

Re-capture of *Sinobirma malaisei* in China: description of the female genitalia and comments on the systematic position of the genus in the tribe Urotini (Saturniidae)

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Summary. The recent re-capture in China of the enigmatic *Sinobirma malaisei* (Bryk, 1944), the only Asian member of the otherwise wholly African tribe Urotini of the subfamily Saturniinae, is recorded. A few previously uncertain characters of the external habitus are verified and the female genitalia are described and illustrated for the first time. The systematic position of *S. malaisei* is discussed and a possible close relationship with the Madagascan species *Maltagorea auricolor* (Mabille, 1879) is proposed.

Résumé. L'espèce énigmatique *Sinobirma malaisei* (Bryk, 1944) a été re-capturée en Chine; elle est la seule représentante en Asie de la tribu des Urotini dont tous les autres membres vivent en Afrique ou à Madagascar. Quelques caractères incertains de l'habitus sont précisés et l'armature génitale femelle est décrite et illustrée pour la première fois. La position systématique de *S. malaisei* est discutée et une relation de parenté étroite avec l'espèce malgache *Maltagorea auricolor* (Mabille, 1879) est proposée.

Key words. Saturniidae, Urotini, China, *Sinobirma malaisei*, relict, eastern Gondwana fragmentation.

Introduction

Sinobirma malaisei (Bryk, 1944), the sole known species of the genus *Sinobirma* Bryk, 1944, was discovered in 1934 by René Malaise in mountains on the border between north-eastern Burma and the Yunnan Province of China. Since the original few specimens of both sexes taken by Malaise, only a single male is known to have been collected in 1998 in northern Burma by a Russian collector (S. Naumann, pers. comm.).

Because so few specimens of this species are available for study, and because of its extraordinary taxonomic and biogeographical significance (Nässig & Oberprieler 1994), the author initiated an expedition to China in 2001 to try and recollect it. An account of this successful venture is presented here, together with the description of the previously unrecorded female genitalia of *S. malaisei* and some comments on the analysis of its taxonomic position and relationships by Nässig & Oberprieler (1994).

Sinobirma was described as a subgenus of the Australian and New Guinean genus *Opodiphthera* Wallengren, 1858, a member of the tribe Saturniini in the Saturniinae. Nässig & Oberprieler (1994) raised *Sinobirma* to generic status and demonstrated its belonging to the Afro-Madagascan tribe Urotini (= Pseudapheliini sensu Bouvier 1928, see Oberprieler 1997 for details about the tribal name and its full synonymy). From an examination of the wing pattern, antennae and male genitalia, these authors concluded that, within Urotini, *Sinobirma* is closely related to a group of three genera, namely *Tagoropsis* Felder, 1874, *Pseudantheraea* Weymer, 1892 (both from continental Africa) and *Maltagorea* Bouyer, 1993 (from Madagascar).

A possible closer relationship between *Sinobirma* and *Maltagorea* led them to hypothesise that *S. malaisei* may be “the relict (or offspring) of a formerly eastern Gondwanan species that lived in India and Madagascar during the late Cretaceous and then travelled north on the ‘Arc India’ to Asia” and that “it does seem very likely [...] that *Sinobirma* is some kind of ‘living fossil’ of considerable age”.

