

Review

Review of the Genus *Aemene* Walker, 1854 (Lepidoptera: Erebidae: Arctiinae) in Korea with Description of a New Species

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Abstract: The genus *Aemene* Walker, 1854 (Lithosiini, Cistheniina) is reviewed from Korea, with one new species, *Aemene copaeininsulana* sp. nov. Photographs of male and female and genitalia of the examined species from Korea are given. A key to Korean species of the genus *Aemene* is provided.

Keywords: Lithosiini; Cistheniina; key; new species; distribution; Palaearctic region



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1. Introduction

The tribe Lithosiini Billberg (Erebidae, Arctiinae), known as lichen tiger moths, are cosmopolitan moths comprising approximately 3445 described species [1,2] within 457 genera [3] in the world. Adults of this tribe usually have aposematic coloration. However, larvae are dull-colored and nocturnal feeders [4,5], typically feeding on lichens, free-living algae, and bryophytes [6,7]. Bryophytes and lichens are important components of forests and other ecosystems of all regions. Despite their small size, by draping on tree branches and trunks and carpeting the forest floor, logs, and rocks, they provide much of the graceful appearance of a forest. Moreover, many species are sensitive to air pollution and have been used as biological indicators of change. The subtribe Cistheniina Bendib and Minet, 1999 is one of seven subtribes of Lithosiini. They are small to medium-sized, often with dark, banded forewings. The resting positions of adults are “roof-like”, with the antenna exposed, not directed backward.

The genus *Aemene* Walker, 1854 was established with the species type *Aemene taprobanis* (Walker, 1854) from Sri Lanka and members are widely distributed in Oriental and eastern Palaearctic regions. Later, Sevastopulo [8] found larvae and pupae of *A. taprobanis* and lichens were presumed to be their food [9]. Issiki et al. [10] illustrated the larva of *Aemene altaica* (Lederer, 1855) from Japan and noted a foliose liverwort as the host. Recently, a checklist of the genus *Aemene* was provided by Volynkin et al. [11], comprising a total of 75 valid species. However, Černý and Pinratana [12] described a new species, *Aemene mar-morosa* Černý, 2009 from Thailand, and Kirti and Singh [13] described a new species, *Aemene spotoptera* Singh and Kirti, 2016 from India; both species are omitted from Volynkin et al.'s checklist. Kishida [14] described one new species, *Aemene takahashii* Kishida, 2018 from Japan. Bucsek [15] described four new species and provided a new synonym for *Aemene coniuncta* Černý, 2009. Volynkin [16] described three new additional species, and two subspecies' statuses were upgraded. Currently, 86 described species are known in the genus *Aemene* worldwide, among them, about 32 species are distributed in northeast Asia: China, Russian Far East, Korean Peninsula, Japan, and Taiwan [11,16–21].

The first work on the Korean species of *Aemene* was published by Doi [22], who recorded *Parasiccia altaica* (Lederer, 1855) from Mt. Daedeok, Jeollabuk-do, Korea. According to Volynkin et al.'s checklist, the two recently recorded species of *Siccia* Walker, 1854 in Korea [23,24], *Siccia obscura* (Leech, 1889) and *S. shikatai* Kishida, 2010, are placed into the genus *Aemene*. This study aims to describe a new species for Korea. The number of the Korean *Aemene* species now reaches now species, including one new species *A. copaieninsulana* **sp. nov.** hereunder.

2. Materials and Methods

The adults were collected by the following methods with two kinds of trap lights, a 220 V/200 W mercury vapor lamp (Dongseong Co., Busan, Korea) and four black light FL20SbL lamps (Kumho Co., Gwangju, Korea), in the mountains and forests of eight provinces (Chungcheongbuk-do; Chungcheongnam-do; Gyeongsangbuk-do; Gyeonggi-do; Gangwon-do; Jeollabuk-do; Jeju-do; and Jeonlanam-do). A Dhyana 400DC camera (Tucsen Photonics, Fuzhou, China) attached to a Leica S6D (Wetzlar, Germany) stereomicroscope with a dome illuminator Leica LED5000 HDI (Wetzlar, Germany) was used for images of adults and a Leica EZ4 stereomicroscope (Wetzlar, Germany) was used for preparing genitalia slides. Pictures of genitalia were taken by using a Dhyana 400DC camera (Tucsen Photonics, Fuzhou, China) attached to a Leica S8AP0 stereomicroscope.

