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A review of the subgenus *Epicterodes* of *Arichanna* (Lepidoptera, Geometridae, Ennominae), with description of one new species

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ABSTRACT

The subgenus *Epicterodes* Wehrli, 1933 of *Arichanna* Moore, 1868 is reviewed. Six species are recognized, of which, *A. (E). denticularia* sp. nov. is described as new to science from China. One new synonym is established based on morphological and genetic similarity: *A. (E.) flavomacularia* Leech, 1897 (=*A. (E.) perimelaina* Wehrli, 1933 syn. nov.). Results of DNA barcoding for *Epicterodes* are briefly discussed. Diagnoses for all the species are provided and illustrations of adults, genitalia and distribution map are presented.

Introduction

The genus *Arichanna* was originally established by Moore (1868) on the basis of *Scotosia plagifera* Walker, 1866. *Arichanna* is a large genus of the tribe Boarmiini (Stüning, 2000; Jiang et al., 2017), which contains more than 70 species (Scoble, 1999; Scoble and Hausmann, 2007) in five subgenera, mainly distributed in Southeast Asia. These species are large or moderate-sized moths, and were variously described by more than 20 authors. Among them, Leech (1891, 1897) established a total of 14 species, Warren (1888, 1893) described ten species, and Wehrli (1933, 1939) named 13 species. The most recent additions were made by Sato (1999), Stüning (2000), and Sato and Fu (2010), who erected three species and one subspecies.

Hampson (1895) divided *Arichanna* into three sections (Section I, subgenera *Arichanna* Moore and *Icterodes* Butler, 1878) based on the male antennae, hind tibia and the fovea on the forewing. Prout (1915) also split *Arichanna* into three sections (*Arichanna*, *Icterodes* and *Phyllabraxas* Leech, 1897) on the basis of the male antennae. Wehrli (1933, 1939) divided *Arichanna* into six subgenera (*Arichanna*, *Icterodes*, *Phyllabraxas*, *Paricterodes* Warren, 1893, *Epicterodes* and *Dictyodea* Wehrli, 1933), mainly based on the male antenna and the male genitalia. Later *Dictyodea* was considered to be a junior synonym of the genus *Alcis* Curtis, 1826 by Inoue (1987). Although Inoue (1970) followed Wehrli's subgeneric partition for the sake of convenience, he pointed out that Wehrli's treatment must be critically reconsidered by observing the female genitalia. Sato (1987) suggested that a study of the early stages was needed to advance the taxonomy of *Arichanna* when studying the immature stages of three Japanese *Arichanna* species. Sato (1989) also considered that *Icterodes* and *Paricterodes* might need to be raised to generic rank in future, since they are very different in male antenna, forewing venation and genitalia. Thus, the application of the subgeneric names has been quite confusing in the different approaches of different researchers: for example, Sato (1993, 1994, 1995, 1998) and Stüning (2000) adopted the subgeneric names for *Arichanna* in the Moths of Nepal (part 2–6), and Hashimoto (1992) also accepted *Icterodes* as one subgeneric name of *Arichanna*. However, Sato (1999) did not mention the subgenus *Icterodes* when studying *jaguararia* Guenée, 1858 which is obviously a member of *Icterodes* based on Wehrli's partition. Thus, it remains controversial whether the subgenera should be treated as such, raised to generic rank, or abandoned as not being monophyletic.

The main differences between the five subgenera, summarized from Wehrli (1939), Hashimoto (1992) and Stüning (2000) are as follows: usually, the male antennae are ciliate-fasciculate in *Arichanna*, bipectinate in *Paricterodes*, *Epicterodes* and *Icterodes*, and filiform or occasionally ciliate in *Phyllabraxas*; on the wing pattern, members of *Arichanna*, *Paricterodes* and *Phyllabraxas* are usually greyish brown or yellowish brown, while *Epicterodes* and *Icterodes* often share a yellowish hindwing; in the male genitalia, the nominate subgenus *Arichanna* often possesses a saccular process; *Paricterodes* and *Phyllabraxas* lack a harpe on the valva; the former is characterized by a setose cornutus of the aedeagus, and the latter is distinguished by a hooked cornutus; *Icterodes* and *Epicterodes* share a long cucullus on the valva (Stüning, 2000), and the spinous harpe is present and developed in *Icterodes* but reduced or absent in *Epicterodes*. In the female genitalia, the signum is usually a rounded sclerite decorated with numerous spines in *Paricterodes* and

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Phyllabraxas (only *A. (Ph.) violacea* examined), but in *Arichanna*, *Icterodes* and *Epicterodes*, if the signum is present, it is often an irregular sclerite, often with two or four short spines. Based on these features, most species of the genus *Arichanna* can be assigned into different subgenera. However, there are some intermediate forms, and it is not easy to find a single character or combination of characters to define each subgenus accurately; it is also difficult to judge if the present subgenera are monophyletic or not without comprehensive phylogenetic research, which is yet to be done. In this paper we tentatively follow the Wehrli's concept of the subgenus *Epicterodes* in order to clarify the relationships between the species presently included in it, but recognise that the subgenus may need modification when further molecular results are available, or indeed may not survive at all as a separate phylogenetic taxon (see Discussion section below).

The subgenus *Epicterodes*, with *Arichanna (Epicterodes) flavomacularia* as the type species, is a small group in *Arichanna*, embracing up to the present time six known species (*flavinigra* Hampson, 1907, *flavomacularia* Leech, 1897, *undularia* Leech, 1897, *perimelaina* Wehrli, 1933, *leucocirra* Wehrli, 1933 and *sinica* Wehrli, 1933). Through examination of newly collected specimens of *Epicterodes* and comparison with many other specimens from different sources, a new species and one new synonymy was discovered, based on morphology and DNA barcodes. The purposes of this paper are: to provide a survey of the subgenus *Epicterodes* as presently constituted, to describe one new species, *A. (E). denticularia* sp. nov., to establish one synonymy involved, *A. (E.) flavomacularia* Leech (=*A. (E.) perimelaina* Wehrli, syn. nov.), to provide diagnostic characters of all known species, and to present illustrations of adults, genitalia and distribution map. This produces a worldwide total of six species in the subgenus *Epicterodes*.

Material and methods

Specimens of *Epicterodes* examined were mainly from the Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS); the Natural History Museum, London, United Kingdom (BMNH); and the Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK). Dissection and preparation of genitalia slides were performed applying standard protocols (Robinson, 1976); the genitalia were embedded in Canada balsam and mounted on slides. The definition of species is mainly based on morphological features, especially genital characters, combined with the results of DNA barcoding. Terminology for wing venation follows the Comstock-Needham System (Comstock, 1918) as adopted for Geometridae by Scoble (1992) and Hausmann (2001), and that for the genitalia was based on Pierce (1914), reprint 1976, Klots (1970) and Nichols (1989). Photographs of the moths were taken with digital cameras. Composite images were generated using Auto-Montage software version 5.03.0061 (Synoptics Ltd). The plates were compiled using Adobe Photoshop software. The distribution map of the species was generated by ArcGIS, based on the label data of the examined specimens (Fig. 57).

A total of 44 DNA barcodes for *Epicterodes* were included for this study, covering most of the known species of *Epicterodes*, except *A. (E.) undularia*, including 16 sequences from *A. (E.) perimelaina* that had been used previously of our previous work (Li et al., 2017). In addition, five barcodes for two *Icterodes* species were included in this study, including three sequences from *Arichanna (Icterodes) tientsuena* (Wehrli, 1933) and two sequences from *A. (I.) melanaria* (Linnaeus, 1758) that had been used previously of Hausmann et al. (2011) and Mutanen et al. (2012). Details of studied specimens, including GenBank accession numbers are summarized in Table 1.

DNA barcodes of all our specimens were successfully amplified and yielded full-length barcodes (672 bp). Protocols of DNA extraction and sequencing followed the previous works (Yang et al., 2013; Liu et al., 2014; Jiang et al., 2014, 2016, 2017; Li et al., 2017). Sequences were aligned using MEGA 6.0 (Tamura et al., 2013). The neighbour-joining (NJ) tree (Saitou and Nei, 1987) was reconstructed based on Kimura 2-parameter (K2P) distances (Kimura, 1980) using MEGA 6.0.

Systematics

Genus *Arichanna* Moore, 1868

Arichanna Moore, 1868, *Proc. zool. Soc. Lond.* 1867: 658. Type species: *Scotosia plagifera* Walker, 1866.

Hemipyrrha Grote, 1896, *Proc. ent. Soc. Lond.* 1896: xv. Type species: *Phalaena melanaria* Linnaeus, 1758.

Rhyparia Hübner, 1825, *Verz. bekannter Schmett.*: 305. Type species: *Phalaena melanaria* Linnaeus, 1758.

Subgenus *Epicterodes* Wehrli, 1933

Epicterodes Wehrli, 1933, *Ent. Z., Frankf. a. M.* 47: 29, 41, 47, 51. Type species: *Arichanna flavomacularia* Leech, 1897.