Re-capture of *Sinobirma malaisei*

The capture of *Sinobirma malaisei* was one of the major aims of a collecting trip in south-western China which took place between 3 June and 9 July, in accordance with the dates of Malaise’s expedition and the original captures of *S. malaisei* (9 and 17 June 1934). The collecting site was chosen as close as possible to the type locality of the species, which was given by Bryk (1944) as ‘China, Yunnan Province, Kambaiti, 2000 m a.s.l.’ It is situated in the Tongbinguan nature reserve, less than two kilometres from the Burmese border and about 70 km south of Malaise’s locality, in the same mountain massif, at 2080 m a.s.l. (GPS co-ordinates: 24°49'N 97°44'E). The vegetation consisted of low and medium-sized trees, including numerous flowering *Castanopsis* (Fagaceae), and small cleared zones with grass and ferns. The vegetation composition of this region appeared very singular to us, and we have never seen similar forests elsewhere in Yunnan province. At the site, we operated a single 125 W mercury-vapour lamp powered by a small generator and placed in front of a vertical white sheet facing the forest. During the nights of 12 and 13 June we collected, among numerous other Lepidoptera, seven males and four females of *S. malaisei* (Figs. 1–2). Their flight times were remarkably constant, the females arriving at the sheet at about 21:00 and the males between 23:30 and 00:00 local time. Like many other saturniids, *S. malaisei* arrived at the light in an erratic fashion, fluttering around on the ground before settling on the sheet or surrounding shrubs. This rediscovery of *S. malaisei*, almost 70 years after René Malaise took the first specimens, proves that the species is still present and relatively abundant in this border zone mountain massif. The recent capture of a single male in northern Burma (at Nan Thi, 50 km east of Putao, GPS co-ordinates: 27°27'N 97°55'E, 950 m, 11–16 May 1998) by a Russian collector indicates that *S. malaisei* also occurs further north and probably has a wider distribution in this region.



Figs. 1–2. Female (1) and male (2) of *Sinobirma malaisei*.

Morphology

The habitus of *Sinobirma malaisei* (Nässig & Oberprieler 1994: 373, Figs. 2–3, and Figs. 1–2 in this paper) was redescribed by Nässig & Oberprieler (1994), who also described and illustrated its male genitalia for the first time, adding some new and important information about its relationships and systematic position. The redescription by Nässig & Oberprieler (1994) differs from Bryk's (1944) original account in a few features, assumed to be due to fading of the specimens. Our fresh specimens allow clarification of these aspects, as follows:

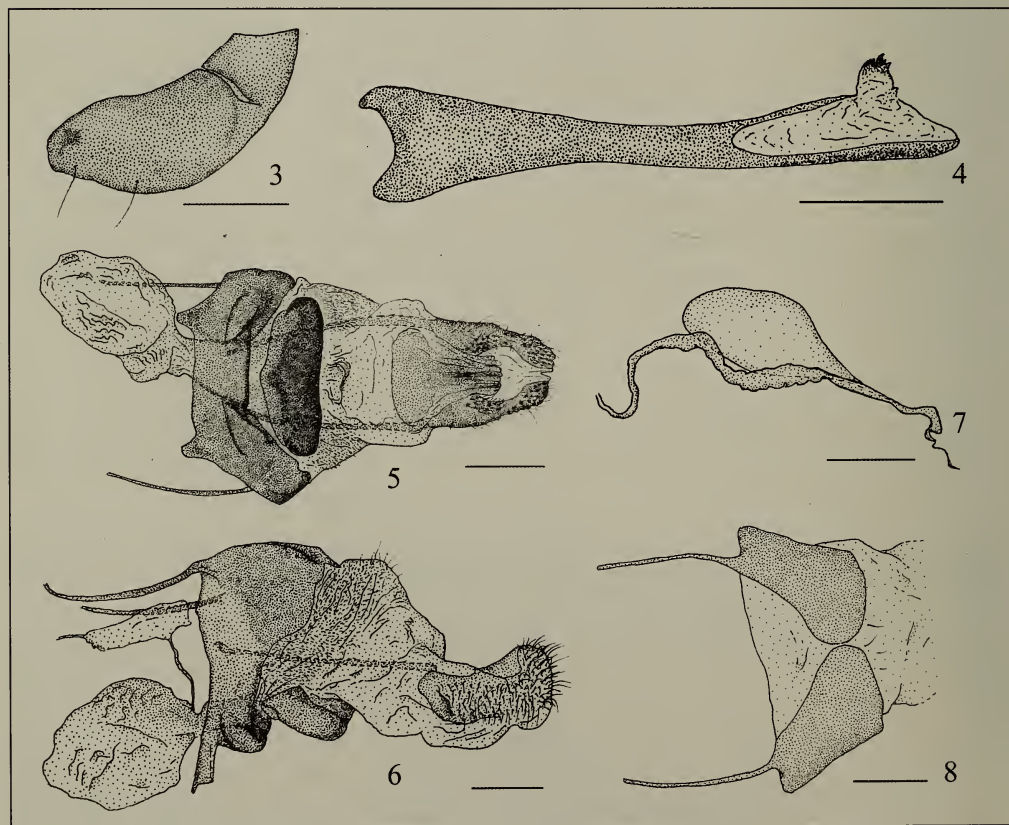
- the antennae are indeed rusty brown, as described by Bryk, not yellowish brown as observed by Nässig & Oberprieler on Bryk's specimens 50 years later;
- similarly, the anterior part of the head and the legs are purplish brown, as described by Bryk;
- the black borderline of the patagia mentioned by Bryk, but invisible on some specimens available to Nässig & Oberprieler, is clearly present on fresh specimens of both sexes (Figs. 1–2);
- the distal area of the female forewings, beyond the postmedial line, is clearly covered with reddish scales (Fig. 1) in all four female specimens collected, as is the case in the female holotype specimen illustrated by Nässig & Oberprieler (1994).

