Zootaxa 4472 (3): 489–504
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4472.3.4
http://zoobank.org/urn:lsid:zoobank.org:pub:12C23A83-2B3C-4E35-A024-DCC74A771668

Revision of the genus *Eumorphobotys* with descriptions of two new species (Lepidoptera, Crambidae, Pyraustinae)

KAI CHEN[1], DANDAN ZHANG[1,3] & MIHAI STĂNESCU[2]

[1]*Institute of Entomology/ State Key Laboratory of Biocontrol/The Museum of Biology, Sun Yat-sen University, Guangzhou, Guangdong 510275, China.*

[2]*"Grigore Antipa" National Museum of Natural History, Şos. Kiseleff 1, RO-011341, Bucharest, Romania*

[3]*Corresponding author. E-mail: zhangdd6@mail.sysu.edu.cn*

Abstract

The genus *Eumorphobotys* Munroe & Mutuura (1969) comprises two species that have been found in southern China. Two new species, *E. concavuncus* **sp. n.** and *E. horakae* **sp. n.**, are described from southwest China. In appearance, this genus also resembles *Calamochrous* Lederer, 1863, *Sclerocona* Meyrick, 1890, *Prodasycnemis* Warren, 1892, and *Loxoneptera* Hampson, 1896. In order to evaluate the generic placement of the new taxa, the phylogeny of *Eumorphobotys* species and several species representing the potential related genera based on sequence data of *COI*, *16S rRNA*, *EF-1α* and *28S rRNA* gene regions were reconstructed and the taxonomy of these genera based on morphological characters was re-assessed. The results are as follows: (i) the monophyly of *Eumorphobotys* is well supported; (ii) *Loxoneptera* is paraphyletic. Two species of *Calamochrous* were recovered as terminal lineages within *Loxoneptera*; (iii) the clade comprising species of *Loxoneptera* and *Calamochrous* is in the sister position to *Eumorphobotys* with a robust support; (iv) species of *Loxoneptera* and *Calamochrous* resemble *Eumorphobotys* in the wing shape and the porrect labial palpus but differ in genitalia structures. The relationships of these genera are discussed; (v) two new species, *E. concavuncus* **sp. n.** and *E. horakae* **sp. n.**, are described, *Calamochrous obscuralis* (Caradja, 1925) **syn. n.** is synonymized with *E. eumorphalis* (Caradja, 1925) based on the male genitalia and the adults and genitalia of all species (except the female of *E. horakae* **sp. n.**) are illustrated.

Key words: *Loxoneptera*, identification key, systematics, genitalia, molecular phylogeny, new synonyms, China

Introduction

The genus *Eumorphobotys* was established by Munroe & Mutuura in 1969. *Calamochrous eumorphalis* Caradja, 1925 was designated as the type species and the generic description was mainly based on this species. *Calamochrous obscuralis* Caradja, 1925 was also transferred to *Eumorphobotys* by Munroe & Mutuura (1969) but no detailed description was given. In the original description, Caradja (1925) distinguished these two species based on the differences in wing colour. For *C. eumorphalis*, he described the forewing as "monotonously very isabell pale pink" and the hindwing as "yellow"; for *C. obscuralis*, he described both wings as "single-colored dark smoky slightly playing lead-gray". Zhang (2003) first mentioned the sexual dimorphism in wing colour of *E. eumorphalis* and suggested that *E. eumorphalis* and *E. obscuralis* might be conspecific. Externally, species of *Eumorphobotys* can be best recognized by the relatively large wingspan, the long, porrect labial palpus, the usually concolorous forewing with no obvious pattern and the weakly curved to straight forewing termen.

To date the genus has only been reported from southern China (Caradja 1925; Wang 1980; Shen & Tang 1992; Song 1993; Song & He 1997; Song 2001; Wang *et al*. 2003; Zhang 2009). According to Tiansen (1985), the larvae of *Eumorphobotys obscuralis* have been reported as attacking several species of bamboo (*Phyllostachys* sp., *Bambusa* sp. and *Dendrocalamus* sp.), feeding individually in leaf cases or inside the stem. The infestation can result in blight and breaking of the hosts (Wang 1980). Hundreds of adults of *E. eumorphalis* appeared at a light trap during one night at Luoxiao Mountain. There is little doubt that large numbers of larvae of *E. eumorphalis* occur in this area and cause serious damage to bamboos.

Accepted by S.-H. Yen: 20 Jul. 2018; published: 11 Sept. 2018

While examining the collections of Pyraustinae deposited at the Museum of Biology, Sun Yat-sen University (SYSBM), we came across seven species superficially similar to *Eumorphobotys*. Among these species, two are undescribed and five are identified as *Calamochrous carnealis* (Swinhoe, 1895), *C. medialis* Caradja, 1925, *Loxoneptera albicostalis* Swinhoe, 1906, *L. carnealis* Hampson, 1896 and *Sclerocona acutella* (Eversmann, 1842) (the genus *Loxoneptera* Hampson, 1896 is recorded for the first time from China). Further studies based on the genitalia morphology and the genetic data suggest that the two undescribed species are closer to *E. eumorphalis* rather than the five species mentioned above.

The aim of the present study is to evaluate the generic placement of the new taxa, to re-assess the taxonomic boundary of *Eumorphobotys* and to provide a preliminary phylogenetic hypothesis of the relationships between *Eumorphobotys* and potentially related genera using selected genetic markers.

Material and methods

Molecular phylogenetic analysis. All species of the genus *Eumorphobotys*, two species of the genus *Loxoneptera*, two species of *Calamochrous* and one species of *Sclerocona* Meyrick, 1890 were included for molecular phylogenetic analyses (Table 1). *Loxoneptera*, *Calamochrous* and *Sclerocona* were chosen as the related genera of *Eumorphobotys* because they resemble *Eumorphobotys* in appearance. *Pseudebulea fentoni* Butler, 1881 was chosen as the outgroup because it was considered as a basal lineage of the Chinese Pyraustinae (Zhang 2003). According to Munroe and Mutuura (1969), *Prodasycnemis inornata* (Butler, 1879) was considered to be closely related to *Eumorphobotys*. In the present study, this species was not included in the phylogenetic analyses because no specimen with confirmed identification was collected in China. *Prodasycnemis inornata* was recorded in central China and subsequently identified as *Pionea inornata* by Caradja (1925). However, examination of the male genitalia of a specimen collected by Caradja revealed that it was misidentified and should be placed in *Sitochroa* Hübner, 1825.

Total DNA was extracted from a hindleg and a midleg, or occasionally from the abdomen (Knölke *et al*. 2005) of dried adult specimens using the TIANGEN DNA extraction kit following the manufacturer's instructions. The nucleotide sequences of two mitochondrial genes, *cytochrome c oxidase subunit I* (*COI*) and *16S ribosomal RNA* (*16S rRNA*), and two nuclear genes, *Elongation factor-1 alpha* (*EF-1α*), *28S ribosomal RNA* (*28S rRNA*) were selected for study. Primers used in this study were chosen according to Wahlberg & Wheat (2008), Simon *et al*. (2006), Hundsdoerfer *et al*. (2009) and Lee & Brown (2008). PCR cycle conditions were an initial denaturation of 5 min at 95°C, 30 s at 94°C, 30 s at 48°C (*COI* and *16S rRNA*) or 52°C (*EF-1α*, *28S rRNA*), and 1 min at 72°C for 35 cycles, and a final extension at 72°C for 10 min. PCR products were confirmed with 1.5% agarose gel electrophoresis in TAE buffer and were direct-sequenced at Majorbio Bio-pharm Technology Co., Ltd (Guangzhou), utilizing the same primers used for PCR amplification.

The sequences were aligned using Clustal W (Thompson *et al*. 1994) in MEGA 6 (Tamura *et al*. 2013) under default settings. The aligned matrix was corrected by eye. Gaps were treated as missing data in all analyses. Phylogenetic analyses were conducted using Bayesian inferring (BI) method and Maximum likelihood (ML). BI analysis was run in MrBayes 3.2.6 (Ronquist *et al*. 2012) with independent parameters for *COI* under the GTR + I model, *16S rRNA* under the GTR + G model, for *EF-1α* under the K80 + I + G model and for *28S rRNA* under the HKY + G model as suggested by jModelTest 0.1.1 (Posada, 2008). Four chains were run simultaneously for 10 million generations sampled every 1000th generation. The first 25% trees were discarded as burn-in, and posterior probabilities (PP) were determined from remaining trees. ML analysis was executed in RAxML 8.2.10 (Stamatakis 2014) under the GTR + I + G model and with 1000 iterations for bootstrap test. The pairwise Kimura 2-Parameter (K2P) distances between species were calculated from the *COI* gene using MEGA 6 (Tamura *et al*. 2013).