Specimens examined are deposited in the insect collections of Incheon National University (INU, Incheon, Korea), the National Institute of Biological Resources (NIBR, Incheon, Korea) for a paratype of new species (adult and gen. slide No. INU-10941K), and Mokpo National University (MNU, Muan, Korea) for *A. shikatai*.

3. Results

3.1. Systematic Accounts of the Genus *Aemene* Walker, 1854

Aemene Walker [25]: 541. TS: *Aemene taprobanis* Walker, 1854.

Panassa Walker [26]: 607. TS: *Panassa cingalesa* Walker, 1865.

Autoceras Felder, in Felder and Rogenhofer [27]: 1. TS: *Autoceras grammophora* Felder, 1874.

Parasiccia Hampson [28]: 407. TS: *Aemene maculifascia* Moore, 1878.

Hyposiccia Hampson [28]: 406. TS: *Aemene amnaea* Swinhoe, 1894.

Note: *Aemene* was characterized by Holloway [29].

3.2. Species Key to the Genus *Aemene* from Korea Based on Male Genitalia

1. Uncus wide; valva tapering; aedeagus with apical spines ... *A. copaieninsulana* **sp. nov.**
 - Uncus slender; valva wide; aedeagus without apical spine 2
2. Costal margin of valva broadly rounded; saccus rectangular *A. altaica*
 - Costal margin of valva not broadly rounded; saccus rounded 3
3. Costal process of valva slender, almost half-length of uncus *A. obscura*
 - Costal process of valva stout, 1/3 length of uncus *A. shikatai*

3.3. Species of Korean *Aemene*

3.3.1. *Aemene altaica* Lederer, 1855

Nudaria altaica Lederer [30]: 104, pl. 1: 3. TL: Russia (Altai).

Aemene fasciata Butler [31]: 399. TL: Japan.

Parasiccia altaica Hampson [28]: 409, Figure 319.

Parasiccia altaica coreana Bryk [32]: 34. TL: Korea [North Korea]: Shuotsu [Kyeongseong].

Aemene altaica Holloway [29]: 387.

Specimens examined. KOREA: 1♂, 2♀, GG Mt. Soyo, 7–8 September 1996 (Ryu and Bok); 1♀, GG Mt. Soyo, 7–8 September 1996 (Chung and Jin); 1♀, GG Mt. Soyo, 7 September 1996 (Bae, Paek, Lee and An); 1♂, GG, Gapyong-gun, Mt. Hwaak, 25 August 1998 (Paek, Lee and Ahn); 2♀, GG, Gapyong-gun, Mt. Hwaya, 5 September 1998 (Paek and Lee); 1♀, GG,

Yeoncheon-gun, Mt. Godae, 12 July 2001 (Kim, Kim, Oh and Choi); 1♀, GG, Yangpyeong-gun, Mt. Cheonggye, 21 June 2003 (Bae et al.), adult and gen. slide No. INU-12563K; 2♀, GG, Uiwang-shi, Mt. Cheonggye, 7 September 2001 (Bae et al.); 1♂, 4♀, GW, Sokchoshi, Mt. Seolaksan, V. Jeohangryong, 20 September 2002 (Y.-S. Bae et al.), adult and gen. slide No. INU-12566K; 1♀, GW, Yangyang-gun, Mt. Seolak, Osaek, 23 September 2006 (Park, Choi, Lee and Chae); 1♀, GW, Yeongwol-gun, Mureungdowon-myeon, Dowonunhak-ro 1083-15, 12 June 2018 (Ko J.-H. and Cha Y.-B.); 1♀, GW, Hoengseong-gun, Ucheon-myeon, Owon-ri, San 119, 21 June 2018 (Ko J.-H. and Cha Y.-B.), wing venation slide No. INU-12569K; 1♂, GB, Uljin-gun, Mt. Tonggo, 26–31 June 2000 (Y.-S. Bae et al.); 1♀, CB, Cungju-shi, Mt. Nam, 24–26 August 2000 (Paek, Kim and Kim); 1♀, JB, Imsil-gun, Unam-myeon, Ssangam-ri 811, 18 September 2018 (Jang C.M. and Lee D.J.); and 1♀, JB, Muju-gun, Muju-eup, Wontongsa Temple, 14 September 2021 (Oh G.S. and Ko J.-H.).

Distribution: Korea, Japan, NE China, Russian Far East, S Siberia, E Kazakhstan.

Host plants: Lichen [10,19].