Nässig & Oberprieler (1994) did not study an important character, the number of segments of the labial palpus, so as to avoid destruction of the head of one of the few specimens known at the time. The head of a damaged male of the newly collected specimens was partially dissected, revealing that the labial palpus consists of two ventrally partially fused segments (Fig. 3).

With regard to the male genitalia (Nässig & Oberprieler 1994: 376, Figs. 10a–c), one of the most important characters is the presence of a pair of postero-medial processes on the eighth abdominal sternum. Nässig & Oberprieler also described a strongly sclerotised structure – guiding the phallus dorsally – and interpreted this as “probably” representing a transtilla. Closer examination of this structure showed it to be connected not only to the proximal part of the costae of the valves – what is consistent with the ‘transtilla’ as defined in Klots (1970) and Scoble (1992) – but also to the lateral arms of the gnathos, arising from the uncus at a ventral position. This transverse sclerite is also present in other Saturniidae and its identity has been the subject of several discussions (Michener 1952, Lemaire 1978, Balcazar-Lara & Wolfe 1997). I interpret this part as a fusion of the transtilla and the gnathos. Another character of the male genitalia of *S. malaisei*, not noticed by previous authors, is that the posterior tip of the aedeagus opens toward the left side of the moth (Fig. 4), whereas this opening is apical or oriented to the right in most of the other related Saturniidae (Table 1). Such variations were already documented in sphingids by Kitching (2002), and were attributed to a twisting of the aedeagus (clockwise or counter clockwise) assessed by the observation of internal structures. The hypothesis of a similar twisting of the aedeagus in some saturniid moths would be premature but is an interesting candidate to explain our observations; further anatomical studies are necessary to assess the origin of the variations in the orientation of the distal opening of the aedeagus.

The genitalia of one of the collected females of *Sinobirma malaisei* were dissected; they are described and illustrated here for the first time (Figs. 5–8). The ovipositor is

formed by a pair of fleshy papillae anales with numerous setae; the posterior apophyses, attached to the anterior edges of the papillae anales, are about one quarter longer than the anterior apophyses (Fig. 7). Ventrally, between the papillae anales, the membranous zone is weakly sclerotised and shows some marked longitudinal folds (Fig. 5). The vaginal plate ('sterigma') is composed of two, clearly distinct, ventral parts (Figs. 5–6): a strongly sclerotised anterior part contiguous with tergum A8 (forming a complete ring with it), and a large sclerotised posterior part with an important posterior thickening. The latter, usually called "lamella postvaginalis", is clearly distinct from, though very close to the posterior edge of the anterior part of the sterigma. The ostium bursae is large and lies on the anterior part of the sterigma. Tergum A8 is divided by a membranous zone which is enlarged anteriorly (Fig. 8). The ductus bursae is short, weakly sclerotised dorsally; the corpus bursae is small, with numerous wrinkles on its surface and without signum. The ductus seminalis enters on dorso-lateral right side of the posterior part of the corpus bursae. The spermatheca (Fig. 7) is large, nearly as long as the whole genitalia; the internal and external canals are short and very thin, converging towards a thick and long receptacular canal that separates into an