Morphological analysis. The studied specimens, including the types of the newly described species, are all deposited at the Museum of Biology, Sun Yat-sen University, Guangzhou (SYSBM), except for those held at the following institutions: the Forest Canopy Ecology Lab, Yunnan (FCEL) and the Insect Collection of the College of Life Sciences, Nankai University (NKU). Types of the previously known species were examined in the "Grigore Antipa" National Museum of Natural History, Bucharest (MGAB). Several specimens of *Loxoneptera* and *Calamochrous* were loaned from NKU. Slides of dissected genitalia were prepared according to the protocols of Robinson (1976) and Li & Zheng (1996). Terminology of genitalia follows Klots (1970), Munroe (1976), Maes

(1995) and Kristensen (2003). Images of the specimens were taken using a Canon EOS 1DX camera provided with a Canon 100 mm macro lens; the genitalia pictures were taken using Zeiss Axio Scope.A1 in combination with a Zeiss AxioCam camera and the Axio Vision SE64 programme on a Windows PC; source images were then aligned and stacked with Helicon Focus to obtain composite image.

Results

Phylogenetic relationships. The concatenated dataset of four genes consisted of 2505 nucleotide positions (658 for *COI*, 463 for *16S rRNA*, 771 for *EF-1α* and 613 for *28S rRNA*, respectively). Pairwise distances of the barcoding region (*COI*) are given in Table 2. The genetic distances between *Eumorphobotys* and other genera ranged from 9.2% (*Calamochrous*) to 15.7% (*Pseudebulea*). Interspecific genetic distances within *Eumorphobotys* ranged from 7.0% (*E. concavuncus* to *E. horakae*) to 8.3% (*E. eumorphalis* to *E. horakae*) while intraspecific genetic distances ranged from 0% (*E. eumorphalis*) to 0.6% (*E. concavuncus*).

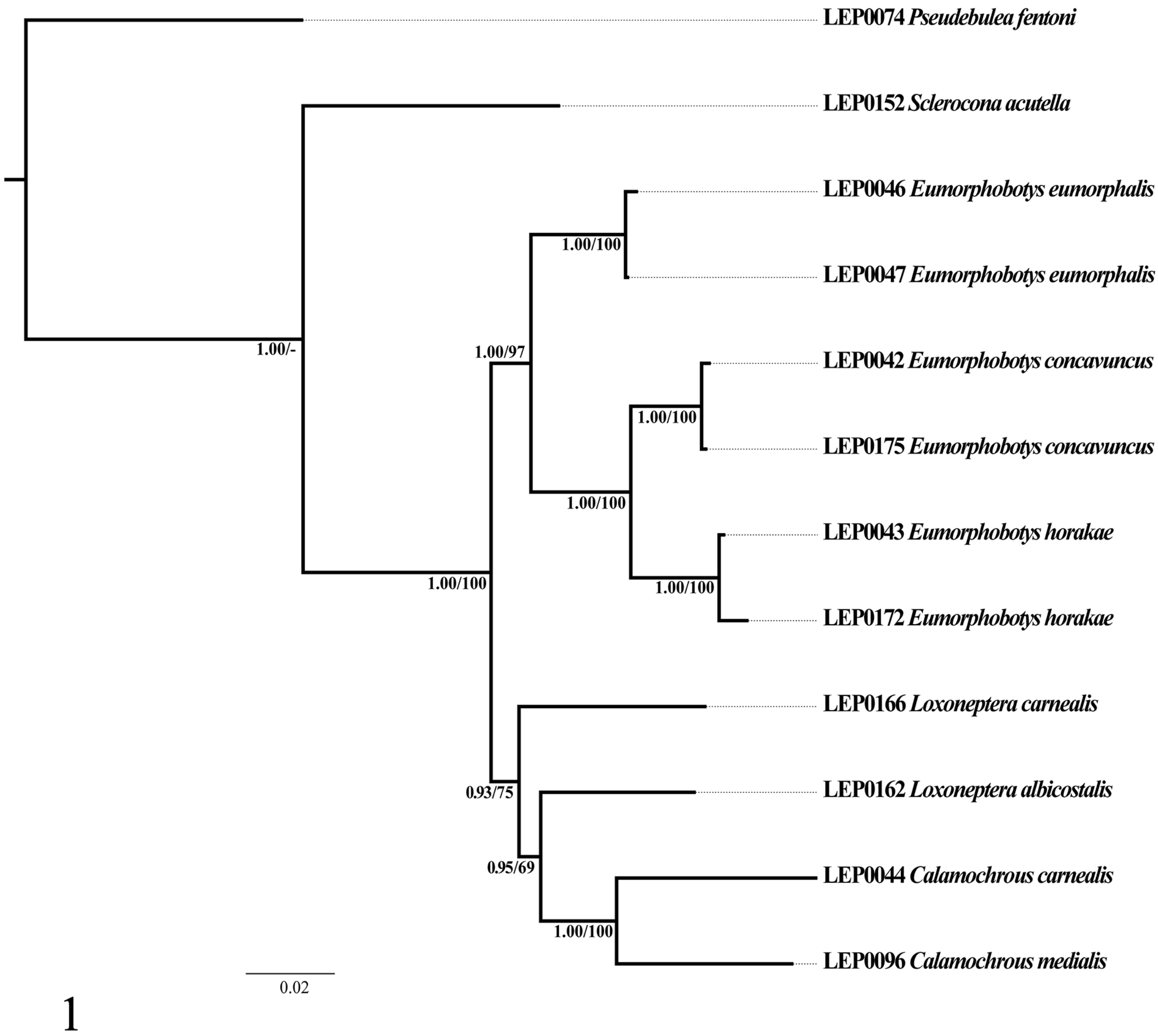


FIGURE 1. Phylogenetic hypotheses combined from results of Bayesian inference and Maximum likelihood, which are congruent topologically. Numbers at the branches indicate Bayesian posterior probabilities (Values larger than 0.8 are labelled) and ML bootstrap values probabilities (Values larger than 50% are labelled), respectively.

TABLE 1. Species sampled for the molecular phylogenetic analysis.

Genus	Species	Voucher	Locality	Genbank accession number			
				COI	*16S*	*EF-1α*	*28S*
Pseudebulea	*fentoni*	SYSULEP0074	Hunan	MG739570	MG739582	MG739594	MG739605
Calamochrous	*carnealis*	SYSULEP0044	Guizhou	MG739573	MG739585	MG739597	MG739608
Calamochrous	*medialis*	SYSULEP0096	Hainan	MG739576	MG739588	MG739600	MG739611
Eumorphobotys	*eumorphalis*	SYSULEP0046	Fujian	MG739574	MG739586	MG739598	MG739609
Eumorphobotys	*eumorphalis*	SYSULEP0047	Fujian	MG739575	MG739587	MG739599	MG739610
Eumorphobotys	*concavuncus*	SYSULEP0042	Yunnan	MG739571	MG739583	MG739595	MG739606
Eumorphobotys	*concavuncus*	SYSULEP0175	Guangxi	MG739581	MG739593	MG739604	MG739616
Eumorphobotys	*horakae*	SYSULEP0043	Sichuan	MG739572	MG739584	MG739596	MG739607
Eumorphobotys	*horakae*	SYSULEP0172	Sichuan	MG739580	MG739592	missing	MG739615
Loxoneptera	*albicostalis*	SYSULEP0162	Yunnan	MG739578	MG739590	MG739602	MG739613
Loxoneptera	*carnealis*	SYSULEP0166	Hainan	MG739579	MG739591	MG739603	MG739614
Sclerocona	*acutella*	SYSULEP0152	Macau	MG739577	MG739589	MG739601	MG739612

TABLE 2. Pairwise distances of the *COI* barcoding region based on Kimura-2-parameter.

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0074 *Pseudebulea fentoni*											
2	0152 *Sclerocona acutella*	0.148										
3	0046 *Eumorphobotys eumorphalis*	0.130	0.106									
4	0047 *Eumorphobotys eumorphalis*	0.130	0.106	0.000								
5	0042 *Eumorphobotys concavuncus*	0.157	0.123	0.076	0.076							
6	0175 *Eumorphobotys concavuncus*	0.152	0.123	0.074	0.074	0.006						
7	0043 *Eumorphobotys horakae*	0.157	0.129	0.083	0.083	0.072	0.070					
8	0172 *Eumorphobotys horakae*	0.157	0.129	0.079	0.079	0.072	0.070	0.003				
9	0044 *Calamochrous carnealis*	0.148	0.135	0.108	0.108	0.111	0.116	0.128	0.128			
10	0096 *Calamochrous medialis*	0.145	0.114	0.092	0.092	0.100	0.098	0.107	0.105	0.070		
11	0162 *Loxoneptera albicostalis*	0.159	0.116	0.093	0.093	0.097	0.097	0.115	0.111	0.085	0.081	
12	0166 *Loxoneptera carnealis*	0.157	0.116	0.102	0.102	0.121	0.115	0.129	0.129	0.121	0.096	0.093