Remarks: *A. altaica* was first recorded from Korea (Mt. Daedeok, JB) by Doi [22] as *Parasiccia altaica* and cited in recent Korean references (Kim et al. [33], Shin et al. [34], Park [18], Paek et al. [35], and Bae et al. [36]) and as *Aemene altaica* in Bayarsaikhan et al. [21], NIBR [37], and KSAE and ESK [38]. It can be easily distinguished by the pale gray, broad, triangular forewing spotted with black or dark gray spots; minutely waved antemedian band consisting of dark gray spots; and fuscous gray hindwing with a brown discoidal spot.

3.3.2. *Aemene obscura* (Leech, 1889)

Eugoa obscura Leech [39]: 604, pl. 30, f. 15. TL: Japan.

Siccia obscura Hampson [28]: 394.

Aemene obscura Volynkin, Černý, and Ivanova [11]: 449.

Specimens examined. KOREA: 2♂, GG, Gwangleung, 10 June 1998, adult and gen. slide no. INU (KNAE)-12564K, 12565K; 1♂, GG, Gwangneung, Lake Yuklim, 24 September 2015 (Park, Lim, Kim, Nam, Shin, Shin, Choi), N 37°44'54.73", E 127°9'50.09"; 2♂, GG, Korea, Gwangneung, National Arboretum, Rest Area, 8 June 2016 (Park, Kim, Choi, Shin, Oh), N 37°45'00.17", E 127°10'03.46", deposited in KNAE; 1♂, GW, Heongseong-gun, Mt. Taegi, 4 August 2015 (Bo-Sun Park, Sol-Moon Na, Dong-June Lee and Yang-Seop Bae), adult and gen. slide no. INU-1653K; 1♀, GW, Heongseong-gun, Mt. Taegi, 10 August 2018 (Y.-S. Bae et al.), adult no. INU-10443K; 1♂, GW, Yeongwol-gun, Mureungdowon-myeon, Dowonunhak-ro 1083-15, 12 June 2018 (Ko J.-H. and Cha Y.-B.), wing venation slide no. INU-12570K; 2♂, GW, Hwacheon-gun, Sangseo-myeon, Damok-ri, 17 June 2019 (Ko J.-H. and Jang C.M.); 1♀, JB, Imsil-gun, Unam-myeon, Ssangam-ri 811, 18 September 2018 (Jang C.M. and Lee D.J.), adult and gen. slide no. INU-12567K; and 1♂, CN, Daejeon, Seo-gu, Mt. Jangtae, 4 October 2015 (Bo-Sun Park, Sol-Moon Na, Dong-June Lee and Yang-Seop Bae), adult and gen. slide no. INU-1654K, deposited in INU.

Distribution: Korea, Japan.

Host plants: Unknown.

Remarks: *A. obscura* was first recorded from Korea (GW and CN) by Bayarsaikhan et al. [23] as *S. obscura*. Later, Volynkin et al. [11] placed it in the genus *Aemene*, without Korean distribution. It can be easily distinguished by the sordid gray, narrow forewing marked with brown or dark brown speckles and a discal cell covered with a dark brown ovoid patch.

3.3.3. *Aemene shikatai* (Kishida, 2010)

Siccia shikatai Kishida [40]: 59. TL: Japan (Tsushima Island).

Aemene shikatai Volynkin, Černý, and Ivanova [11]: 449.

Specimens examined. ♂, Korea, JN, Muan, Sangma-ri, Chungkye-myeon, 34°55' N, 126°25' E, 50 m, 15 August 2006 (leg. Choi S.W.); 1♂, 1♀, Korea, JJ, Seoqui-po, Gunsan, Gamsan-ri, Andeog-myeon, 33°14' N, 126°21' E, 50 m, 19 June 2012 (leg. Kim S.S.) (Choi and Kim, [24]).

Distribution: Korea, Japan, Russian Far East.

Host plants: Unknown.

Remarks: *A. shikatai* was first recorded from Korea (JN and JJ) by Choi and Kim [24] as *S. shikatai*. Later, Volynkin et al. [11] placed it in the genus *Aemene*, without Korean distribution. It can be easily distinguished by the gray, narrow forewing with a dark broad antemedial band and a dark discal V-shaped spot.