Figs. 3–8. – 3 – Left labial palpus in lateral view (anterior at left) of male *S. malaisei*. 4 – Aedeagus in ventral view. 5, 6 – Female genitalia in ventral and lateral view. 7 – Spermatheca. 8 – Tergum A8. Scale bar: 0.5 mm (Fig. 3), 1 mm (Figs. 4 to 8).

ellipsoid lagena and a long utriculus which is slightly thickened for a length approximately equal to that of lagena.

Systematics

For comparative purposes, the material examined for this study is listed in Table 1 together with the conditions of the characters described below. Nässig & Oberprieler (1994) uncovered Bryk's error of placing *Sinobirma malaisei* in the Australian and New Guinean saturniine genus *Opodipphthera*, and demonstrated its surprisingly close relationship with the Afro-Madagascar *Tagoropsis* group of genera (Bouyer 1993) of Urotini, based on characters of the male (bipectinate) antennae, general wing pattern, and male genitalia. In particular, they pointed out that *Sinobirma* and *Pseudantheraea* share a similar general habitus, with eyespots present on the hindwings (a plesiomorphic character in the Saturniinae), and that *Sinobirma* and some species of the genus *Maltagorea* share an unusual character: the presence of a pair of posterior processes on the eighth sternum in the male (possibly indicating a sister-group relationship but then leaving *Maltagorea* as paraphyletic, Table 1). Oberprieler (1997) later showed that this character also occurs in other genera of Urotini and even in *Eochroa* Felder, 1874, currently included in the tribe Bunaeni but of uncertain placement.

The present study of the female genitalia and mouthparts of *S. malaisei* reveals further characters of possible taxonomic significance. First, *S. malaisei* has a two-segmented labial palpus like *Tagoropsis* and unlike *Maltagorea* (three segments) or *Pseudantheraea* (one segment); however, as already pointed out by Nässig & Oberprieler (1994), this character is of poor phylogenetic value and very likely to be homoplastic, as reductions in the number of labial palpus segments occur widely in Saturniidae. Second, *S. malaisei* and *Maltagorea auricolor* (Mabille, 1879) share a number of characters:

- (1) the membranous interruption of female tergum A8 (Fig. 8), whereas it is continuous in all other species of the group (Table 1);
- (2) the conformation of the posterior lobes of male sternum A8; these lobes are weakly sclerotised and directed toward the posterior end of the body, whereas (when present) they are shorter, strongly sclerotised and directed toward the interior of the body in the other species of the genus *Maltagorea* (Table 1);
- (3) the presumed fusion of gnathos and transtilla;
- (4) the distal opening of the aedeagus (Fig. 4) is oriented to the left (Table 1).

Within the *Tagoropsis* group, these four shared character states are unique to *Sinobirma malaisei* and *Maltagorea auricolor*, suggesting a probable sister-group relationship between these two taxa. The evolution of characters (3) and (4) must be considered cautiously and further research is needed within the subfamily to evaluate their phylogenetic significance. The isolated taxonomic position of *M. auricolor* among the Madagascan Urotini was already pointed out by Griveaud (1962) and again by Bouyer (1993) who suggested a possible relationship between *M. auricolor* and *Pseudantheraea*, but he was then unaware of the affinities of *Sinobirma* to this group of genera. A close relationship between *M. auricolor* and *S. malaisei* had not been proposed before.