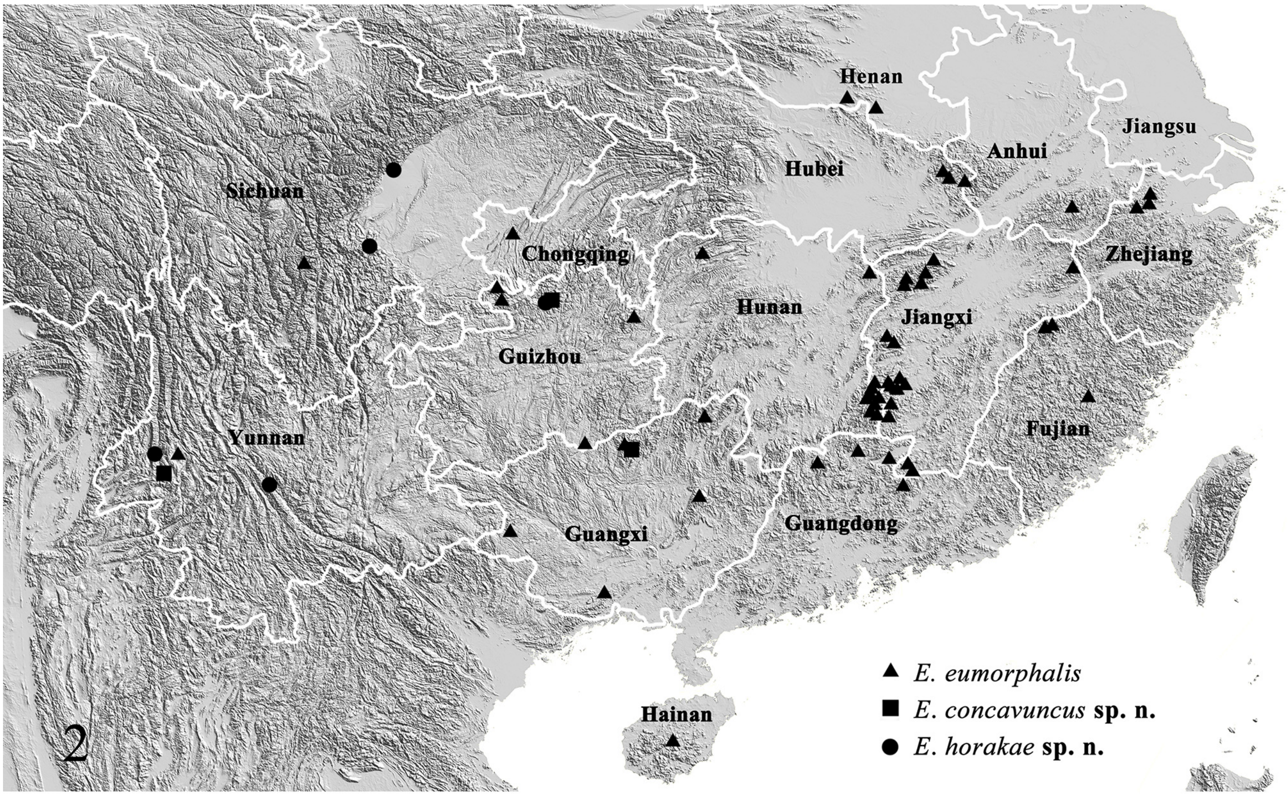


FIGURE 2. Distribution map of *Eumorphobotys* spp.

Both the BI and ML analyses of the concatenated dataset obtained congruent topologies with only subtle differences in posterior probability and bootstrap values probability (Fig. 1). The results robustly support the monophyly of *Eumorphobotys* (PP = 1.00, BS = 97). Among the *Eumorphobotys* species included in the analysis, *E. concavuncus* and *E. horakae* form a sister group with a robust support (PP = 1.00, BS = 100), while *E. eumorphalis* takes a sister position to *E. concavuncus* + *E. horakae*. *Loxoneptera albicostalis* appears to be sister of *Calamochrous carnealis* + *C. medialis* with a robust support in BI but with a relatively low support in ML (PP = 0.95, BS = 69). *Loxoneptera carnealis* is associated with the clade *L. albicostalis* + (*C. carnealis* + *C. medialis*) (PP =0.93, BS =0.75).

Due to the fact that the monophyly of clade *Eumorphobotys* is well-supported and the two undescribed species within the clade are morphologically and molecularly distinct from the potential sister groups, we concluded that these two undescribed species should be placed in the genus *Eumorphobotys*. The taxonomic details are given below.

Taxonomic accounts

Eumorphobotys Munroe & Mutuura, 1969

Eumorphobotys Munroe & Mutuura, 1969: 303. Type species: *Calamochrous eumorphalis* Caradja, 1925, by original designation.

Diagnosis. Species of *Eumorphobotys* can be superficially recognized by the long, porrect labial palpus, the usually concolorous forewing with no obvious pattern and the weakly curved to straight forewing termen. The male genitalia are characterized by a short and stout uncus, usually bearing few hair-like setae laterally; a distinct, strongly sclerotized and expanded joint at the base of costa; a finger-like, tapering editum with sparse setae; a pointed process extended from ventral margin of the valva and a large shield-shaped juxta with a broad base. In the female genitalia, the sinus vaginalis is densely spinulose and the signum is narrowly rhombic.

In appearance, species of *Eumorphobotys* resemble *Calamochrous* and *Sclerocona* through the long, porrect labial palpus and *Loxoneptera* through the long, porrect labial palpus and the usually concolorous forewing with no obvious pattern and a straight termen. However, they can be distinguished from *Calamochrous* and *Sclerocona* species by the straighter forewing termen, and from *Loxoneptera* by the smoky brown underside of forewing with a pale yellow area, the absence of the scales tuft on the inner margin of forewing and mid-lateral abdomen in males. In male genitalia, it differs from *Calamochrous*, *Sclerocona* and *Loxoneptera* through the short and stout uncus, the finger-like editum and the process extended from the ventral margin of the valva. *Eumorphobotys* is close to *Prodasycnemis* Warren, 1892 according to Munroe and Mutuura (1969). It differs from *Prodasycnemis* through the straighter forewing costa and termen, the brown to black fringe of the forewing at apex and tornus and in the male genitalia by the stout, distally blunt uncus and the basally expanded sacculus (not obvious in *E. horakae*). In males of *Prodasycnemis*, the basal mid-tibia with dense scales and forewing with weakly concave costa are differentiators from *Eumorphobotys*.

Description. Head. Frons oblique, smoothly scaled, with white lateral bands. Vertex with moderately raised scales projecting between antennae. Labial palpus brown, porrect, exceeding frons by about 2 times the length of head; first segment with white scales at the base; second segment obliquely upward; third segment long, porrect, somewhat slightly downward. Maxillary palpus brown, prominent, weakly broadened distally with scales. Proboscis well developed, with creamy white scales at base. Antennae yellowish brown, with cilia shorter than antennal diameter. **Thorax.** Dorsal side yellowish brown to smoky brown with appressed, yellowish to dark brown or reddish brown scales; ventral side white to pale yellow. Legs unmodified, white to pale yellow, outer spur 1/3 to 1/2 the length of inner spur. **Wings.** Forewing elongated triangular, costa straight to arched apex, white except in *E. eumorphalis*, apex sharp, termen slightly curved to straight, tornus obtuse; upperside with no pattern except the obscure reniform stigma, underside usually pale smoky brown except pale yellow inner margin; fringe yellowish with dark brown base, entirely brown at apex and from CuA_2 to tornus; frenulum hook in male well developed, retinaculum made up a tuft of curved bristles from below base of discal cell; discal cell about half the length of wing; R_1 free from about 2/3 of anterior margin of cell, R_2 free but adjacent to stem of R_3+R_4 for most of the basal half, R_3 and R_4 stalked to about 2/3, R_4 to just before apex, R_5 from anterior angle of cell, parallel to stalked R_3+R_4 at base, then diverging; M_1 moderately close to R_5 at base, M_2 widely separated from M_1, closing vein concavely curved, angled medially; M_2, M_3 and CuA_1 from inner angle of cell, M_3 closer to M_2 at base than to CuA_1, then diverging; CuA_2 from 1/4 of the inner margin of cell; 1A faintly sinuate to tornus; 2A forming complete loop and distally recurved before joining 1A. Hindwing broad, fan-shaped, termen rounded; upperside smoky brown, sometimes with a pale yellow patch at central area; underside paler, distal fifth smoky brown from apex to about CuA_2; fringe yellowish, with yellowish or dark brown base; frenulum single in male, with 2 acanthae in female; discal cell less than half length of wing, Sc+R_1 and Rs anastomosed for 1/3 beyond end of discal cell, Rs and M_1 short-stalked, closing vein concave; M_3 closer to M_2 at base than to CuA_1, parallel with M_2 at base, then diverging; 3A present. **Abdomen.** Pale brown to smoky or reddish brown, sometimes with first two segments paler than other segments. **Male genitalia.** Uncus short and stout, distally rounded or concave in the middle, with few hair-like setae at ventro-lateral sides. Tegumen trapezoid. Vinculum U-shaped. Saccus short-triangular. Valva tongue-shaped, slightly narrow or tapering to rounded apex, ventral margin extended, usually forming pointed process; transtilla nearly triangular, usually with ventral process weakly sclerotized; costa straight to moderately curved, broad, with distinct, strongly sclerotized and expanded joints (connecting to vinculum and tegumen) at base; editum finger-like, upcurved, sparely setose; sella only present in *E. eumorphalis*; sacculus with a indistinct process at middle. Juxta large shield-shaped with broad base. Phallus broad, vesica distinct, rough-textured, with various strongly sclerotized cornuti in distal half. **Female genitalia.** Ovipositor lobes flat, densely setose. Anterior apophysis two times longer than posterior apophysis. Lamella postvaginalis densely spinous. Antrum sclerotized. Ductus seminalis arising from anterior end of antrum. Ductus bursae long and slender, wrinkled longitudinally near antrum, sinuate near corpus bursae. Corpus bursae globular, accessory bursae present, signum narrowly rhomboid.