Subgeneric characters

Antennae bipectinate in male and filiform in female. Frons not protruding. Labial palpi slightly projecting beyond frons. Hind tibia with two pairs of spurs in both sexes, dilated and with hair-pencil in male. Third sternite of male abdomen with setal comb. Sterno-tympanal process present on second sternite. Outer margin of forewing slightly arc-shaped, that of hindwing rounded, neither fore nor hind wing elongate, apices rounded. Wings usually yellow, with many dark grey to black spots; hindwing with base tinged with grey, and terminal area tinged with yellow decorated with black spots. Forewing with Sc, R_1 and R_2 separate; R_{3+4} stalked with R_5. Hindwing with Rs and M_1 separate, M_3 and CuA_1 separate, 3A present. *Male genitalia.* Uncus broad basally and tapering terminally, tip rounded or shallowly concave. Gnathos with median process of similar length to uncus or shorter, shaped as a short or long stick-like process. Juxta developed, a broad or narrow sclerite. Saccus rounded terminally. Valva narrow, sometimes slightly tapered; costa slightly curved or straight, strongly sclerotized, developed into cucullus terminally, covered with dense setae, following a dentate ridge from its end, harpe very small or absent. Aedeagus stick-like, with terminal section bifid, the diverging part short and often with tip pointed, and the main part long with rounded tip, cornutus absent. *Female genitalia.* Papilla analis oval or elongate. Apophyses anteriores shorter than apophyses posteriores. Lamella antevaginalis unmodified; lamella postvaginalis oval, arc-shaped or unmodified. Ductus bursae sclerotized, colliculum developed. Corpus bursae moderate or large; signum usually present, with two or four tiny spines marginally, occasionally absent.

Diagnosis

Hashimoto (1992) and Stüning (2000) summarized the differences between *Epicterodes* and *Icterodes*; the following is based on their work, with some modifications. Among the five subgenera of *Arichanna*, the subgenus *Epicterodes* is externally close to the subgenus *Icterodes*, most species of both subgenera having a yellow hindwing, which is decorated with black spots. However, they can be distinguished by the following genital characters: the harpe is usually absent or occasionally very small in *Epicterodes*, but it is strongly developed in *Icterodes*; the sclerotized ridge of the valva is dentate in *Epicterodes*, but usually smooth in *Icterodes*; in the aedeagus, the diverging part is distinctly shorter than the main part in *Epicterodes*; however, in *Icterodes*, the diverging part is longer than the main part, or the two parts are of similar length; the cornutus is absent in *Epicterodes* but sometimes present in *Icterodes*.

Distribution

China, India, Nepal, Myanmar.

***Arichanna (Epicterodes) flavomacularia* Leech, 1897** *(Figs. 1-9, 23-28, 35-38, 45-50)*

Arichanna flavomacularia Leech, 1897, *Ann. Mag. nat. Hist.* (6) 19: 438. Syntypes, China (western): Wa-shan; Tachien-lu [Kangding].

Table 1
Details of specimens used in molecular analysis of the DNA barcode region.

Sample ID	Species	Date collected	Collecting locality	Collectors	GenBank accession numbers
LEP M 30752	*A. (E.) denticularia*	11.May.2017	Zhangjiajie, Hunan	Li H.N.	MG680458
LEP M 30753	*A. (E.) denticularia*	11.May.2017	Zhangjiajie, Hunan	Li H.N.	MG680459
LEP M 30861	*A. (E.) denticularia*	15–16.May.2017	Xuanen, Hubei	Li H.N.	MG680460
LEP M 30878	*A. (E.) denticularia*	15–16.May.2017	Xuanen, Hubei	Li H.N.	MG680461
LEP M 30879	*A. (E.) denticularia*	15–16.May.2017	Xuanen, Hubei	Li H.N.	MG680462
LEP M 30880	*A. (E.) denticularia*	15–16.May.2017	Xuanen, Hubei	Li H.N.	MG680463
LEP M 20919	*A. (E.) flavinigra*	24.Jun.2016	Yadong, Tibet	Li X.X.	MG680464
LEP M 20920	*A. (E.) flavinigra*	24.Jun.2016	Yadong, Tibet	Li X.X.	MG680465
LEP M 20921	*A. (E.) flavinigra*	24.Jun.2016	Yadong, Tibet	Li X.X.	MG680466
LEP M 14722	*A. (E.) flavomacularia*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	MG680467
LEP M 14729	*A. (E.) flavomacularia*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	MG680468
LEP M 14796	*A. (E.) flavomacularia*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	MG680469
LEP M 14802	*A. (E.) flavomacularia*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	MG680481
LEP M 14961	*A. (E.) flavomacularia*	15–17.Aug.2014	Siguniangshan, Xiaojin, Sichuan	Li X.X., Pan X.D.	MG680470
LEP M 14973	*A. (E.) flavomacularia*	15–17.Aug.2014	Siguniangshan, Xiaojin, Sichuan	Li X.X., Pan X.D.	MG680471
LEP M 15009	*A. (E.) flavomacularia*	15–17.Aug.2014	Siguniangshan, Xiaojin, Sichuan	Li X.X., Pan X.D.	MG680472
LEP M 15016	*A. (E.) flavomacularia*	15–17.Aug.2014	Siguniangshan, Xiaojin, Sichuan	Li X.X., Pan X.D.	MG680473
LEP M 15018	*A. (E.) flavomacularia*	15–17.Aug.2014	Siguniangshan, Xiaojin, Sichuan	Li X.X., Pan X.D.	MG680474
LEP M 17618	*A. (E.) flavomacularia*	29.Aug.2015	Mêdog, Tibet	Yao J.	MG680482
LEP M 17625	*A. (E.) flavomacularia*	29.Aug.2015	Mêdog, Tibet	Yao J.	MG680483
LEP M 17635	*A. (E.) flavomacularia*	30.Aug.2015	Mêdog, Tibet	Yao J.	MG680484
LEP M 17641	*A. (E.) flavomacularia*	30.Aug.2015	Mêdog, Tibet	Yao J.	MG680485
LEP M 23032	*A. (E.) leucocirra*	7–10.Aug.2016	Kangding, Sichuan	Cui L.	MG680475
LEP M 23033	*A. (E.) leucocirra*	7–10.Aug.2016	Kangding, Sichuan	Cui L.	MG680476
LEP M 23054	*A. (E.) leucocirra*	7–10.Aug.2016	Kangding, Sichuan	Cui L.	MG680477
LEP M 1173	*A. (E.) perimelaina*	10.Jul.2013	Xianggelilaxiagu, Yunnan	Cheng R.	KY391887[a]
LEP M 1176	*A. (E.) perimelaina*	10.Jul.2013	Xianggelilaxiagu, Yunnan	Cheng R.	KY391890[a]
LEP M 1872	*A. (E.) perimelaina*	15.Aug.2013	Gaoshanzhiwuyuan, Lijiang, Yunnan	Liu S.X., Li X.X.	KY391906[a]
LEP M 1893	*A. (E.) perimelaina*	15.Aug.2013	Gaoshanzhiwuyuan, Lijiang, Yunnan	Liu S.X., Li X.X.	KY391926[a]
LEP M 14175	*A. (E.) perimelaina*	30.Jun–1.Jul.2014	Danzha, Tengchong, Yunnan	Li X.X., Pan X.D.	KY391946[a]
LEP M 14220	*A. (E.) perimelaina*	30.Jun–1.Jul.2014	Danzha, Tengchong, Yunnan	Li X.X., Pan X.D.	KY391952[a]
LEP M 14340	*A. (E.) perimelaina*	11–12.Jul.2014	Yuhu, Lijiang, Yunnan	Li X.X., Pan X.D.	KY391954[a]
LEP M 14359	*A. (E.) perimelaina*	11–12.Jul.2014	Yuhu, Lijiang, Yunnan	Li X.X., Pan X.D.	KY391957[a]
LEP M 14509	*A. (E.) perimelaina*	20–21.Jul.2014	Gezan, Xianggelila, Yunnan	Li X.X., Pan X.D.	KY391960[a]
LEP M 14559	*A. (E.) perimelaina*	20–21.Jul.2014	Gezan, Xianggelila, Yunnan	Li X.X., Pan X.D.	KY391965[a]
LEP M 14640	*A. (E.) perimelaina*	30–31.Jul.2014	Yajiang, Sichuan	Li X.X., Pan X.D.	KY391966[a]
LEP M 14738	*A. (E.) perimelaina*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	KY391979[a]
LEP M 14794	*A. (E.) perimelaina*	2–4.Aug.2014	Hailuogou, Luding, Sichuan	Li X.X., Pan X.D.	KY391982[a]
LEP M 17436	*A. (E.) perimelaina*	5.Sep.2014	Zayü, Tibet	Liu H.	KY391984[a]
LEP M 17438	*A. (E.) perimelaina*	7.Sep.2014	Zayü, Tibet	Liu H.	KY391986[a]
LEP M 17468	*A. (E.) perimelaina*	31.Jul.2014	Yajiang, Sichuan	Li X.X., Pan X.D.	KY392006[a]
LEP M 17305	*A. (E.) sinica*	23–24.Aug.2014	Yadong, Tibet	Cheng R., Cui L.	MG680478
LEP M 17306	*A. (E.) sinica*	23–24.Aug.2014	Yadong, Tibet	Cheng R., Cui L.	MG680479
LEP M 17619	*A. (E.) sinica*	29.Aug.2015	Mêdog, Tibet	Yao J.	MG680480
ZSM Lep 21,060	*A. (I.) melanaria*	3.Jul.2008	Germany	K. Ambil	HQ601063[b]
MM08115	*A. (I.) melanaria*		Finland	M. Mutanen, P. Vaelimaeki	HM873784[c]
LEP M 14016	*A. (I.) tientsuena*	23–24.Jun.2014	Dali, Yunnan	Li X.X., Pan X.D.	MG680486
LEP M 14088	*A. (I.) tientsuena*	26–27.Jun.2014	Tengchong, Yunnan	Li X.X., Pan X.D.	MG680487
LEP M 18088	*A. (I.) tientsuena*	4.Aug.2013	Tengchong, Yunnan	Li X.X., Pan X.D.	MG680488

[a] From Li et al., 2017.
[b] From Hausmann et al., 2011.
[c] From Mutanen et al., 2012

(BMNH).

