eine neue Saturniide vom Banggai Archipel, Indonesien (Lepidoptera: Saturniidae). — Beiträge zur Kenntnis der wilden Seidenspinner, Wilhelmshaven, 7 (8): 416–424.
- , & — (2010): Beitrag zur Identität von *Cricula pelengensis* PAUKSTADT & PAUKSTADT, 2009 und weiterer Taxa der Gattung *Cricula* WALKER, 1855 (Lepidoptera: Saturniidae). — Beiträge zur Kenntnis der wilden Seidenspinner, Wilhelmshaven, 8 (2): 3–14.
- RATNASINGHAM, S., & HEBERT, P. D. N. (2007): Barcoding. BOLD: The barcode of life data system (www.barcodinglife.com). — Molecular Ecology Notes, Hoboken, 7 (3): 355–364.
- ROEPKE, W. [K. J.] (1940): Aanteekeningen over het geslacht *Cricula* Wlk. (Lep., Saturniidae). — Entomologische Mededeelingen van Nederlandsch-Indië, Buitenzorg, 6 (2): 23–32, pl. 4.
- RZHETSKY, A., & NEI, M. (1992): A simple method for estimating and testing minimum evolution trees. — Molecular Biology and Evolution, Oxford, 9 (5): 945–967.
- SAITOU, N., & NEI, M. (1987): The neighbor-joining method: A new method for reconstructing phylogenetic trees. — Molecular Biology and Evolution, Oxford, 4 (4): 406–425.
- SWINHAE, C. (1890): The moths of Burma, Part 1. — Transactions of the Entomological Society of London, London, 1890: 161–200, 1 pl.
- TAMURA, K., & KUMAR, S. (2002): Evolutionary distance estimation under heterogeneous substitution pattern among lineages. — Molecular Biology and Evolution, Oxford, 19 (10): 1727–1736.
- , NEI, M., & KUMAR, S. (2004): Prospects for inferring very large phylogenies by using the neighbor-joining method. — Proceedings of the National Academy of Sciences (USA) [PNAS], Washington, 101 (30): 11030–11035.
- , PETERSON, D., PETERSON, N., STECHER, G., NEI, M., & KUMAR, S. (2011): MEGA5: Molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. — Molecular Biology & Evolution, Oxford, 28 (10): 2731–2739.

Received: 14. I. 2013