Biology. The larvae of *E. eumorphalis* (= *obscuralis* Caradja, 1925, see *E. eumorphalis*) feed on Bambusoideae species (Wang 1980, Wang *et al*. 2003).

Distribution. China (Fig. 2).

***Eumorphobotys eumorphalis* (Caradja, 1925)**
Figs 2, 3–7, 11, 14

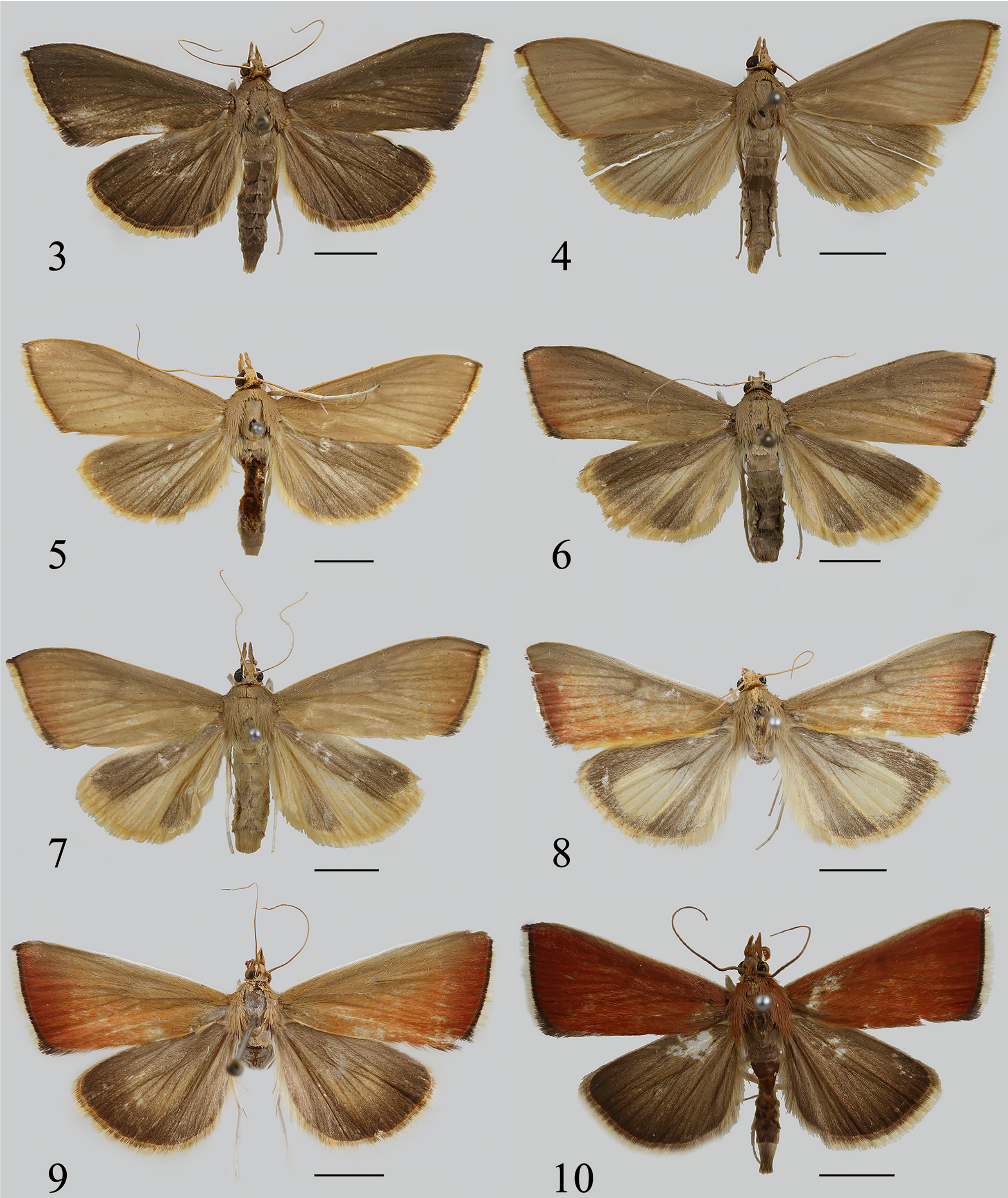
Calamochrous eumorphalis Caradja, 1925: 362, pl. 2 fig. 60.
Calamochrous obscuralis Caradja, 1925: 363, **syn. n.**
Eumorphobotys eumorphalis (Caradja, 1925): Munroe & Mutuura, 1969: 304, figs 3, 7.
Eumorphobotys obscuralis (Caradja, 1925): Munroe & Mutuura, 1969: 304.

Diagnosis. *Eumorphobotys eumorphalis* is best distinguished from other *Eumorphobotys* species as follows: forewing smoky brown (male) or yellowish brown, usually tinged with rose pink (female) and termen slightly curved. In the male genitalia, it can be distinguished by a distally rounded uncus, the dorsally divided juxta, the triangular sella (reduced in *E. concavuncus* and *E. horakae*), as well as broadly expanded sacculus. In the female genitalia, the ductus bursae is broader than in *E. concavuncus*, the length of ductus bursae is about two and a half times as long as the diameter of corpus bursae; arms of signum bearing carina are rounded distally.

Redescription. Head. As for the genus. **Thorax.** Yellowish brown to smoky brown. Legs with outer tibial spur about half length of the inner one. **Wings.** Wingspan 30–40 mm. Forewing smoky brown in male (occasionally yellowish brown in some specimens, Figs 4–5), yellowish brown, usually tinged with pink towards termen in female; underside pale smoky brown in male except for the slightly paler inner margin, in female pale yellowish with costal area pale smoky brown; costa somewhat darker than background colour, weakly arched, most arched near apex; termen slightly curved. No obvious wing pattern, reniform stigma rather obscure; fringe yellowish with smoky brown base, entirely smoky brown at apex and from CuA_2 to tornus, in some male specimens fringe with pale brown base (Figs 4–5). Hindwing smoky brown in male (occasionally paler in central area and termen), in the female (Fig. 7) usually smoky brown except pale yellow costa, inner margin and termen, pale yellowish brown area from M_3 to 1A (the pale yellowish brown area occasionally reduced in some specimens, Fig. 6); underside pale brown in male, pale yellow in female; fringe yellow with smoky brown base in male and yellowish brown base in female. **Abdomen.** Smoky brown in male, yellowish brown (sometimes smoky brown except the first three segments) in female dorsally, underside pale yellow. **Male genitalia** (Fig. 11)**.** Uncus rather flat, distally rounded and smooth. Valva narrowing to a rounded apex, with a spine-shaped, strongly sclerotized process extended from middle of ventral margin; transtilla slightly larger than in *E. concavuncus*; costa nearly straight; editum broad at base, upcurved; sella triangular, strongly sclerotized, pointed to ventral margin; sacculus broadly expanded, with a semi-circular process at middle and a relatively small semi-circular process distally. Juxta large, with its dorsal quarter divided into two arms. Phallus strong and thick, weakly narrow basally, length about 4 times as long as width; vesica twisted and densely spinulose, with a group of sharp, straight cornuti of graded size (occasionally fall off, Fig. 11B), basal cornuti followed with two shell-like, strongly sclerotized and densely spinous structures. **Female genitalia** (Fig. 14)**.** The seventh sternite with a sclerotized band distally. Antrum cup-shaped, strongly sclerotized and very broad, about 3–4 times of width of ductus bursae. Ductus bursae long and broad, about two and a half times the diameter of corpus bursae. Corpus bursae relatively large; signum with two arms large and distally rounded bearing carina, other two arms not extended.

Material examined. Type material. Lectotype of *Calamochrous eumorphalis*: 1♂, Mokanshan (Prov. Chekiang), CHINA, VII, designated by Caradja, confirmed by Eugen Munroe (1964); allolectotype of *Calamochrous eumorphalis*: 1♀, Mokanshan (Prov. Chekiang), CHINA, VIII, designated by Aurelian Popescu-Gorj; lectotype of *Calamochrous obscuralis*: 1♂, Amoy, 6.IV., designated by Eugen Munroe (1964); paralectotype of *Calamochrous obscuralis*: 1♂, Amoy, 28.IV., designated by Aurelian Popescu-Gorj, genitalia slide no. 621 (2017). Type specimens in MGAB.