Arichanna (Epicterodes) perimelaina Wehrli, 1933, *Ent. Z., Frankf. a.M.* 47 (6): 47, fig. 10. Holotype ♀, [China]: Szechuan [Sichuan]. (ZFMK) **syn. nov.**

Arichanna (Epicterodes) flavomacularia: Wehrli, 1933, *Ent. Z., Frankf. a. M.* 47 (4): 41.

Diagnosis

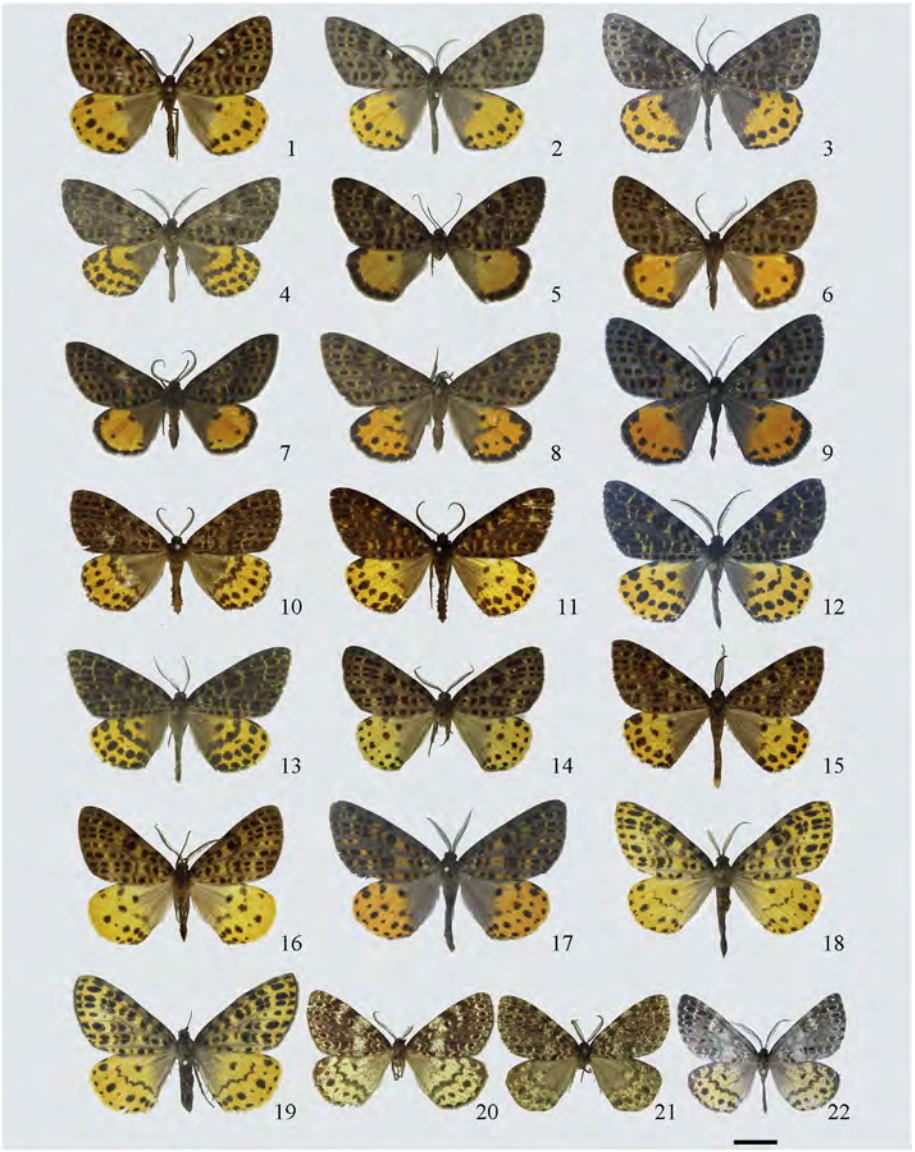
As a result of the above new synonymy of *perimelaina* with *flavomacularia*, the species becomes quite variable in wing pattern. Some specimens (previous *perimelaina*, Figs. 5-9) can be distinguished by the confluent black terminal band on the hindwing; some (previous *flavomacularia*, Figs. 1–3) are differentiable by the lack of a postmedial line on the hindwing. The species is characterized by the broad juxta of the male genitalia, which is shared with *A. (E). undularia* and *A. (E). denticularia*. However, the uncus and gnathos are more developed (compared with the length of the valve) in *flavomacularia*, and less developed in *denticularia* and *undularia*. The large corpus bursae in the female genitalia can separate *flavomacularia* from *flavinigra*, and the signum can distinguish it from *denticularia* and *sinica*.

Type-material examined

CHINA: Sichuan: 1♂ (BMNH), syntype of *flavomacularia*, Ta-Chien-Lu, 8300 ft., Pratt coll. July & Aug. 1890, Leech Coll. 1900-64, BMNH (E)#1008649; 1♀ (ZFMK), holotype of *perimelaina*, Siao Lou, Chasseurs Indigènes, du P. Déjean, 1902, Genital präp. Nr. 819, ex coll. Wehrli; 1♂ (ZFMK), syntype [paratype] of *perimelaina*, Siao-Loû, Chasseurs Indigènes du P. Déjean, 1903; 1♀ (BMNH), paratype of *perimelaina*, Siao Lou, Chasseurs Indigènes, du P. Déjean, 1901, BMNH(E) #1008652.

Additional material examined

CHINA: Gansu (IZCAS): 2♀, Wenxian, Liziba, 1971 m, 22–24.VIII.2014, coll. Li Xinxin & Pan Xiaodan. **Sichuan** (IZCAS):



Figs. 1-22. Adults. 1–9. *Arichanna (Epicterodes) flavomacularia*. 1, male (syntype, Ta-chien-lu, Sichuan, BMNH); 2, male (Xiaojin, Sichuan); 3, male (Hailuogou, Sichuan); 4, male (Mêdog, Tibet); 5, female (holotype of *perimelaina*, Siao Lou, Sichuan, ZFMK); 6, male (paratype of *perimelaina*, Siao Lou, Sichuan, ZFMK); 7, male (Ertan, Sichan); 8, male (Xiaozhongdian, Yunnan); 9, male (Yajiang, Sichuan); 10, *A. (E.) undularia*, male (syntype, Sichuan, BMNH); 11–13. *A. (E.) flavinigra*. 11, male (syntype, Kashmir, BMNH); 12, male (Yadong, Tibet); 13, male (Nyingchi, Tibet); 14–17. *A. (E.) sinica*. 14, *A. (E.) sinica sinica*, male (holotype, Sichuan, ZFMK); 15, *A. (E.) sinica himalayensis*, male (holotype, Nepal, BMNH); 16, *A. (E.) sinica refracta*, male (holotype, Taiwan, BMNH); 17, *A. (E.) sinica sinica*, male (Tengchong, Yunnan); 18–19. *A. (E.) denticularia* sp. **nov.** 18, male (holotype, Hubei, IZCAS); 19, female (paratype, Hubei, IZCAS); 20–22. *A. (E.) leucocirra*. 20, *A. (E.) leucocirra leucocirra*, male (syntype, Sichuan, ZFMK); 21, *A. (E.) leucocirra anthracia*, male (syntype, Yunnan, ZFMK); 22, *A. (E.) leucocirra leucocirra,* male (Sichuan). Scale bar = 1 cm.