Table 1. Material examined and character distribution within the *Tagoropsis* group of genera. n – number of preparations (m – males, f – females). ad – aedeagus (its opening can be apical (ap), oriented toward the left (l) or the right (r) side of the moth). st.8 – male sternum A8 (x – posterior lobes absent, w – posterior lobes weakly sclerotized and directed toward the posterior end of the body, s – posterior lobes strongly sclerotized and directed toward the interior of the body, t – reduced tubercle-shaped posterior lobes). t8 – female tergum A8 (i – interrupted medially, c – continuous). – lp = number of segments of the labial palpus.

Genus	Species	n		ad	st.8	t8	lp
		m	f				
<i>Sinobirma</i>	<i>malaisei</i> (Bryk, 1944)	2	1	l	w	i	2
<i>Maltagorea</i>	<i>andriai</i> (Griveaud, 1962)	18	7	r	s	c	3
	<i>ankaratra</i> (Viette, 1954)	3	1	r	x	c	3
	<i>auricolor</i> Mabilie, 1879	6	1	l	w	i	3
	<i>cincta</i> Mabilie, 1879	1	-	r	s	-	-
	<i>dentata</i> (Griveaud, 1962)	1	-	r	s	-	3
	<i>dura</i> (Kefersteine, 1870)	3	1	r	s	c	3
	<i>fusicolor</i> (Mabilie, 1879)	2	1	r	x	c	3
	<i>griveaudi</i> Bouyer, 1996	5	1	r	s	c	3
	<i>monsarrati</i> (Griveaud, 1968)	1	1	r	x	c	3
	<i>rostaingi</i> (Griveaud, 1962)	8	1	r	x	c	3
	<i>rubriflava</i> (Griveaud, 1962)	2	1	r	x	c	3
	<i>sogai</i> (Griveaud, 1962)	3	-	r	s	-	3
	<i>vulpina</i> (Butler, 1880)	10	1	r	s	c	3
<i>Pseudantheraea</i>	<i>discrepans</i> (Butler, 1878)	2	1	ap	x	c	1
	<i>imperator</i> Rougeot, 1962	1	1	ap	x	c	1
<i>Tagoropsis</i>	<i>genoviefae</i> Rougeot, 1950	2	1	ap	t	c	2
	<i>hanningtoni</i> (Butler, 1883)	2	-	ap	t	-	2
	<i>natalensis</i> (Felder, 1874)	1	1	ap	t	c	2

Conclusions

The re-capture of *Sinobirma malaisei* in China confirms that this enigmatic species still exists in the mountain massif on the border between Burma and the Chinese province of Yunnan, and apparently in a sizeable population. It also enabled the first study of the female genitalia of this species and now allows a more detailed comparison with other members of the *Tagoropsis* group of Urotini. Such a study and a phylogenetic analysis of the group, using both morphological and molecular data, are currently in progress (Rougerie, in preparation) and intend to clarify the relationships and taxonomic position of this extraordinary species, as well as the presumed paraphyly of *Maltagorea*.

As already pointed out by Nässig & Oberprieler (1994), the occurrence of this single species of the otherwise wholly Afrotropical tribe Urotini in south-east Asia has considerable biogeographical implications. Reconstructing the evolutionary history and biogeography of *S. malaisei* is, however, dependent on a rigorous phylogenetic analysis of its relationships within the Urotini. Nässig & Oberprieler (1994) preferred a vicariant hypothesis of the ancestor of *S. malaisei* drifting to Asia on the Indian subplate after the cretaceous break-up of eastern Gondwana, over a dispersal hypothesis of colonisation by long-distance flight or migration within a formerly more exten-

sive (forest) habitat. Clarification of whether *Sinobirma* is most closely related to a Madagascar member of Urotini (*Maltagorea* or part of it) or a continental African one (*Pseudantheraea* or *Tagoropsis*) will significantly increase our understanding of the evolutionary history of not only *S. malaisei* and the Urotini but also the subfamily Saturniinae.

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