Other material examined. CHINA, Zhejiang: 9♂, 9♀, Mt. Tianmushan, 30.31°N, 119.44°E, alt. 295 m, 11.V.2012, Li Jinwei leg., genitalia slide no. SYSU0923 (♂), 0924 (♀); 1♀, Mt. Mokanshan, 30.VIII.1926, genitalia slide no. 619 (2017) (coll. MGAB); 1♀, Mt. Mokanshan, 15.VIII.1930, genitalia slide no. 618 (2017) (coll. MGAB); 3♀, Mt. Mokanshan, 18, 20 and 21.VIII.1930 (coll. MGAB); 1♂, Mt. Mokanshan, genitalia slide No. 620 (2017) (coll. MGAB); 4♂, 7♀, Back gate of Mt. Tianmushan, 16.VIII.1999, alt. 500 m, Li Houhun *et al.* leg. (coll. NKU); 2♂, 4♀, Sanmuping, Mt. Tianmushan, 19.VIII.1999, alt. 800 m, Li Houhun *et al.* leg. (coll. NKU); 11♂, 13♀, Chanyuan Temple, Mt. Tianmushan, 15–20.VIII.1999, alt. 350 m, Li Houhun *et al.* leg. (coll. NKU); 1♀, Kaishanlaodian, Mt. Tianmushan, 17.VIII.1999, alt. 1140 m, Li Houhun *et al.* leg. (coll. NKU); **Anhui:** 1♂, 1♀, Tangkou Town, Huangshan City, 30.05°N, 118.11°E, alt. 580 m, 19.IX.2012, Li Jinwei leg., genitalia slide



FIGURES 3–10. Adults of *Eumorphobotys* spp. 3. *E. eumorphalis*, male (Tongmu, Fujian). 4. *E. eumorphalis*, male (Mt. Tianmushan, Zhejiang). 5. *E. eumorphalis*, male (Mt. Tianmushan, Zhejiang). 6. *E. eumorphalis*, female (Chebaling, Guangdong). 7. *E. eumorphalis*, female (Mt. Jiuwandashan, Guangxi). 8. *E. concavuncus* **sp. n.**, holotype, male (Mt. Gaoligongshan, Yunnan). 9. *E. concavuncus* **sp. n.**, paratype, female (Kuankuoshui Tea Factory, Guizhou). 10. *E. horakae* **sp. n.**, paratype, male (Rangshui Watershed, Guizhou). (Scale bars = 5 mm)

FIGURES 11–13. Male genitalia of *Eumorphobotys* spp. 11. *E. eumorphalis*, A: phallus with several sharp, straight cornuti of graded size, genitalia slide no. SYSU0975; B: phallus with no straight cornuti, genitalia slide no. SYSU0972. 12. *E. concavuncus* **sp. n.**, genitalia slide no. SYSU0974. 13. *E. horakae* **sp. n.**, genitalia slide no. SYSU0983. (Scale bars = 1 mm)

no. SYSU0975 (♂), 0976 (♀); **Fujian:** 7♂, 9♀, Tongmu, Mt. Wuyishan, 27.75°N, 117.68°E, alt. 759 m, 19.V.2012, Li Jinwei leg.; 5♂, 3♀, Tongmu, Mt. Wuyishan, 27.75°N, 117.68°E, alt. 759 m, 20.V.2012, Li Jinwei leg.; 51♂, 7♀, Sangang, Tongmu Village, Mt. Wuyishan, 27.75°N, 117.68°E, alt. 758 m, 20.VIII.2016, Chen Kai & Duan Yongjiang leg., genitalia slide no. SYSU0164 (♂), molecular voucher no. LEP0046; 12♂, 7♀, Guadun, Mt. Wuyishan, 27.74°N, 117.64°E, alt. 1220 m, 17.V.2012, Li Jinwei leg., genitalia slide no. SYSU0608 (♀); 8♂, 3♀, Guadun, Mt. Wuyishan, 27.74°N, 117.64°E, alt. 1220 m, 18.V.2012, Li Jinwei leg., genitalia slide no. SYSU0606 (♀); 6♂, 9♀, Guadun, Mt. Wuyishan, 27.74°N, 117.64°E, alt. 1220 m, 23.VIII.2016, Chen Kai & Duan Yongjiang leg., genitalia slide no. SYSU0162 (♀), molecular voucher no. LEP0047; 1♀, Chishui Station, Mt. Daiyunshan, 25.64°N, 118.14°E, alt. 1015 m, 22.V.2012, Li Jinwei leg.; 1♀, Daiyun Village, Mt. Daiyunshan, 25.64°N, 118.21°E, alt. 902 m, 23.V.2012, Li Jinwei leg.; 1♀, Mt. Daiyunshan, Dehua County, 15.IX.2002, alt. 850 m, Wang Xinpu leg.; **Jiangxi:** 1♂, 2♀, Daqishan Forest Farm, Jing'an County, 28.67°N, 115.07°E, alt. 350 m, 16.VII.2014, Chen Kai leg.; 9♂, 2♀, Guanyinyan, Jing'an County, 29.03°N, 115.25°E, alt. 195 m, 20.VII.2014, Chen Kai leg., genitalia slide no. SYSU0921(♂), 0922(♀); 10♂, 1♀, Guanshan National Nature Reserve, Yifeng County, 28.55°N, 114.58°E, alt. 394m, 14.VI.2016, Chen Kai & Duan Yongjiang leg.; 4♂, 5♀, Shixi Village, Fengxin County, 28.44°N, 114.54°E, alt. 506 m, 22.IX.2012, Li Jinwei & Yang Lijun leg.; 9♂, 1♀, Shangfu Town, Fengxin County, 28.41°N, 115.00°E, alt. 108 m, 21.IX.2012, Li Jinwei & Yang Lijun leg., genitalia slide no. SYSU0609(♀), 0610(♂); 8♂, 4♀, Mt. Sanqingshan, Shangrao County, 28.93°N, 118.09°E, alt. 389 m, 15.V.2012, Li Jinwei leg.; 50♂, 67♀, Mt. Wugong, Luxi County, 27.48°N, 114.15°E, alt. 500 m, 23.IX.2016, Chen Kai & Duan Yongjiang leg.; 34♂, 14♀, Mt. Wugong, Anfu County, 27.33°N, 114.23°E, alt. 400 m, 24.VII.2014, Chen Kai leg.; 15♂, Mt. Bijiashan, Jinggangshan, 17.X.2010, Zhang Dan-dan, Zhao Shuang & Tong Bo leg.; 12♂, 9♀, Xiangzhou, Jinggangshan, 31.V.2011, Yang Lijun leg.; 5♂, Xiangzhou, Jinggangshan, 26.IV.2011, Yu Yali leg.; 1♂, Xiangzhou, Jinggangshan, 4.IX.2011, Li Jinwei leg.; 1♂, Xiaoxidong, Jinggangshan, 24.IV.2011, Liu Ping & Mei Yan leg.; 2♂, Xiaoxidong, Jinggangshan, 30.V.2011, Li Jinwei leg.; 7♂, Xiaoxidong, Jinggangshan, 2.VIII.2011, Li Jinwei leg.; 1♀, Xiaoxidong, Jinggangshan, 29.X.2011, Li Jinwei leg.; 15♂, Sanjizhan Reservoir, Luofu, Jinggangshan, 18.IX.2010, Zhang Dan-dan, Zhao Shuang & Tong Bo leg.; 2♂, Luofu, Jinggangshan, 3.III.2011, Li Jinwei leg.; 1♀, Luofu, Jinggangshan, 29.V.2011, Li Jinwei & Yang Lijun leg.; 1♀, Luofu, Jinggangshan, 31.V.2011, Yang Lijun leg.; 2♂, Dajing, Jinggangshan, 19.IX.2011, Zhang Dan-dan, Zhao Shuang & Tong Bo leg.; 1♂, Nanfengmian Natural Reserve, Qianmo Village, Suichuan County, 26.28°N, 114.06°E, alt. 816 m, 19.VI.2015, Chen Kai leg.; 2♀, Nanfengmian Natural Reserve, Qianmo Village, Suichuan County, 26.29°N, 114.06°E, alt. 820 m, 19.IX.2017, Chen Kai leg.; 3♀, Mt. Guanggushan, Wuzhifeng Village, Shangyou County, 25.92°N, 114.05°E, alt. 183 m, 22.VI.2015, Chen Kai leg., genitalia slide no. SYSU0934; 4♀, Mt. Guanggushan, Wuzhifeng Village, Shangyou County, 25.92°N, 114.05°E, alt. 183 m, 20.IX.2016, Chen Kai & Duan Yongjiang leg.; 1♂, Xiagongtang, Mt. Jiulianshan, Longnan County, alt. 630 m, 29.VIII.2007, Zhang Dan-dan leg., genitalia slide No. HFX08312; 1♂, Xiagongtang, Mt. Jiulianshan, Longnan County, alt. 500 m, 11.VII.2008, He Fengxia leg.; 2♂, 1 (♀) Daqiutian, Mt. Jiulianshan, Longnan County, alt. 500 m, 31.VIII.2007, Zhang Dan-dan leg., genitalia slide no. HFX08219 (♂), 08311 (♀); 1♂, Daqiutian, Mt. Jiulianshan, Longnan County, alt. 500 m, 12.VII.2008, Jia Fenglong leg., genitalia slide no. HFX08220; 2♂, Mt. Jiulianshan, Longnan County, 24.54°N, 114.46°E, alt. 625 m, 27.IV.2012, Li Jinwei leg.; 1♀, Mt. Jiulianshan, Longnan County, 24.54°N, 114.46°E, alt. 625 m, 28.IV.2012, Li Jinwei leg.; 34♂, 1♀, Mt. Jiulianshan, Longnan County, 24.58°N, 114.43°E, alt. 620 m, 26.IX.2016, Chen Kai & Duan Yongjiang leg.; 4♂, Mt. Jiulianshan, Longnan County, 24.58°N, 114.43°E, alt. 620 m, 24.IX.2017, Chen Kai leg.; **Henan:** 2♂, Shuiliandong, Tongbai County, 25–26.V.2000, alt. 300 m, Yu Haili leg. (coll. NKU); 1♀, Lingshan Temple, Luoshan County, 22.V.2000, alt. 350 m, Yu Haili leg. (coll. NKU); **Hubei:** 9♂, 8♀, Mt. Wujiashan, Yingshan County, 31.05°N, 115.47°E, alt. 880 m, 29.VI.2014, Chen Xiaohua & Pan Chang leg.; 4♂, 6♀, Qingtaiguan, Luotian County, 31.11°N, 115.41°E, alt. 524 m, 2.VII.2014, Liu Zhenhua & Pan Chang leg.; 4♀, Taohuachong, Mt. Dabieshan, 31.00°N, 115.90°E, alt. 661 m, 24.VI.2014, Chen Xiaohua & Pan Chang leg.; **Hunan:** 4♂, 1♀, Mt. Mufushan, National Forest Park, Pingjiang County, 28.97°N, 113.82°E, alt. 1062 m, 11.VI.2016, Chen Kai & Duan Yongjiang leg.; 9♂, 7♀, Shennonggu National Forest Park, Yanling County, 26.52°N, 114.01°E, alt. 379 m, 17.VI.2016, Chen Kai & Duan Yongjiang leg.; 4♂, 3♀, Shennonggu National Forest Park, Yanling County, 26.52°N, 114.01°E, alt. 379 m, 19.IX.2017, Chen Kai leg.; 39♂, 122♀, Jiashui, Taoyuandong, 26.59°N, 113.99°E, alt. 420 m, 19.V.2014, Chen Xiaohua leg.; 22♂, 26♀, Visitor Center, Taoyuandong, 26.47°N, 114.04°E, alt. 870 m, 20.V.2014, Chen Xiaohua leg.; 6♂, 6♀, Shigang, Taoyuandong, 26.56°N, 113.99°E, alt. 621 m, 24.V.2014, Liu Xiaolin leg.; 22♂, 27♀, Mihua Village, Taoyuandong, 26.50°N, 114.07°E, alt. 598 m, 25.V.2014, Lin Renchao leg.; 30♂, 16♀, Mihua Village, Taoyuandong, 26.50°N, 114.07°E, alt. 598 m, 25.V.2014, Pan Chang leg.; 63♂, 108♀, Zhulian Waterfall, 26.50°N, 113.99°E, alt. 500 m, 26.V.2014, Liu Xiaolin leg.; 25♂, 81♀, Zhulian Waterfall, 26.50°N, 113.99°E, alt. 500 m, 26.V.2014, Lin Renchao leg.; 1♂, 5♀, Mt. Huilongshan, Zixing City, 26.08°N, 113.39°E, alt. 886 m, 8.VI.2016, Chen Kai & Duan Yongjiang leg.; 2♂, Mt. Huilongshan, Zixing City, 26.08°N, 113.39°E, alt. 886 m, 17.IX.2017, Chen Kai leg.; 1♂, Jinyinpu, Bamianshan Natural Reserve, 25.97°N, 113.71°E, alt. 973 m, 16.VI.2015, Chen Kai leg.; 1♂, Zhangjiajie, 7.VIII.2001, alt. 650 m, Li Houhun & Wang Xinpu leg. (coll. NKU); **Guangdong:** 8♂, 1♀, Chebaling National Nature Reserve, Shixing County, 24.73°N 114.27°E, alt. 496 m, 29.V.2017, Chen Kai leg.; 4♂, Chebaling National Nature Reserve, Shixing County, 24.73°N 114.27°E, alt. 496 m, 29.V.2017, Duan Yongjiang leg.; 4♂, Chebaling National Nature Reserve, Shixing County, 24.73°N 114.27°E, alt. 496 m, 29.V.2017, Zhang Dan-dan leg.; 1♂, 2♀, Mt. Danxiashan, Shaoguan, 25.04°N, 113.64°E, alt. 96 m, 6.VI.2012, Li Jinwei leg.; 2♀, Mt. Danxiashan, Shaoguan, 25.04°N, 113.64°E, alt. 96 m, 7.VI.2012, Li Jinwei leg.; 1♂, 1♀, Mt. Danxiashan, Shaoguan, 25.04°N, 113.64°E, alt. 96 m, 6.VI.2012, Chen Xiaohua leg.; 1♀, Mt. Dadongshan, Lianzhou, alt. 650