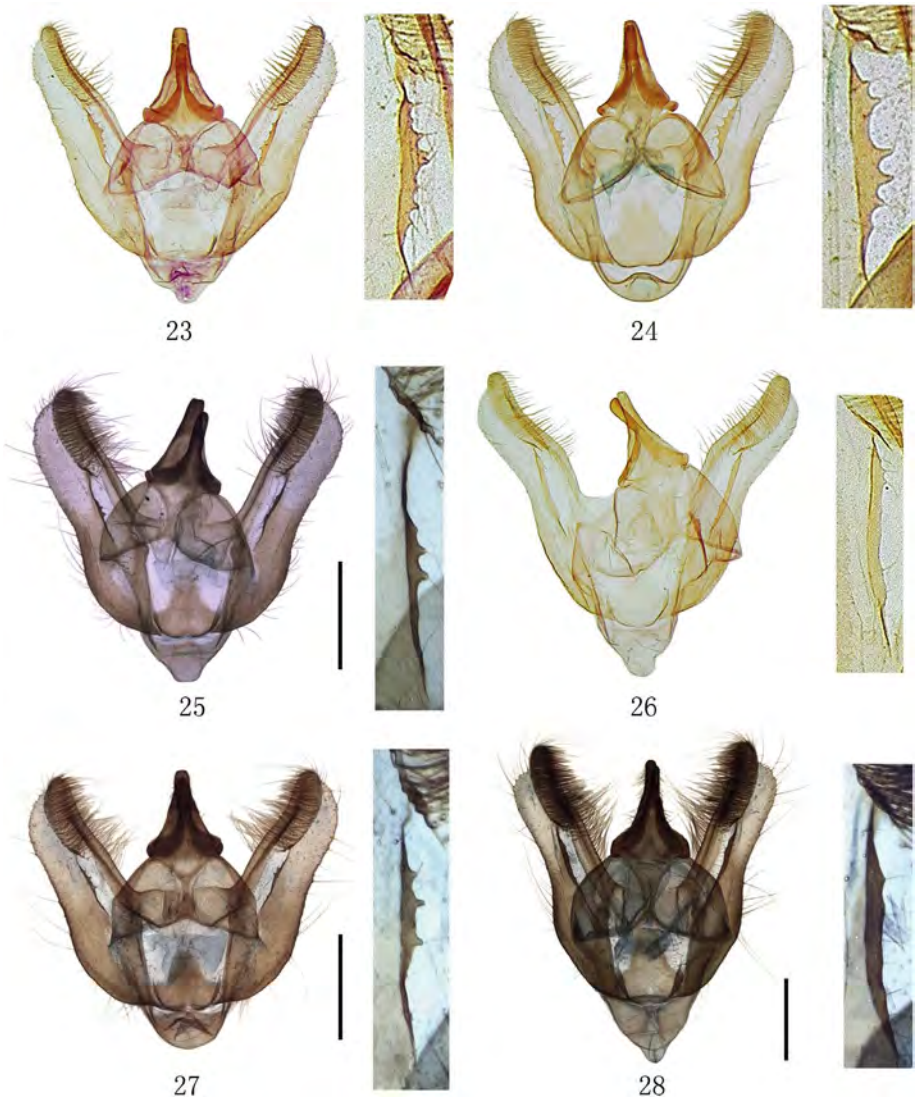
30♂14♀, Luding, Hailuogou, 3010 m, 2–4.VIII.2014, 10–11.IX.2016, Slide No. Geom-2747, 4320, 4321, 4323, coll. Li Xinxin & Pan Xiaodan; 26♂19♀, Xiaojin, Siguniangshan, Changpingcun, 3264 m, 15–17.VIII.2014, Slide No. Geom-4060, 4061, 4318, 4319, coll. Li Xinxin & Pan Xiaodan; 1♂ (ZFMK), Frontière orientale du Thibet, Chasseurs indigènes du P. Déjean, 1905, ex coll. Wehrli 17.55; 1♀ (BMNH), Chasseurs Thibétains de Ta-tsien-lou, Eté 1896, recudu R.P.Déjean, Ex. Oberthür Coll. Brit. Mus. 1927–3; 1♂, Batang, 2600 m, 16.VIII.1982, coll. Wang Shuyong; 2♀, Kangding, Liuba, 3450 m, 8.IX.1982, coll. Niu Chunlai; 1♀, Gonggashan, Yanzigou, 2140 m, 3.VI.1983, coll. Chai Huaicheng; 1♀, Wolong, 1920 m, 24.VI.1983, coll. Wang Shuyong; 1♀, Yingjing, Siping, 1100 m, 25.VI.1984, coll. Chen Yixin; 1♂1♀, Ertan, VI.1994, Slide No. Geom-3846, 3847, coll. Dong Dazhi; 24♂1♀, Yajiangbingzhan, 3340 m, 30–31.VII.2014, coll. Li Xinxin & Pan Xiaodan; 6♂2♀, Luding, Hailuogou, 3010 m, 2–4.VIII.2014, 11.IX.2016, coll. Li Xinxin. **Yunnan** (IZCAS):1♂, Lijiang, Yulongshan, 22.VII.1962, coll. Song Shimei; 1♂, Dali, Cangshan, 2226 m, 23–24.VI.2014, coll. Li Xinxin; 54♂32♀, Lijiang, Yulong Shan, 2800–3200,m, 22–28.VII.1962, 20.VII.1982., 14–20.VII.1984, Slide No. Geom-3844, 3845, coll. Chen Yixin et al.; 5♂, Lijiang, Yuhu, 2700 m, 27.VII.1984, coll. Liu Dajun; 46♂14♀, Lijiang, Gaoshanzhiwuyuan, 3272 m, 15–16.VIII.2013, coll. Liu Shuxian & Li Xinxin; 1♀, Zhongdian, 3220 m, 14.VII.1983, coll. Wang Jixian; 2♂, Zhongdian, Gezan, 3150 m, 5–6.VIII.1987, coll. Liao Subai & Wang Shuyong; 9♂9♀, Xiaozhongdian, 3100 m, 22.VII.1983. 30.VII.1984, Slide No. Geom-4316, coll. Chen Yixin et al.; 3♂1♀, Xianggelilaxiagu, 3029 m, 10.VIII.2013, coll. Cheng Rui; 8♂, Xianggelila, Gezan, 3141 m, 20–21.VII.2014, coll. Pan Xiaodan; 6♂4♀, Xianggelila, Xiaozhongdian, 3235 m, 15.VIII.2016, coll. Ban Xiaoshuang; 8♂6♀, Tengchong, Danzhalinchang, 2479 m, 30.VI–1.VII.2014, coll. Pan Xiaodan; 8♂6♀, Yulong, Yuhu, 2768 m, 11–12.VII.2014, coll. Pan Xiaodan. **Tibet** (IZCAS): 2♂1♀, Zayü, Dazhengtongkezhan, 3918 m, 5.IX.2014, coll. Liu Hong; 1♀, Zayü, Jumuchangkezhan, 3346 m, 7.IX.2014, coll. Liu Hong; 9♂9♀, Mêdog, Lage, 3213 m, 7–8.VIII.2006, Slide No. Geom-2752, 4213, 4214, coll. Lang Songyun; 1♀, Mêdog 62 K, 2787 m, 29–30.VIII.2015, Slide No. Geom-4322, coll. Yao Jian; 1♀, Bomi, Zhamo, 2751 m, 26–28.VIII. 2006, coll. Lang Songyun.

Distribution

China (Shaanxi, Gansu, Sichuan, Yunnan, Tibet).

Genetic data

The mean intraspecific distance of *flavomacularia* is 0.82% (min.



Figs. 23-28. Male genitalia. 23–28, *A. (E.) flavomacularia*. 23–24, Tatsienlu, Sichuan (ZFMK); 25, Xiaojin, Sichuan; 26, Siao Lou, Sichuan (*perimelaina*, ZFMK); 27, Muruo, Tibet (*perimelaina*); 28, Gezan, Yunnan (*perimelaina*). Scale bars = 1 mm.

0%, max. 1.63%; $n = 29$). Nearest neighbour in the present study: *A. (I.) tientsuena* (2.92%).

Remarks

A. (E.) flavomacularia and *A. (E.) perimelaina* can only be differentiated by hindwing pattern: the terminal line is composed of interrupted small black patches in *flavomacularia*, and always appears as a confluent black band with shallow or deep wavy inner margin in *perimelaina*.

Li et al. (2017) studied the evolutionary history of *A. (E.) perimelaina*, in which, six and four populations were recognized based respectively on mtDNA and ncDNA data; variations of wing pattern, and differences in male and female genitalia among different populations, such as the variable width and length of the setose cucullus, and the presence or absence of a distinct shape to the lamella postvaginalis, were pointed out. In our study, it is worth noting that the genitalia of *flavomacularia* fall well within the parameters of these variations.

The genetic distance (based on the sampled specimens) ranges from 0.32% to 1.3% between *flavomacularia* and *perimelaina*, and all these genetic distances fall within the range 0% to 1.63% in *perimelaina*. The two taxa cluster together throughout the clade in which they occur (Fig. 58).

The type localities of *A. (E.) flavomacularia* (Wa-shan, Tachien-lu) and *A. (E.) perimelaina* (Siao Lu) are very close to each other, with Tachien-lu as the westernmost and Wa-shan as the most easterly, with a distance less than 300 km. The common flying time (based on the label data) for the two species is from June to September. This means that these two species are sympatric and flying in the same season.