3.3.4. *Aemene copaieninsulana* Bayarsaikhan and Bae, **sp. nov.**

Type materials. **Holotype** ♂, Korea, GG, Gwangju, Mt. Taehwa, Experiment Forest of Seoul National University, 21 June 2018 (Y.-S. Bae et al.), adult and gen. slide no. INU-10494K, deposited in INU. **Paratypes** (3 males, 1 female) KOREA: 1♂, GG, Incheon-shi, Is. Daecheongdo, 22 August 2004 (Bae, Ha and Oh), adult and gen. slide no. INU-12568K; 1♂, GG, Yangpyeong-gun, Danwol-myeon, Buan-ri 44, 26 July 2021 (Jang C.M. and Kim H.), N 37°35'20", E 127°40'45.2", adult and gen. slide no. INU-10492K; 1♀, GW, Hoengseong, Mt. Balkyosan-choji, 29 July 2016 (Y.-S. Bae et al.), adult and gen. slide no. INU-12506K; 1♂, JN, Wando-gun, Is. Wando, recreation forest, 21 July 2021 (Bayarsaikhan U., Lee T.G. and Cha Y.-B.), N 34°20'17.475", E 126°41'46.725", Alt.: 158 m, adult, wing venation and gen. slide no. INU-10493K, deposited in INU; 1♂, JN, Yeonggwang-gun, Seongsan-ri, 12 September 2012 (Bae Y.-S.), adult and gen. slide no. INU-10491K, deposited in NIBR.

Diagnosis. *Aemene copaieninsulana* **sp. nov.** has remarkable external differences from the other members of the genus by the short dark, horizontal line in the center of the antemedial line, broad dark brown medial band, and V-shaped discoidal dark stigma in the cell of brownish gray forewing. In the male genitalia, tapering valva has three to four small, thin spine-shaped apical processes and a finger-shaped subbasal costal lobe; the short, stout aedeagus has two apical spines; and vesica has a stout spine placed on ovoid plate. In female genitalia, membranous watchglass-shaped ductus bursae are wrinkled and the globular corpus bursae has two spine-shaped signa, which are placed on the rounded plate distinguishes *A. copaieninsulana* Bayarsaikhan and Bae, **sp. nov.** from all the known Palaearctic *Aemene* species.

Description. Adult (Figure 1e–g). Head, patagium, tegula, and thorax are dark gray. Antennae are ciliate in both sexes. Length of the forewing is 5–6.5 mm in males ($n = 4$), 7.5 mm in females ($n = 1$). Forewings are ground color, dark brown–gray; antemedial line is dark brown, weakly zigzag; discal area with the short dark horizontal line basally is located in center of antemedial line and a thin, V-shaped dark stigma distally; a broad dark brown medial band is weakly curved; postmedian dark line consists of several short, dark horizontal lines; terminal area darker than medial area; terminal series of dots on dark brownish-gray cilia. Hindwings are ground color, dark brownish gray; cilia are brownish-gray. Male genitalia (Figure 2c–e). Stout uncus is bent, mucronate, covered with setae dorsally. Weakly sclerotized tegumen is broadly U-shaped. Membranous anal tube is broad with weakly sclerotized scaphium. Tapering valva is weakly sclerotized and covered with setae apically; apex of valva has three to four small, thin, spine-shaped apical processes; a subbasal costal lobe is finger shaped, half size of uncus. Sclerotized juxta is roundly rectangular. Vinculum is broadly U-shaped. Saccus is triangular. Short stout aedeagus is weakly sclerotized, with two short, stout apical spines, and vesica with a stout spine placed on the ovoid plate; it is two times longer than apical spine of aedeagus. Female genitalia (Figure 3c). Papillae anales are truncated, weakly covered with setae. Slender, long apophysis anterioris and posterioris are almost same length. Weakly sclerotized lamella antevaginalis is “tail-butterfly”-shaped. Membranous watchglass-shaped ductus bursae is wrinkled, with two strongly sclerotized plates and short robust spines near cervix of bursae. Membranous corpus bursae are globular, with two spine-shaped signa that emerge from a rounded plate.

Distribution: Korea (GG, GW, JN).

Etymology: The specific epithet is derived from the Latin “*Coreanica paeninsula*” meaning “Korean Peninsula”, which refers to the distribution of this species.