m, 21.VI.2004, Zhang Dan-dan leg.; 1♂, Mt. Nankunshan, Huizhou City, 16.VII.2003, Li Zhiqiang & Zhang Dan-dan leg., genitalia slide no. ZDD03033; 1♂, Lianping County, 12.VIII.2009, Zeng Yanyi leg.; **Guangxi:** 10♂, 4♀, Gaozhai, Xing'an County, 28.VIII.2011,Li Jinwei & Zhang Dan-dan leg.; 2♂, 2♀, Mt. Shengtang, Jinxiu County, 25.VIII.2011, Li Jinwei, Yang Lijun & Zhang Dan-dan leg.; 3♂, 2♀, Mt. Shengtang, Jinxiu County, 26.VIII.2011,

FIGURES 14–15. Female genitalia of *Eumorphobotys* spp. 14. *E. eumorphalis*, genitalia slide no. SYSU0971. 15. *E. concavuncus* **sp. n.**, genitalia slide no. SYSU0163. (Scale bars = 5 mm)

Li Jinwei, Cheng Muchun & Zhang Dan-dan leg.; 1♀, Dawangling, Baise City, 23.54°N, 106.37°E, alt. 133 m, 19.VII.2013, Chen Xiaohua leg.; 17♂, 39♀, Yangmei'ao, Mt. Jiuwandashan, 25.19°N, 108.65°E, alt. 1183 m, 22.VII.2015, Chen Kai leg.; 1♂, 1♀, Mt. Pinglongshan, Shangxi County, 6.IV.2002, alt. 510 m, Hao Shulian & Xue Huaijun leg. (coll. NKU); **Hainan:** 1♂, Mt. Limushan, 5.V.2011, Yang Lijun & Zhang Dan-dan leg.; 1♂, Mt. Limushan, 2.XI.2013, 19.17°N 109.73°E, alt. 755 m, Chen Xiaohua & Chen Kai leg., genitalia slide no. SYSU0972; **Chongqing:** 1♀, Shamuyuan, Mt. Jinyunshan, 11.IX.2009, Du Xicui leg.; **Sichuan:** 1♀, Hailuogou, Luding County, 29.33°N 101.59°E, alt. 496 m, 2.VII.2012, Li Jinwei leg., genitalia slide no. SYSU 0971; 1♂, Hailuogou, Luding County, 29.33°N 101.59°E, alt. 496 m, 4.VII.2012, Li Jinwei leg., genitalia slide no. SYSU0970; **Guizhou:** 1♂, Maolan Natural Reserve, 1.IX.2011, Li Jinwei leg., genitalia slide no. SYSU0977; 1♂, 6♀, Linjiang Village, Xishui County, 31.V.2000, 24–26.IX.2000, alt. 500–550 m, Du Yanli & Yu Haili leg. (coll. NKU); 5♂, 10♀, Suoluo, Chishui Town, 29–30.V.2000, 22.IX.2000, alt. 240–390 m, Du Yanli & Yu Haili leg. (coll. NKU); 4♂, Heiwan, Jiangkou County, 28.VII.2001, 600 m, Li Houhun & Wang Xinpu leg. (coll. NKU).

Distribution. China (Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou).

Remarks. Examination of the wing colour of *E. eumorphalis* specimens collected from thirteen provinces of China reveals that *E. eumorphalis* is a sexually dimorphic species. In most male specimens both wings are smoky brown while in female specimens the forewing is yellowish brown and hindwing smoky brown with pale yellow. However, several male specimens collected in Mt. Tianmushan (the same mountain as where types of *E. eumorphalis* were collected, but the exact collection point of types is unknown) have similar wing colour to the females (Figs 4–5). Variations encountered in wing colour are restricted to few male specimens. It is reasonable to assume that Caradja, Munroe and Mutuura treated *E. obscuralis* as distinct species only based on the different wing colour between male specimens collected from Amoy and Mokanshan. However, the male genitalia of paratype of the *C. obscuralis* (genitalia slide no. 621, MGAB) shows no difference to those of *E. eumorphalis*. Consequently, *E. obscuralis* is synonymized with *E. eumorphalis* in the present study.

Eumorphobotys eumorphalis is mainly distributed in the south of the Chinese mainland. It is also recorded from Taiwan (see http://twmoth.tesri.gov.tw/peo/MothQuery.aspx?F=Crambidae&G=Eumorphobotys&S=Eumorphobotys%20eumorphalis).

Eumorphobotys concavuncus Chen & Zhang, sp. n.

Figs 3, 10, 19, 27

Diagnosis. *Eumorphobotys concavuncus* resembles female specimens of *E. eumorphalis* through its similar forewing colour of yellowish brown tinged with rose pink to reddish brown. In *E. concavuncus*, the area of the forewing tinged with rose pink to reddish brown stretches from M_2 to the inner margin, whereas in the females of *E. eumorphalis* only the termen of forewing is tinged with pink. The white costa and the straight termen of the forewing are also differentiators from *E. eumorphalis*. The smoky brown termen of the hindwing differentiates *E. concavuncus* from most female *E. eumorphalis*. In the male genitalia, *E. concavuncus* can be distinguished from the other *Eumorphobotys* species as follows: uncus with stronger sides and a concavity in the middle of its distal margin; a sclerotized editum, except for the dorsal base; valva with a tighter rounded tip, bearing two unequal (the distal one shorter) sclerotized processes on the ventral margin. In the female genitalia, the ductus bursae is more than 5 times the diameter of corpus bursae and the signum's arms are more acute than those of *E. eumorphalis*.