On the basis of genital morphology and molecular evidence, there are no grounds for separation of these two taxa as separate species. This is reinforced by the similarity of type localities and distributions (Hailuogou, Sichuan, LEP M 14796, 14722, 14729, 14802 for *flavomacularia*; 14738, 14794 for *perimelaina*). Although the genitalia of the type material of *flavomacularia* were not available for examination, the male and female genitalia of specimens from the type locality (Tachienlu) were examined (Figs. 23, 24, 35, 45). For all these reasons we formally synonymise the two taxa.

Four specimens from Mêdog, Tibet have a developed postmedial line on the hindwing (Fig. 4), and clustered with two specimens of *perimelaina* in the NJ tree (Fig. 58). The differences on the pattern of the hindwing (among previous *flavomacularia*, *perimelaina* and Mêdog specimens) may represent different populations, which are not distinctly separated geographically at present. Further biological and molecular studies are needed to test this hypothesis.

Figs. 29-34. Male genitalia. 29, *A. (E.) undularia* (Sichuan, ZFMK); 30, *A. (E.) flavinigra* (Tibet); 31, *A. (E.) sinica* (Yunnan); 32, *A. (E.) denticularia***sp. nov.** (holotype, Hubei); 33, *A. (E.) leucocirra leucocirra* (Sichuan); 34, *A. (E.) leucocirra anthracia* (syntype, Yunnan, ZFMK). Scale bars = 1 mm.

Arichanna (Epicterodes) undularia Leech, 1897 (Figs. 10, 29, 39)

Arichanna undularia Leech, 1897, *Ann. Mag. nat. Hist.* (6) 19: 438. Syntypes 4♂, 2♀China (western): Tachien-lu [Kangding]; Omei-shan; Pu-tsu-fong; Wa-shan. (BMNH)

Arichanna (Epicterodes) undularia: Wehrli, 1939, *in* Seitz, *Gross-Schmett. Erde* 4 (Suppl.): 250.

Diagnosis

On the wing pattern, *A. (E.) undularia* can be distinguished by the following combined characters on the hindwing: a smaller discal spot is merged with the greyish brown basal area; the black postmedial band is more strongly serrate. In the male genitalia, the uncus is much shorter than *flavomacularia*, and stouter than *denticularia*; the median process of the gnathos is stouter than *denticularia*, distinctly shorter than *flavomacularia*, but longer than *flavinigra*; the apical part of the juxta is much broader than *flavinigra*, *sinica*, and *leucocirra*. In the female genitalia, the lamella postvaginalis is unmodified in *undularia*, but appears as an oval sclerite in *flavinigra*; the ductus bursae between the colliculum is a pair of triangular scleites in *undularia*, but is sclerotized but unmodified in *flavinigra*.

Type-material examined

CHINA: Sichuan: 1♂ (BMNH), syntype, Ta-Chien-Lu, 8300 ft., May & June 1890, Pratt coll., Leech Coll. 1900-64, BMNH(E)#1008656; 1♀ (BMNH), syntype, Ta-Chien-Lu, 7500 ft., July 1889, A.E.Pratt coll., Leech Coll. 1900-64, BMNH(E)#1008657.

Additional material examined

CHINA: Sichuan: 1♂ (ZFMK), Frontière orientale, du Thibet, Chasseurs Indigènes, du P. Déjean, 1905, ex coll. Wehrli; 1♂ (ZFMK), Tâ-tsien-Lou, 1898, Chasseurs indigènes, ex coll. Wehrli 17/55.

Distribution

China (Sichuan).

Arichanna (Epicterodes) flavinigra Hampson, 1907 (Figs. 11–13, 30, 40, 51)

Arichanna flavinigra Hampson, 1907, *J. Bombay nat. Hist. Soc.* 18 (1): 42. Syntypes, Kashmir; Chamba; Duggre; Jumnotri; Punjab, Dalhousie; Dharmsala; Kumaon, Ralam Valley, Yatong (Sikhim/Tibet border); Sikkim. (BMNH).

Arichanna (Epicterodes) flavinigra: Wehrli, 1933, *Ent. Z., Frankf. a. M.* 47 (4): 41.

Figs. 35-44. Aedeagus. 35–38, *A. (E.) flavomacularia*. 35, Tatsienlu, Sichuan (ZFMK); 36, Xiaojin, Sichuan; 37, Siao Lou, Sichuan (*perimelaina*, ZFMK); 38, Gezan, Yunnan (*perimelaina*); 39, *A. (E.) undularia* (Sichuan, ZFMK); 40, *A. (E.) flavinigra* (Tibet); 41, *A. (E.) sinica* (Yunnan); 42, *A. (E.) denticularia***sp. nov.** (holotype, Hubei); 43, *A. (E.) leucocirra leucocirra* (Sichuan); 44, *A. (E.) leucocirra anthracia* (Yunnan, ZFMK). Scale bars = 1 mm.

Diagnosis

Externally, *A. (E.) flavinigra* is close to *A. (E.) sinica*, but it can be distinguished by the following characters: the upperside of the forewing is much darker in *A. (E.) flavinigra*; sometimes the spots composing the postmedial line of the hindwing are confluent, forming a black band in *A. (E.) flavinigra* but never so in *A. (E.) sinica*; the underside of the forewing is decorated with yellow in *A. (E.) flavinigra* but lacks a yellow tinge in *A. (E.) sinica*. In *flavinigra*, specimens with a postmedial band on the hindwing are similar to *A. (E.) undularia*, but can be distinguished by the patches being less concave than in the latter. In the male genitalia, *flavinigra* and *sinica* are the two species with a short median process of the gnathos, contrasting with other species, where the long median process of the gnathos is of similar length to the uncus. The cucullus of *flavinigra* is generally longer than in *sinica*. In the female genitalia, a signum is present with two tiny processes in *flavinigra*, but this is absent in *sinica*.

Type-material examined

1♂ (BMNH), syntype, Kashmir, Leech Coll. 1900-64 (other label: *Arichanna flavinigra* Hmpsn. type ♂).

Additional material examined

CHINA: Tibet (IZCAS): 1♀, Cona, Mamaxiang, 2900 m, 6.VIII.1974, coll. Huang Fusheng; 11♂24♀, Zham, 2200–2400 m, 21–29.VI.1975, coll. Huang Fusheng et al.; 2♂4♀, Zham Kouan, Quxiang, 3300 m, 6.VII.1975, coll. Huang Fusheng & Wang Ziqing; 3♀, Zham Kouan, 11.VIII.1981, 24.VII.2014, coll. Chen Tailu, Chen Rui; 2♀, Gyirong, Xiao Gyirong, 2400–2800 m, 2–22. VII.1975, coll. Huang Fusheng & Wang Ziqing; 1♂2♀, Gyirong, 2800 m, 8–28.VII.1975, coll. Wang Ziqing; 3♂1♀, Gyirong Xian, Gyirong Qu, 2800 m, 18–30.VII.1975, Slide No. Geom-4541, 4542, coll. Wang Ziqing & Huang Fusheng; 49♂1♀, Yadong, Linchang, 2690 m, 17.VII.1980, 29.VIII.1984, 24.VI.2016, Slide No. Geom-4553, coll. Li Aihua, Li Xinxin; 4♂, Nyingchi, Bayi, 2999 m, VI.1990, 3.VIII.2006, Slide No. Geom-4217, coll. Lang Songyun, De Jimeiduo; 2♀, Nyingchi, Nanyigou, Bianjingbingzhan, 3180 m, 4.IX.2005, coll. Wang Xuejian; 3♀, Mainling, Paixiang, Zhuanyunzhan, 2883 m, 4–6.VIII.2006, Slide No. Geom-4218, coll. Lang Songyun; 6♂5♀, Mêdog, Lage, 3213 m, 7–8.VIII.2006, 8–9.VIII.2015, Slide No. Geom-2754, coll. Lang Songyun, Wang Mingqiang; 1♀, Mêdog, Hanmi, 2095 m, 10–11.2006.VIII, coll. Lang Songyun; 4♂3♀, Mêdog 80K, 2095–2121 m, 1–3.VIII.2014, 15.VI.2016, coll. Li Xinxin et al.; 1♂7♀, Mêdog 62K, 2787 m, 29–30.VIII.2015, coll. Yao Jian. **NEPAL** (IZCAS): 1♀, Matathati Village, 15.VII.2014, coll. Chen Rui. **INDIA:** 1♀ (BMNH), Sikkim, Lachin Lachoong, 8000 à 16000 l, Eté, 1895, Chasseurs Bretaüdeau, ex coll. Oberthür Coll. Brit. Mus. 1927-3.

Distribution

China (Tibet), India, Nepal, Myanmar.

Genetic data

The mean intraspecific distance of *flavinigra* ranges from 0% to 0.16% in three samples. Nearest neighbour in China: *leucocirra* (2.73%).

***Arichanna (Epicterodes) sinica* Wehrli, 1933** (Figs. 14–17, 31, 41, 52)

Arichanna (Epicterodes) flavinigra sinica Wehrli, 1933, *Ent. Z., Frankf. a.M.* 47 (5): 41, fig. 14. Holotype ♂ (ZFMK), [China]: Siao Lou. (ZFMK).

Arichanna (Epicterodes) sinica: Sato, 1994, *Tinea* 14 (suppl. 1): 41, pl. 73: 3, fig. 397.