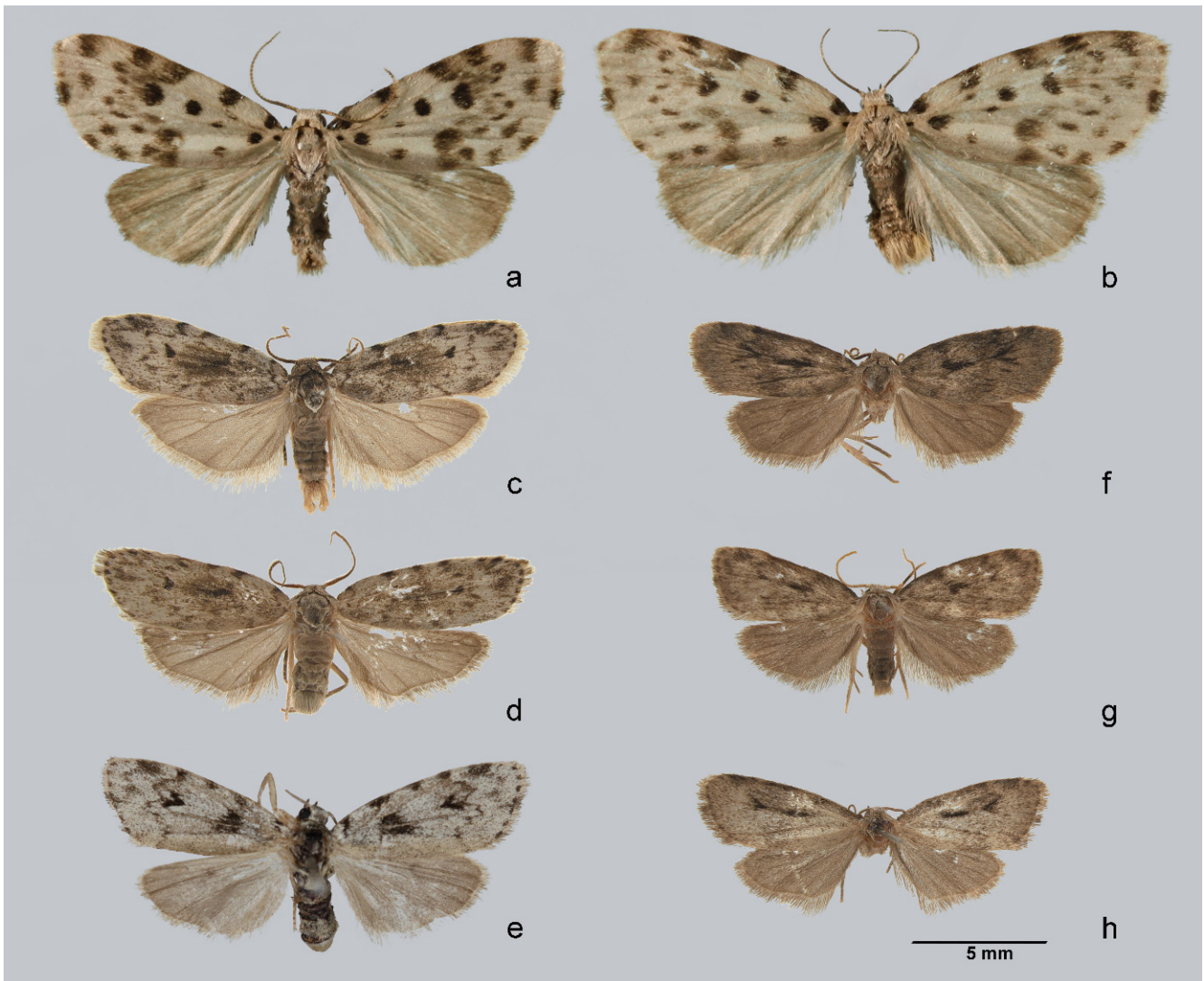


Figure 1. Adults of *Aemene* spp. (a) *A. altaica*, male, adult no. INU-1859. (b) *ditto*, female, adult no. INU-12563. (c) *A. obscura*, male, adult no. INU-12630 (d) *ditto*, female, adult no. INU-10443. (e) *A. shikatai*, female (after Choi and Kim, 2016). (f) *A. copaeininsulana* **sp. nov.**, male, holotype, adult no. INU-10494. (g) *ditto*, male, paratype, adult no. INU-12568. (h) *ditto*, female, paratype, adult no. INU-12506 (Scale bars: (a–h) = 5 mm).