Description. Head. As for the genus. **Thorax.** Yellowish brown. Legs unmodified with outer tibial spur about 1/3 length of the inner one. **Wings.** Wingspan 31–37 mm. Forewing yellowish brown, tinged with rose pink to reddish brown from about M_2 to its inner margin (occasionally diffuse to apex), darkened at the inner margin; underside pale smoky brown except for the inner margin; costa white, straight, weakly arched near apex; apex sharp; termen straight to rounded tornus; reniform stigma obscure, slightly curved; fringe whitish yellow with smoky brown base, entirely smoky brown at apex and at CuA_2 to tornus. Hindwing diffuse smoky brown, with the exception of a pale yellow central area and the inner margin (the pale yellow area is reduced in some specimens, Fig. 9); underside pale yellow, termen pale brown; fringe whitish yellow with brown base. **Abdomen.** Brown dorsally, underside pale yellow. **Male genitalia** (Fig. 12). Uncus sclerotized with stronger sides, rounded distally, with a concavity in the middle. Valva tapers slightly to rounded apex, ventral margin extended and sclerotized in the middle with two unequal processes: the proximal one is longer and slightly curved, with ventral surface densely covered of short hairs, while the distal one is shorter and smaller, with a heavily sclerotized, thick spine inside it; transtilla smaller if compared with the other two species; costa weakly curved near base; sacculus broad, moderately expanded, with an indistinct triangular process in the middle; editum finger-like and barely setose, moderately upcurved, sclerotized with the exception of the dorsal base. Juxta large, shield-shaped, with a broad base which quickly narrows, dorsal half with straight sides. Phallus slender, slightly sinuated; vesica with two sclerotized, ovate cornuti in its distal third, appressed to each other, covered with tiny teeth. **Female genitalia** (Fig. 15). Antrum tubular, narrower than ductus bursae, with its anterior half slightly widened and sclerotized. Ductus bursae more than five times the diameter of corpus bursae, with sclerotized base. Corpus bursae small; signum with two arms bearing a pointed carina, other two arms small and short.

Material examined. Type material. Holotype ♂ (Fig. 8). **CHINA, Yunnan:** Mt. Gaoligongshan, Natural Park, Baoshan, 24.82°N 98.78°E, alt. 1700 m, 22.V.2016, Duan Yongjiang leg., genitalia slide no. SYSU0147, molecular voucher no. LEP0042.

Paratypes: **Guangxi:** 1♂, Yangmei'ao, Mt. Jiuwandashan, 25.19°N 108.65°E, alt. 1183 m, 22.VII.2015, Chen Kai leg., genitalia slide no. SYSU0989, molecular voucher no. LEP0175; **Guizhou:** 1♀, Kuankuoshui Tea Factory, alt. 1500 m, 16.VIII.2010, Du Xicui leg., genitalia slide no. SYSU0163; **Yunnan:** 9♂, Mt. Gaoligongshan, Natural Park, Baoshan, 24.82°N 98.78°E, alt. 1700 m, 22–23.V.2016, Duan Yongjiang leg., genitalia slide no. SYSU0974.

Distribution. China (Guangxi, Guizhou, Yunnan).

Etymology. The specific name derived from the Latin *concav*- and *uncus*, referring to the distal uncus concave in the middle.

Eumorphobotys horakae Chen & Zhang, sp. n.

Figs 2, 10, 13

Diagnosis. The wingshape of *Eumorphobotys horakae* is similar to *E. concavuncus*. It can be best distinguished from other *Eumorphobotys* species by its clean reddish brown forewing. In the male genitalia, it can be differentiated as follows: uncus with a small distal process on its dorsal side, valva with its ventral margin widened and densely spinous in the middle 1/3, juxta with a tapered distal half and spiny cornuti on about half of the phallus vesica.

Description. Head. Frons and vertex reddish brown. **Thorax.** Smoky brown dorsally, with pale reddish brown scales on the sides. Legs as described for genus, outer tibial spur about 1/3 of the inner one. **Wings.** Wingspan 30–32 mm. Forewing shape as in *E. concavuncus*; background colour clean reddish brown; underside as in *E. concavuncus*; reniform stigma faint, stripe-shaped, dark reddish brown; fringe as in *E. concavuncus*. Hindwing uniform smoky brown; underside pale yellow with pale brown termen; fringe whitish yellow with smoky brown base. **Abdomen.** Smoky brown dorsally, first two segments paler, underside light yellow. **Male genitalia** (Fig. 13). Uncus broad, rounded distally, with a small process in the middle of its dorsal side. Valva gradually narrowing towards the rounded apex, ventral margin with its medial third extended with a lamellar structure, densely spinous on its outer margin, with a short thorn at 1/3 of its distal end; a rich layer made up of tufts of relatively longer, stronger sclerotized hairs along the distal half of valva's ventral side; transtilla larger if compared with the other two species; sacculus moderately broad, with a indistinct, small process in its middle. Juxta large, shield-shaped, with the distal half tapered. Phallus slender, slightly downcurved; vesica distally with a long, spine-shaped cornuti, almost half as long as the entire phallus. **Female genitalia.** Unknown.

Material examined. Type material. Holotype ♂. **CHINA, Sichuan:** Gongyihai Conservation Station, Liziping Natural Reserve, Shimian County, Ya'an City, 29.03°N 102.38°E, alt. 2065 m, 24.VII.2016, Duan Yongjiang leg., genitalia slide no. SYSU0148, molecular voucher no. LEP0043.

Paratypes: **Sichuan:** 4♂, Anzihe Natural Reserve, 4.VIII.2015, Du Xicui leg., genitalia slide no. SYSU0988, molecular voucher no. LEP0172; 1♂, Gongyihai Conservation Station, Liziping Natural Reserve, Shimian County, Ya'an City, 29.03°N 102.38°E, alt. 2065 m, 24.VII.2016, Duan Yongjiang leg.; **Guizhou:** 1♂, Rangshui Watershed, Kuankuoshui, 16.VIII.2010, Yang Lin-lin leg., genitalia slide no. SYSU0983; **Yunnan:** 1♂, Dahaoping, Tengchong, alt. 2020 m, 6.VIII.2007, Zhang Dan-dan leg., genitalia slide no. SYSU0973; 1♂, Mt. Ailaoshan, alt. 2200 m, 31.VII.2011, Kitching & Ashton leg. (coll. FCEL).

Distribution. China (Sichuan, Guizhou, Yunnan).

Etymology. The name is a patronym dedicated to Dr. Marianne Horak, a major contributor to the systematics of the Lepidoptera.

Remarks. The appearance of *E. horakae* is somewhat similar to *Loxoneptera albicostalis* Swinhoe, 1906 in the straight forewing termen and the reddish brown forewing colour. The type specimen of the latter species to which the original description of Swinhoe refers is less reddish. However, the wing colour of specimens collected in Yunnan is indistinguishable from *E. horakae*. Yet, males of *L. albicostalis* Swinhoe, 1906 can be distinguished from *E. horakae* by the presence of a tuft of scales on the inner margin of forewing and a large bundle of scales on the mid-lateral side of abdomen. Where these scales have been worn away, some specimens of *L. albicostalis* can still be distinguished from *E. horakae* by the slightly sinuate inner margin and the clean smoky brown underside of forewing, as well as the pale triangular patch in the centre of the hindwing.

Key to the species of *Eumorphobotys* based on males

1. Forewing with slightly curved termen; sella triangular, juxta distally divided. . . . . *E. eumorphalis*
- Forewing with almost straight termen; sella reduced, juxta distally not divided 2
2. Forewing yellowish brown, tinged with rose pink to reddish brown from about M_2 to its inner margin; uncus with a concavity in the middle of its distal margin, valva with two unequal processes on the ventral margin . . . . *E. concavuncus* **sp. n.**
- Forewing reddish brown; uncus with a small process in the middle of its dorsal side, ventral margin of the valva densely spinous in its medial third . . . . *E. horakae* **sp. n.**

Discussion

As is apparent from the tree topology (Fig. 1), *Sclerocona* is less closely related to *Eumorphobotys*. In appearance *S. acutella* (Eversmann, 1842) resembles species of *Eumorphobotys* in having the long, porrect labial palpus. The male genitalia of *S. acutella* is also quite different from those of *Eumorphobotys* species. It can be distinguished by the cone-shaped uncus with dense laterally setae, the lamellar editum and the deeply divided, U-shaped juxta. Unexpectedly, the current phylogenetic analyses reveal that *Loxoneptera* is paraphyletic. Externally *Loxoneptera* species are distinct in the tuft of scales on the inner margin of the male's forewing and the bundle of scales on the side of their middle abdomen. Examinations of the male genitalia of *Loxoneptera* species and Chinese *Calamochrous* species (including several unidentified specimens) suggest that they are probably congeneric. In the male genitalia, all these species share some similar structures such as the cone-shaped uncus, the peculiar long and slender, distally thick hairy extension at the base of the costa and the boat-shaped base of the juxta. The 8th sternite with slender anterolateral processes is another common character shared between *Loxoneptera* species and Chinese *Calamochrous* species. However, the pronounced slender editum, distally with few setae, as well as the undivided juxta of *Loxoneptera* species, makes them different from the Chinese *Calamochrous* species. To clarify this relationship, more *Calamochrous* species, including the types, need to be examined.