Diagnosis

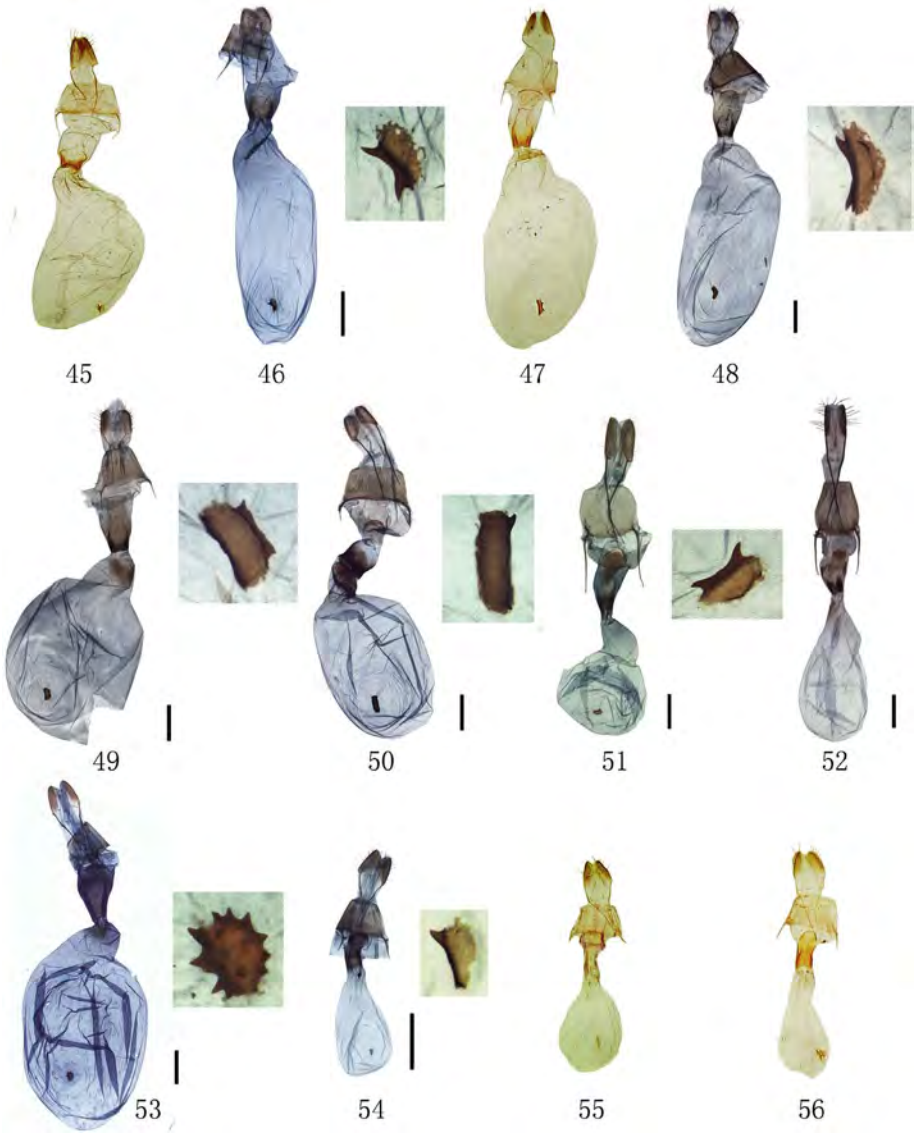
As mentioned under *A. (E.) flavinigra*, *A. (E.) sinica* shares a similar wing pattern and male genitalia with the former. *A. (E.) sinica* can be distinguished by the paler forewing upperside, the spots of the postmedial line of the hindwing, which are always separate, and the lack of yellow on the underside of the forewing. In the male genitalia, the cucullus is shorter than in *flavinigra*. In the female genitalia, the signum is absent in *sinica*, but present in *flavinigra*.

Type-material examined

CHINA: Sichuan: 1♂ (ZFMK), holotype of *sinica*, Siao-Loû, Chasseurs Indigènes, du P. Déjean, 1903, Genitalpräp ZFMK Nr. 816 (genitalia image examined). **Taiwan**: 1♂ (BMNH), holotype of *refracta*, Taiwan, Near Tianchi, Kaohsiung-Hsien, 2200 m, 1. Aug. 1976, Y. Shibata leg., Inoue Coll. B.M. 1992–71. **NEPAL**: 1♂ (BMNH), holotype of *himalayensis*, N.E. Nepal, Between Walunchung & Chowki, 2450 m, Tamur Valley, 28.VII.1963, T. Haruta et al.; 1♀, paratype of *himalayensis*, E. Nepal, Nameless place, Walunchung-Chowki, 2450 m, 28.VII.1963, L.S.J. Exped, Brit. Mus. 1969-15, slide no. 1136.

Additional material examined

CHINA (IZCAS): Sichuan: 2♀, Tian quan, Erlang Shan, 2188 m, 3.VIII.2014, coll. Liu Hong. **Yunnan**: 1♂1♀, Lijiang, Yulong Shan, 3200 m, 22.VII.1962, 15.VII.1984, coll. Liu Dajun & Song Shimei; 1♂, Lijiang, Yuhu, 2700 m, 27.VII.1984, coll. Liu Dajun; 1♂, Weixi, Lidiping, 3200 m, 13.VIII.1984, coll. Liu Dajun; 1♀, Weixi, Pantiange, 2570 m,15–16.VII.2014, coll. Li Xinxin; 6♂3♀, Tengchong, Qushi Dabacun, 1873 m, 4–5.VIII.2013, coll. Li Xinxin; 1♂, Tengchong, Heinitang, 1824 m, 26–27.VI.2014, coll. Li Xinxin; 1♀, Lushui,



Figs. 45-56. Female genitalia. 45–50, *A. (E.). flavomacularia.* 45, Tatsienlu, Sichuan (ZFMK); 46, Xiaojin, Sichuan; 47, Siao Lou, Sichuan (*perimelaina*, ZFMK); 48, Lijiang, Yunnan (*perimelaina*); 49, Danzha, Yunnan (*perimelaina*); 50, Xianggelila, Yunnan (*perimelaina*); 51, *A. (E.) flavinigra* (Tibet); 52 *A. (E.) sinica* (Tibet); 53, *A. (E.) denticularia***sp. nov.** (paratype, Hubei, IZCAS); 54–55, *A. (E.) leucocirra leucocirra.* 54, Ta-Ho, Sichuan (ZFMK); 55, Kangding, Sichuan; 56. *A. (E.) leucocirra anthracia*, Yunnan (ZFMK). Scale bars = 1 mm.

Pianma,1980 m, 3–4.VII.2014, coll. Li Xinxin. **Tibet**: 2♂, Zham, 2200–2400 m, 25–28.VI.1975, coll. Huang Fusheng & Wang Ziqing; 3♂4♀, Zham Kouan, 11.VIII.1981, 24.VII.2014, coll. Chen Tailu & Chen Rui; 2♂4♀, Yadong, 2760 m, 7.VIII.1983, 23–25.VIII.2014, coll. Cheng Rui et al.; 1♀, Yadong Linchang, 29.VIII.1984, coll. Li Aihua; 1♀, Nyingchi, Shang Zayü, 1960 m, 21–23.VIII.2005, coll. Wang Xuejian; 4♀, Nyingchi, Bomi, Tangmai, 2100 m, 29–31.VIII.2005, coll. Wang Xuejian; 2♂6♀, Nyingchi, Pailong, Menbazhuxiang, 2115 m, 1–2.IX.2005, coll. Wang Xuejian; 2♂10♀, Bomi Xian, Tangmai, 1960–2100 m, 29.VIII.2005, 13–14.VIII.2014, Slide No. Geom-4220, coll. Wang Xuejian et al.; 1♂19♀, Bomi, Zhamo, 2751 m, 26–28.VIII.2006, coll. Lang Songyun; 14♀, Bomi, Yi'ong, Tangmai, 2079 m, 29–30.VIII.2006, coll. Lang Songyun; 2♀, Mêdog 80 K, 2095 m,1–3.VIII.2014, coll. Cheng Rui & Cui Le; 5♀, Mainling, Paixiang, Zhuanyunzhan, 2883 m, 4–6.VIII.2006, coll. Lang Songyun; 3♂79♀, Mêdog, Lage, 3213 m, 7–8.VIII.2006, Slide No. Geom-4067, 4219, coll. Lang Songyun; 5♂1♀, Mêdog, Dayandong, 2880 m, 9.VIII.2006, Slide No. Geom-4066, coll. Lang Songyun; 1♂7♀, Mêdog, Hanmi, 2095 m, 10–11.VIII.2006, coll. Lang Songyun; 2♀, Mêdog, Yarang, 1091 m, 20–23.VIII.2006, coll. Lang Songyun; 2♀, Mêdog, 1091 m, 23.VIII.2006, 15.VIII.2015, coll. Lang Songyun & Yao Jian; 2♂10♀, Mêdog, Pomogonglu 80 K, 2118 m, 24–25.VIII.2006, coll. Lang Songyun; 1♀, Mêdog 108 K, 857 m, 28.VIII.2015, coll. Li Xinxin; 2♂14♀, Mêdog 62 K, 2787 m, 29–30.VIII.2015, coll. Yao Jian; 2♂, Gyirong Xian, 2799 m, 20–21.VIII.2014, coll. Cheng Rui & Cui Le; 1♀, Zayü, Zhuwagenzhen, 1973 m, 27.VIII.2014, coll. Liu Hong; 1♂, Xigazê, Yadong, Linchang, 2690 m, 24.VI.2016, coll. Li Xinxin. **Nepal** (IZCAS): 4♂8♀, Matathati Village, 15.VII.2014, coll. Chen Rui.