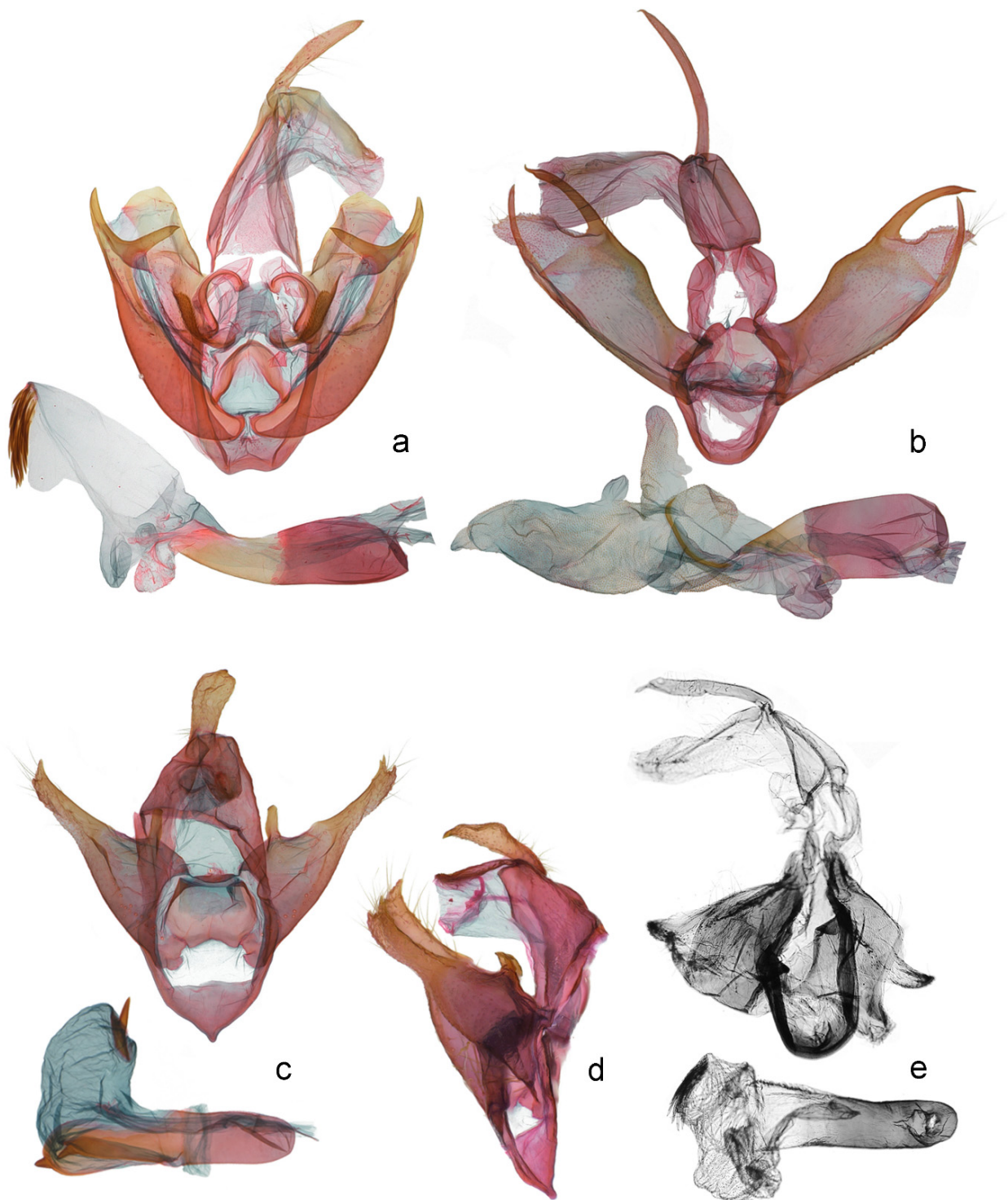


Figure 2. Male genitalia of *Aemene* spp. (a) *A. altaica*, slide no. INU-12566. (b) *A. obscura*, slide no. INU-12564. (c) *A. copaninsulana* sp. nov., holotype, slide no. INU-10494. (d) *ditto*, lateral view, holotype, slide no. INU-10494. (e) *A. shikatai*, female (after Choi and Kim, 2016).