Prodasycnemis inornata was not included in the phylogenetic analyses. Morphologically, *P. inornata* is similar to all the *Eumorphobotys* species through the finger-like, tapering editum, the distinct joint at basal costa, the pointed process extended from ventral valva and the basally bulged juxta, to *E. eumorphalis* also by the weakly curved termen of forewing, the broad phallus with several sharp, straight cornuti and to *E. horakae* by the strong but not broad sacculus and the dorsally tapering juxta. In the female genitalia, the spinulose sinus vaginalis is similar to those of *E. eumorphalis* and *E. concavuncus*; the shape of signum is similar to *E. concavuncus*. *Prodasycnemis* and *Eumorphobotys* are definitely closely related based on these similar characters. Bearing in mind the differences between *Eumorphobotys* and *Prodasycnemis*, noted above within the generic diagnosis of *Eumorphobotys*, we still consider *Eumorphobotys* and *Prodasycnemis* as closely related but distinct genera. Genetic data on *P. inornata* is required to confirm the generic position of *Prodasycnemis*. Considering the similarity in both male and female genitalia between the two genera, it would not be a surprise if they are proved to be congeneric by future research.

Acknowledgements

We would like to express our grateful thanks to Prof. Houhun Li (College of Life Sciences, Nankai University, Tianjin, China) for the loan of specimens, to Dr Koen Maes (Agrobiosys International, Belgium) for a number of helpful suggestions and to Mark Sterling (Allen & Overy LLP, England) for linguistic assistance. This project was supported by the National Natural Science Foundation of China (Grant No. 31672330) and Program of the Ministry of Science and Technology of the People of Republic of China. (2015FY210300).

References

Caradja, A. (1925) Ueber Chinas Pyraliden, Tortriciden, Tineiden nebst kurze Betrachtungen, zu denen das Studium dieser Fauna Veranlassung gibt (Eine biogeographische Skizze). *Academia Romana Memoriile Sectiunii Stiintifice*, Series 3, 3 (7), 257–383, pls. 1–2.

Hundsdoerfer, A.K., Rubinoff, D., Attié, M., Wink, M. & Kitching, I.J. (2009) A revised molecular phylogeny of the globally distributed hawkmoth genus *Hyles* (Lepidoptera: Sphingidae), based on mitochondrial and nuclear DNA sequences. *Molecular Phylogenetics and Evolution*, 52, 852–865.
https://doi.org/10.1016/j.ympev.2009.05.023

Klots, A.B. (1970) Lepidoptera. *In*: Tuxen, S.L. (Ed.), *Taxonomist's glossary of genitalia in insects. Second revised and enlarged edition*. Munksgaard, Copenhagen, pp. 115–130.

Knölke, S., Erlacher, S., Hausmann, A., Miller, M.A. & Segerer, A.H. (2005) A procedure for combined genitalia dissection and DNA extraction in Lepidoptera. *Insect Systematics & Evolution*, 35, 401–409.
https://doi.org/10.1163/187631204788912463

Kristensen, N.P. (2003) Skeleton and muscles: adults. *In*: Kristensen, N.P. (Ed.), *Lepidoptera, moths and butterflies. Vol. 2. Evolution, systematics, and biogeography. Handbook of Zoology IV (35)*. Walter de Gruyter, Berlin & New York, pp. 39–131.
https://doi.org/10.1515/9783110893724.39

Lee, S. & Brown, R.L. (2008) Phylogenetic relationships of Holarctic Teleiodini (Lepidoptera: Gelechiidae) based on analysis of morphological and molecular data. *Systematic Entomology*, 33, 595–612.
https://doi.org/10.1111/j.1365-3113.2008.00430.x

Li, H.H. & Zheng, Z.M. (1996) Methods and techniques of specimens of Microlepidopera. *Journal of Shaanxi Normal University*, Natural Science Edition, 24 (3), 63–70.

Maes, K.V.N. (1995) A comparative morphological study of the adult Crambidae (Lepidoptera, Pyraloidea). *Bulletin et Annales de la* Société *Royale Belge d'Entomologie,* 131, 383–434.

Munroe, E.G. & Mutuura, A. (1969) Contributions to a study of the Pyraustinae (Lepidoptera: Pyralidae) of temperate East Asia V. *The Canadian Entomologist*, 101, 299–305.
https://doi.org/10.4039/Ent101299-3

Munroe, E.G. (1976) Pyraloidea Pyralidae comprising the subfamily Pyraustinae tribe Pyraustini (part). *In*: Dominick, R.B. (Eds.), *The Moths of America North of Mexico including Greenland. 13.2*. Classey EW Ltd and The Wedge Entomological Research Foundation, London, pp. 1–78, pls. 1–4.

Posada, D. (2008) jModelTest: phylogenetic model averaging. *Molecular biology and evolution*, 25 (7), 1253–1256.
https://doi.org/10.1093/molbev/msn083

Robinson, G.S. (1976) The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. *Entomologist's Gazette*, 27, 127–132.

Ronquist, F., Teslenko, M., van derMark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B., Liu, L., Suchard, M.A. & Huelsenbeck, J.P. (2012) MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. *Systematic biology*, 61 (3), 539–542.
https://doi.org/10.1093/sysbio/sys029

Shen, G.P. & Tang, G.Y. (1992) Pyralidae. *In*: Department of Forestry of Hunan Province (Ed.), *Iconography of Forest Insects in Hunan China*. Hunan Science and Technology Publishing House, Changsha, pp. 706–728.

Simon, C., Buckley, T.R., Frati, F., Stewart, J.B. & Beckenbach, A.T. (2006) Incorporating molecular evolution into phylogenetic analysis, and a new compilation of conserved polymerase chain reaction primers for animal mitochondrial DNA. *Annual Review of Ecology, Evolution, and Systematics*, 37, 545–579.
https://doi.org/10.1146/annurev.ecolsys.37.091305.110018

Song, S.M. (1993) Lepidoptera: Pyralidae and Zygaenidae. *In*: Huang, C.M. (Ed.), *Animals of Longqi Mountain.* China Forestry Press, Beijing, pp. 414–473.

Song, S.M. & He, M.S. (1997) Lepidoptera: Pyralidae. *In*: Yang, X.K. (Ed.), *Insects of the Three Gorge Reservoir Area of Yangtze River. Vol. 2*. Chongqing Press, Chongqing, pp. 1096–1220.

Song, S.M. (2001) Pyralidae. *In:* Huang, B.K. (Ed.), *Fauna of Insects in Fujian Province of China. Vol. 5*. Fujian Science and

Technology Press, Fuzhou, pp. 101–226.
Stamatakis, A. (2014) RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. *Bioinformatics*, 30, 1312–1313.
https://doi.org/10.1093/bioinformatics/btu033
Tamura, K., Stecher, G., Peterson, D., Filipski, A. & Kumar, S. (2013) MEGA6: molecular evolutionary genetics analysis. Version 6.0. *Molecular Biology and Evolution*, 30 (12), 2725–2729.
https://doi.org/10.1093/molbev/mst197
Thompson, J.D., Higgins, D.G. & Gibson, T.J. (1994) CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucleic Acids Research*, 22 (22), 4673–4680.
https://doi.org/10.1093/nar/22.22.4673
Tiansen, X. (1985) Study on bionomics of *Eumorphobotys obscuralis*. *Journal of Subtropical Forestry Science and Technology*, 3, 55–56.
Wahlberg, N. & Wheat, C.W. (2008) Genomic outposts serve the phylogenomic pioneers: designing novel nuclear markers for genomic DNA extractions of Lepidoptera. *Systematic Biology*, 57 (2), 231–242.
https://doi.org/10.1080/10635150802033006
Wang, P.Y. (1980) *Lepidoptera. Pyralidae. Economic Insect Fauna of China*. Science Press, Beijing, 229 pp.
Wang, J.S., Song, S.M., Wu, Y.Y. & Chen, T.M. (2003) *Fauna of Pyralidae of Wuyishan Nature Reserve in China*. China Science and Technology Press, Beijing, 328 pp.
Yamanaka, H., Yoshiyasu, Y. & Sasaki, A. (2013) Pyraloidea. *In*: Nasu, Y., Hirowatari, T. & Kishida, Y. (Eds.), *The Standard of Moths in Japan. Vol. IV.* Gakken Education Publishing, Tokyo, pp. 60–84, 314–478.
Zhang, D.D. (2003) *A Taxonomic Study on the Tribe Pyraustini from the Mainland of China (Lepidoptera: Crambidae: Pyraustinae)*. Nankai University, Tianjin, 279 pp.
Zhang, D.D. (2009) Pyraustinae. *In*: Li, H.H. & Ren, Y.D. (Eds.), *Insect Fauna of Henan*. Science Press, Beijing, pp. 192–237.