Distribution

China (Taiwan, Sichuan, Yunnan, Tibet), Nepal.

Genetic data

Three sampled specimens of *sinica* have no intraspecific distance. Nearest neighbour in China: *flavinigra* (3.02%).

Remarks

Inoue (1970) described *A. (E.) himalayensis*, which was synonymized with *A. (E.) sinica* by Sato (1994) on the basis of a comparison of the genitalia of the type material. At the same time, Sato treated the

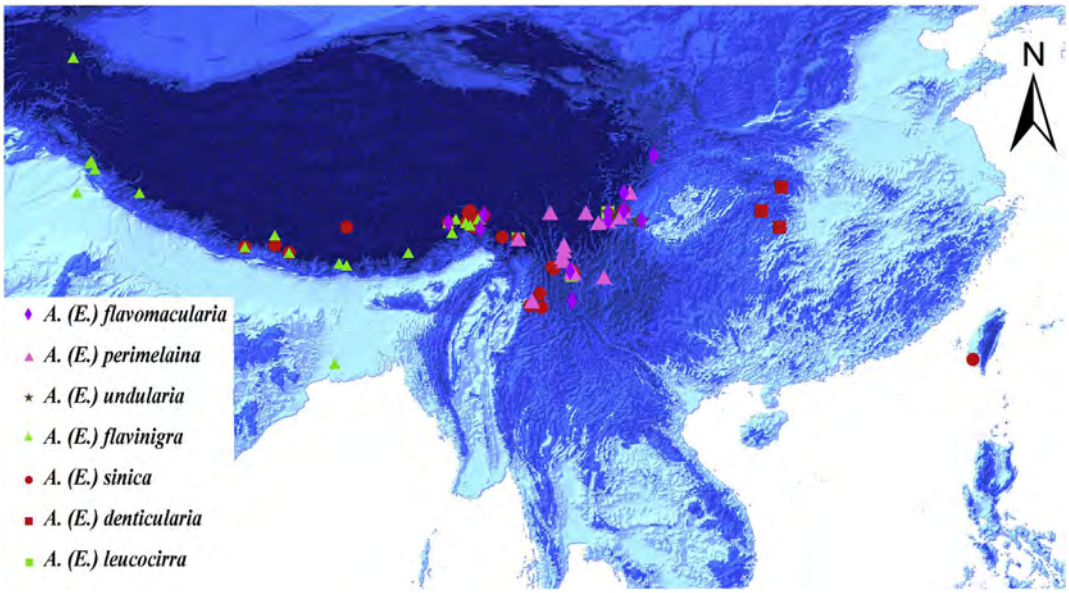


Fig. 57. Distribution map covering all examined material of *Arichanna (Epicterodes)* species.

subspecies *A. himalayensis refracta* Inoue, 1978 as a subspecies of *sinica*, i.e. *A. sinica refracta* (Fig. 13), to represent the Taiwanese population. Inoue (1978) described the female genitalia of *refracta* as possessing a developed signum. After examining the female slide (Inoue slide 1756 in BMNH) of *refracta*, we believe that it is actually a female of *flavinigra*. Stüning (2000) regarded *himalayensis* as a subspecies inhabiting the Himalayan area (Fig. 12). In the collection of IZCAS, material from Tibet and Nepal represents the Himalayan race, i.e. *himalayensis*. There are the following differences between the wing patterns of these two subspecies and the nominate subspecies: the wings are darker in *sinica* and *himalayensis*, paler in *refracta*; the patches composing the submarginal line are larger in *himalayensis*, smaller in *sinica,* and further reduced in *refracta*; the patches of the terminal line are extremely small in *refracta*, or absent in much of the anterior part; the grey area on the hindwing is less extended in *refracta*.

Arichanna (Epicterodes) denticularia Li & Han *sp.* ***nov.*** *(Figs. 18–19, 32, 42, 53)*

Description

Head. Antennae bipectinate in male and filiform in female. Frons dark brown, not protruding. Labial palpus long, slightly extending beyond frons, brown; third segment not elongate in female. Vertex, tegula and patagia greyish brown. *Thorax.* Thorax with dorsal and ventral sides grey. Hind tibia with two pairs of spurs in both sexes, dilated and with hair-pencil in male. *Wing pattern.* Forewing length: male 25–30 mm; female 27–31 mm. Outer margin of forewing slightly arc-shaped, that of hindwing rounded. Wings fresh yellow, decorated with greyish black spots. Forewing base grey, with three black spots. Costa a grey band. Veins pale grey, not accompanied by dense grey on either side, especially in the distal part. Antemedial line double, composed of black dots between veins; medial line angled outside discal spot and concave under cell; postmedial line double, with the patches of the proximal one larger; submarginal line a row of large oval black patches, and that of terminal line a row of small nearly quadrate black spots. Discal spot a large rounded black patch. Fringes yellow, grey on vein ends. Hindwing with basal area pale grey, extending along anal margin; postmedial line a black zigzag line, weak in male and clear in female, not extending to costa; submarginal line a row of black spots of different sizes, much larger above Rs, between M_1 and M_3, and between CuA_1 and CuA_2; terminal line a row of small black spots. Fringes fresh yellow. Underside identical to upperside.

Abdomen. Abdomen with dorsal and ventral sides pale grey. Third sternite of male abdomen with setal comb. Eighth sternite unmodified.

Male genitalia. Uncus long, broad basally, narrow terminally, slightly bifid at tip. Gnathos with median process stick-like. Valva narrow, with costal and ventral margins almost straight; setose cucullus narrow, tapering towards end with ventral margin convex; sclerotized ridge bearing dentate spines, mainly close to the proximal end of the cucullus. Juxta a broad sclerite, with posterior half slightly narrowed. Saccus broad and rounded. Aedeagus with posterior half strongly sclerotized, bifurcate, with one longer blunt process (main part) and another short and blunt process with a tiny lateral spine (diverging part), anterior half columniform and narrow, without cornutus.

Female genitalia. Papillae analis slender, setose. Apophyses anteriores short, about 1/3 length of apophyses posteriores. Lamella postvaginalis an arc-shaped sclerite. Ostium wide-open, ductus bursae sclerotized, colliculum long, collar-like, posterior part tapered; corpus bursae very large, nearly oval, signum round, surface with tiny spines.

Diagnosis

Compared to the congeneric species, *A. (E.) denticularia* is characterized by the colour of the forewing veins, which is pale grey at wing base, and concolorous with the wing background, i.e. fresh yellow, in the distal part, which makes it appear more yellowish than other species. In contrast, in the forewing of the other species, the colour of the veins is dark grey, and is diffused on both sides of the veins. In the male genitalia, the slightly tapering and convex cucullus and the blunt diverging process of the aedeagus can distinguish *denticularia* from most other species. The aedeagus shares a similar posterior half with *undularia*, but with a broader anterior part. In the female genitalia of *denticularia*, the signum is rounded with spines; however, in other species with a signum, the signum is an irregular sclerite with two or four tiny spines. The shape of the signum resembles that of *Paricterodes* and *Phyllabraxas*, but it is much smaller.

Type-material examined

Holotype, ♂ (IZCAS), **CHINA: Hubei**: Xuanen, Dawolongcun, 15–16.V.2017, Slide No. Geom-5058, coll. Li Henan.

Paratypes: **CHINA: Hubei** (IZCAS): 1♀, Xingshan, Longmenhe, 1260 m, 17.VI.1993, Slide No. Geom-4784, coll. Li Wenzhu; 5♂2♀, same data as holotype, Slide No. Geom-4551. **Hunan** (IZCAS): 2♀, Zhangjiajie, Wenfengcun, 11.V.2017, coll. Li Henan.