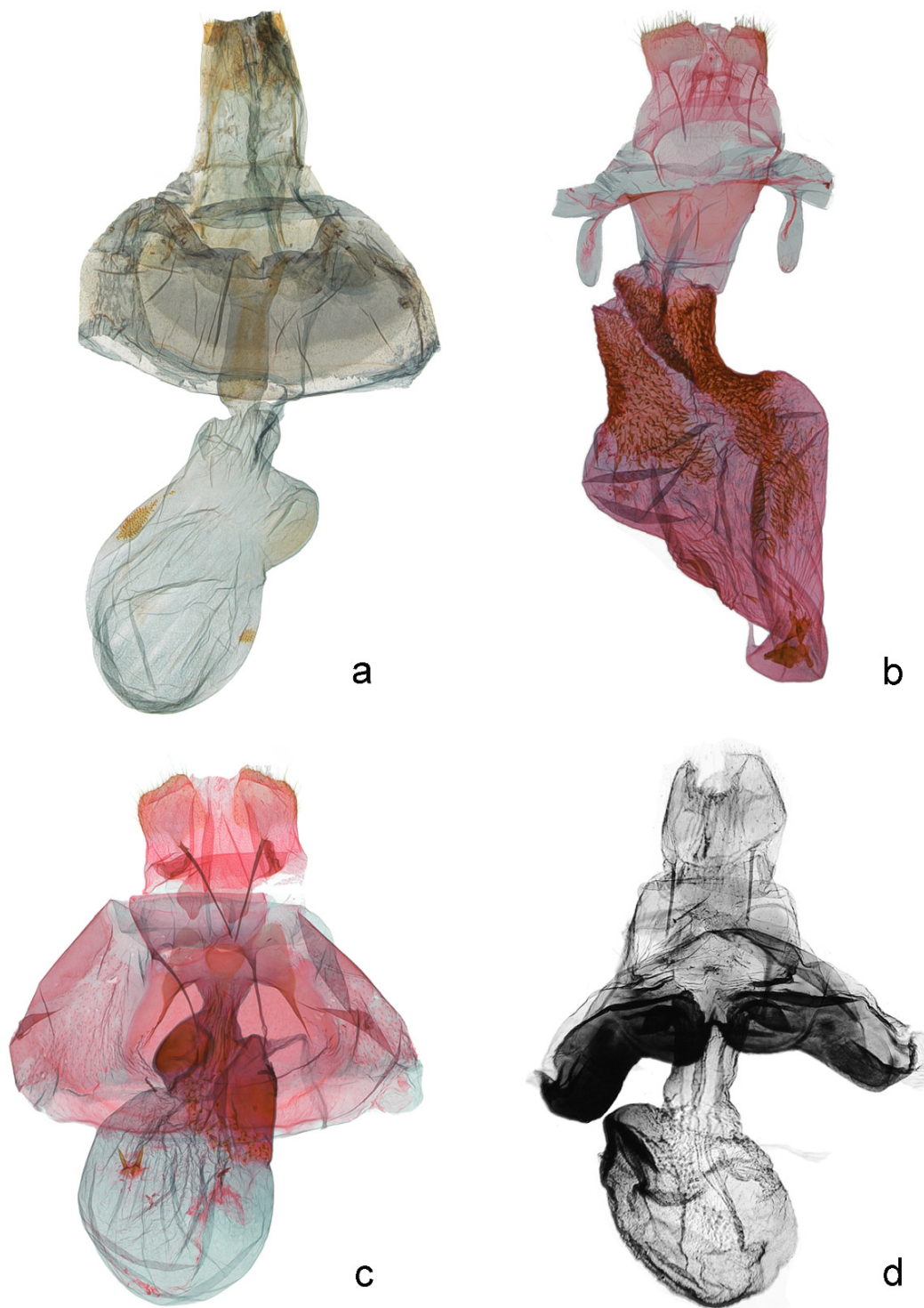


Figure 3. Female genitalia of *Aemene* spp. (a) *A. altaica*, slide no. INU-2081. (b) *A. obscura*, slide no. INU-12567. (c) *A. copaninsulana* **sp. nov.**, paratype, slide no. INU-12506. (d) *A. shikatai*, female (after Choi and Kim, 2016).

4. Discussion

After Hampson [28], Holloway [29] restored *Aemene* as a valid genus, with two junior synonyms of *Hyposiccia* Hampson, 1900 and *Parasiccia* Hampson, 1900. Members of the genus vary in wing venation and genitalia structure but can be distinguished from typical *Siccia* [29]. However, some Asiatic species of this genus remain of dubious generic placement in either *Aemene* or *Siccia*.

Based on the species of Korean *Aemene* recorded, the genus definition is revised as follows: pale gray or dark gray ground color of forewing marked by dark lines and dots, and two dark discal dots or marks in the cell; the uncus is slender (in *A. obscura*) or stout (in *A. altaica*, *A. shikatai*, and *A. copaieninsulana* **sp. nov.**), with apical spine or pointed; short valva has diverse apical processes and the costal lobe (in all described species); aedeagus is stout, with groups of slender spines (in *A. altaica* and *A. shikatai*) and stout spine (in *A. copaieninsulana* **sp. nov.**) or scobination (in *A. obscura*) in the male genitalia; corpus bursae of all Korean species with diverse signa in the female genitalia.

According to Volynkin et al. [11], *Eugoa obscura* var. *formosibia* Strand, 1917 is a synonym of *A. obscura*. Still, this subspecies has been described as a variation of *Eugoa obscura* Hampson, 1900 (= *Eugoa hamsoni* Holloway, 2001: 428, plate 7, Figure 405, a replacement name) [41,42]. Thus, the types of *Eugoa obscura* var. *formosibia* Strand need revision in the future.

5. Conclusions

Based on the present study, the genus *Aemene* includes four species from Korea, including one new species described herein. Of those, one species belongs to the *Parasiccia* group (*altaica*, Figure 4a), and the other three to the *Aemene*-group (*obscura*, *shikatai*, and *copaieninsulana* **sp. nov.**, Figure 4b), based on the wing venation. If the types of the genera *Siccia* (TS: *Siccia caffra* Walker, 1854 from South Africa), *Parasiccia* (TS: *Aemene maculifascia* Moore, 1878 from India), and *Aemene* (TS: *Aemene taprobanis* Walker, 1854 from Sri Lanka) are confirmed, then the Eurasian *Aemene* could be subdivided into two or more different genera, and the African species should probably be placed in the *Siccia*.

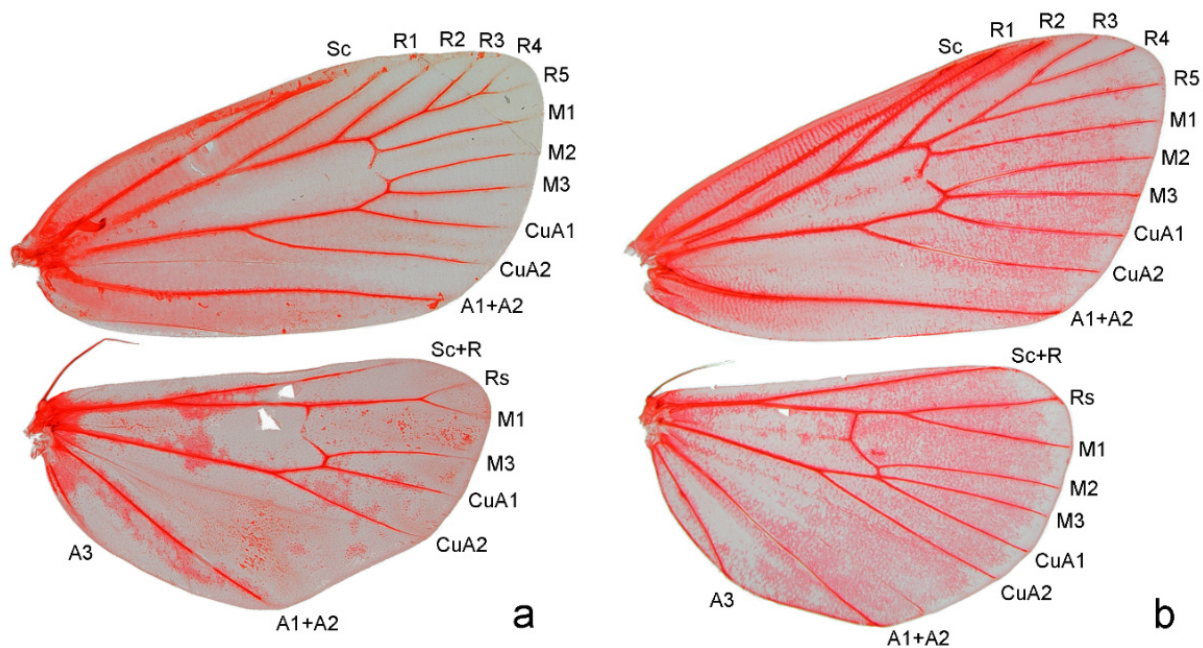


Figure 4. Wing venation of *Aemene* spp. (a) *A. copaieninsulana* **sp. nov.**, paratype, slide no. INU-10493, belonging to *Aemene* type. (b) *A. altaica*, slide no. INU-12569, belonging to *Parasiccia* type.

Author Contributions: U.B. collected some of the specimens and wrote the original manuscript; U.B. and Y.-B.C. prepared dissections and slide mounts of the genitalia and wing venation; J.-H.K. took photographs for adult and slides; H.W.K. and Y.-S.B. discussed and revised the manuscript before submission. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

TL	Type locality
TS	Type species
CB	Chungcheongbuk-do
CN	Chungcheongnam-do
GB	Gyeongsangbuk-do
GG	Gyeonggi-do
GW	Gangwon-do
JB	Jeollabuk-do
JJ	Jeju-do
JN	Jeonnam-do

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