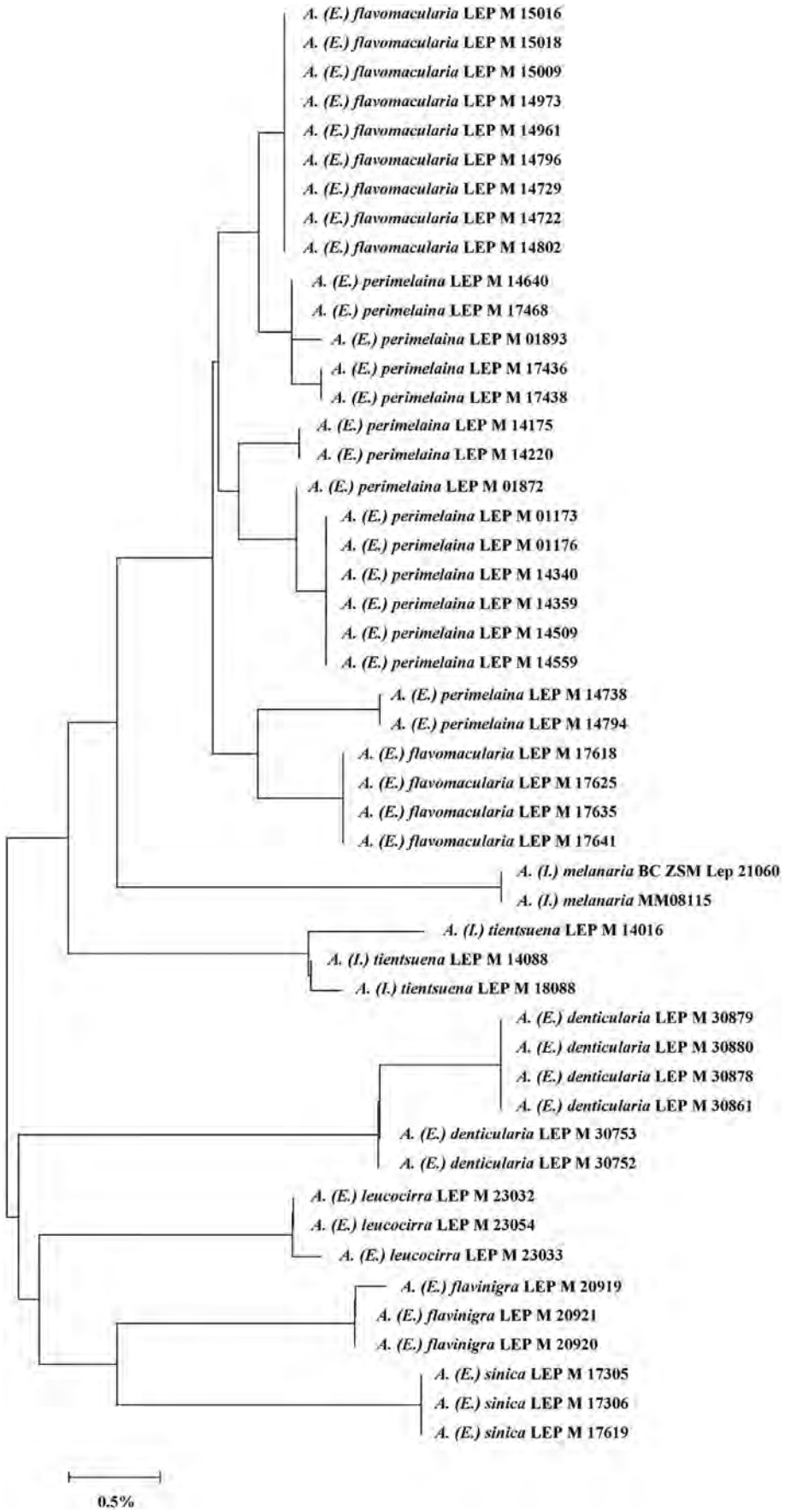


Fig. 58. Neighbour-Joining (NJ) tree, Kimura 2-parameter model.

Distribution

China (Hubei, Hunan).

Etymology

The species name is derived from the adjectival form of the latin word *denticulus*, which means “a little tooth”.

Genetic data

The mean intraspecific distance of *denticularia* is 0.34% (min. 0%, max. 0.65%; $n = 6$). Nearest neighbours in China: *flavainigra* and *leucocirra* (4.15%).

***Arichanna (Epicterodes) leucocirra* Wehrli, 1933** (Figs. 20–22, 33–34, 43–44, 54–56)

Arichanna (Epicterodes) leucocirra Wehrli, 1933, *Ent. Z., Frankf. a. M.* 47 (6): 47, fig. 9. Syntypes 2♂, 1♀, [China]: Ta-Ho, Tachien-lu [Kangding]. (ZFMK)

Diagnosis

In the subgenus *Epicterodes*, *A. (E.) leucocirra* is the smallest species with forewing length ranges from 20 to 22 mm in both males and females, compared with the average male forewing length more than 25 mm in other species. It is also the only species which lacks conspicuous yellow on the hindwing, especially in the type material, which only has a very pale yellow tinge. The postmedial line on the hindwing is dentate as in *A. (E.) undularia*. In the male genitalia, the sclerotized dentate ridge on the valva is more expanded than in most other species, except for *flavinigra*; the juxta is broad in the basal half and quite narrow in the posterior half as in *flavinigra* and *sinica*, but much shorter. In the female genitalia, the lamella postvaginalis is an oval strongly sclerotized sclerite with wrinkles. The subspecies *A. (E.) leucocirra anthracia* was described by Wehrli (1939) from Lijiang, Yunnan. The grey patches composed of transverse lines are more blurred than in the nominate subspecies, and the hindwing base has more grey scales extending to the postmedial line.

Type material examined

A. (E.) leucocirra leucocirra: CHINA: Sichuan: 1♂ (ZFMK), syntype, Chasseurs Thibétains, 1897, ex R.P. Déjean, Genitalpräp ZFMK, Nr. 796. *A. (E.) leucocirra anthracia*: Yunnan: 1♂ (ZFMK), syntype, Li-kiang (China), Provinz Nord-Yuennan, 20.VII.1935, H. Höne, Genitalpräp ZFMK, Nr. 797.

Additional material examined

A. (E.) leucocirra leucocirra: **CHINA: Sichuan**: 2♂2♀ (IZCAS), Kangding, 2582 m, 7–10.VIII.2016, Slide No. Geom-4808, 4809, coll. Cui Le; 1♂ (BMNH), Thibet, Chasseurs de Tà-tsien-loû, 1895, Ex. Oberthür Coll. Brit. Mus. 1927–3. **Tibet** (IZCAS): 1♂2♀, Zhag'yab, 3600 m, 23–29.VIII.1976, Slide No. Geom-4012, coll. Han Yinheng. *A. (E.) leucocirra anthracia*: **CHINA: Yunnan**: 1♂ (BMNH), Li-kiang (China), Provinz Nord-Yuennan, 17.VIII.1935, H. Höne, Brit. Mus. 1962-360, BMNH(E)#1008642.

Distribution

China (Sichuan, Yunnan, Tibet).

Genetic data

The mean intraspecific distance of *leucocirra* is 0.11% (min. 0%, max. 0.16%; $n = 3$). Nearest neighbour in China: *flavinigra* (2.73%).

Discussion

Most species of the genus *Arichanna* can be placed into different subgenera based on the features given by Wehrli (1939), such as: the setose cornutus on the aedeagus vesica of *Paricterodes*, the hooked cornutus of *Phyllabraxas*, the presence of the saccular process of *Arichanna*, and the combination of the yellowish hindwing pattern and the sclerotized ridge from the end of the cucullus in *Icterodes* and *Epicterodes*. However, some exceptions exist, for example, *A. (A.) interplagata* (Guenée, 1858) has a harpe as many species of the subgenus *Arichanna*, but lacks the saccular process of *Arichanna* and bears a setose cornutus as in *Paricterodes*. It is not easy to determine which subgenus it should be placed in, though Stüning (2000) moved it to *Arichanna* from *Icterodes*. Some other species have also been transferred among different subgenera. For example, Stüning (2000) moved *biquadrata* Warren, 1893, *violacea* (Warren, 1893) and *rubrivena* Warren, 1893 from *Arichanna* to *Phyllabraxas,* and *furcifera* Moore, 1888 from *Icterodes* to *Arichanna*. In the two closely related subgenera *Epicterodes* and *Icterodes*, the only species found at present that appears somewhat intermediate between the two subgenera is *A. (I.) pergracilis* Wehrli, 1933, which shares an undeveloped harpe with *Epicterodes*, and has the two parts of the aedeagus of a similar length, and a smooth ridge on the valva, as in *Icterodes*. While recognising the limited exceptions, in our view the main genital features presented by Wehrli (1939) could be sufficient to distinguish different genera, and most of the subgenera of *Arichanna* might well deserve independent generic status.

In the present study, the species recognized in *Epicterodes* are not clustered together in the NJ tree (Fig. 58) based on COI sequences, with the *flavomacularia* complex clustered with *Icterodes tientsuena* Wehrli, 1933 and *Icterodes melanaria* (Linnaeus, 1758) in one clade, while the other four species (*denticularia*, *leucocirrra*, *flavinigra* and *sinica*) are clustered in another clade. This result suggests that *flavomacularia* has a closer relationship with the two species in *Icterodes*, rather than species in *Epicterodes*, and thus we suspect the validity of the subgeneric partition of *Epicterodes* and *Icterodes*. More comprehensive taxa of *Icterodes* and gene samplings need to be included to determine the relationships between members of *Epicterodes* and *Icterodes*. More comprehensive morphoglical data and molecular analysis to explore the phylogenetic relationships in the genus *Arichanna* more widely and to verify the validity of the subgenera, is under preparation by the authors.

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