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A review of tiger moths (Lepidoptera: Erebidae: Arctiinae: Arctiini) from Flores Island, Lesser Sunda Archipelago, with description of a new species and new subspecies

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Abstract
The Wallacean Region is considered a unique evolutionary hotspot, but the current knowledge of lepidopteran faunas on certain islands is very far from being complete. Here we present a preliminary checklist of the Arctiini fauna of the Flores Island based on available collection materials and a review of the body of literature. In total, for the island fauna we list 22 tiger moth species, with eight newly recorded species. Among novel records, local endemic *Spilarctia mikeli* Bolotov, Kondakov & Spitsyn **sp. nov.** and *Aloa cardinalis danau* Bolotov, Kondakov & Spitsyn **ssp. nov.** were discovered. Additionally, several taxa with broad ranges such as *Amerila astreus*, *Creatonotos gangis*, *Euchromia horsfieldi*, *Lemyra maculifascia*, *Nyctemera distincta* and *Utetheisa pulchelloides* were new for the island fauna. In general, 15 taxa are prospective endemic Wallacean elements, among which seven taxa are unknown outside the Flores Island: *Orhantarctia cymbalophoroides*, *Lemyra everetti*, *L. floresina*, *Aethalida owadai floresiensis*, *Nyctemera scalarium regalis*, *Spilarctia mikeli* **sp. nov.** and *Aloa cardinalis danau* **ssp. nov.** Our findings reveal that the tiger moth fauna of the Flores Island has rather moderate level of endemism, with only 32% of putative endemic taxa.

Key words: Wallacea, East Nusa Tenggara, island biogeography, tiger moths, new species, new subspecies.

Introduction

Despite the fact that the Wallacean Region is a famous evolutionary hotspot (Lohman et al. 2011), the current knowledge of the Lepidoptera fauna of the Lesser Sunda Archipelago, including the Flores Island, is very limited (Bolotov et al., 2017). A few notes on records of several tiger moth species (Erebidae: Arctiinae: Arctiini) from Flores are available in the body of literature (e.g., Rothschild, 1910; Roepke, 1954; Holloway, 1988; De Vos, 2002, 2007, 2015; Dubatolov, 2010, 2012; Černý, 2011, 2014; Spitsyn et al., 2016).

The present investigation aims to review the current knowledge of the Arctiini fauna of the Flores Island in a broad biogeographic context. Based on this work, we perform the first but still incomplete checklist of this fauna and describe two taxa new to science, i.e., a new remarkable species in the genus *Spilarctia* Butler, 1875 and a new local subspecies of *Aloa cardinalis* (Butler, 1875).

Figure 1. Map of the study region. The red ball indicates West Flores, the type locality of *Spilarctia mikeli* **sp. nov.** and *Aloa cardinalis danau* **ssp. nov.** The base of the map was modified from Lohman et al. (2011).

Material and Methods

This study is based on available materials from the Lepidoptera collection of the Russian Museum of Biodiversity Hotspots, Federal Center for Integrated Arctic Research, Russian Academy of Sciences, Arkhangelsk, Russia (RMBH thereafter), the Natural History Museum, London, United Kingdom (BMNH) and Naturalis Biodiversity Center, Leiden, The Netherlands (RMNH) (Tables 1 and 2). Additionally, we reviewed published occurrences of tiger moths from the Flores Island (Table 1).

The genitalia were dissected and mounted on a glass slide with Histofluid® (Paul Marienfeld GmbH & Co., Germany). The images of specimens were taken with a Canon EOS 650D camera (Canon, Tokyo, Japan). The photos of the genitalia were obtained using a research stereomicroscope (SteREO Discovery.V8, Carl Zeiss, Germany). Specimens of *Amerila astreus*, *Creatonotos gangis*, and *Spilarctia mikeli* **sp. nov.** were studied by using a molecular approach (Table 2). The total DNA was extracted from a single leg of each dry specimen using a standard phenol/chloroform procedure (Sambrook et al., 1989). The standard primers LepF and LepR were used for the amplification of 660-bp-long barcode fragments of the *cytochrome c oxidase subunit I* (COI) gene (Hajibabaei et al., 2006). The PCR mix contained approximately 200 ng of total cellular DNA, 10 pmol of each primer, 200 µmol of each dNTP, 2.5 µl of PCR buffer (with 10×2 mmol $MgCl_2$), 0.8 units Taq DNA polymerase (SibEnzyme Ltd., Novosibirsk, Russia), and H_2O added for a final volume of 25 µl. Thermocycling included one cycle at 95°C (4 min), followed by 38–40 cycles of 95°C (50 sec), 50°C (50 sec), and 72°C (50 sec) and a final extension at 72°C (5 min). Forward and reverse sequencing was performed on an automatic sequencer (ABI PRISM® 3730, Applied Biosystems) using an ABI PRISM® BigDye™ Terminator v. 3.1 reagent kit. Resulting sequences were checked manually using a sequence alignment editor (BioEdit version 7.2.5; Hall, 1999).

Phylogenetic affinities of the COI haplotypes of our specimens were retrieved with the Barcoding of Life Identification System (BOLD IDS) COI Full Database, which includes records without species designation (Ratnasingham and Hebert, 2013), as well as with the NCBI's GenBank using a Basic Local Alignment Search Tool, BLAST (Altschul et al., 1990). Available COI sequences of nearest neighbors were

Table 1. List of tiger moth species recorded from Flores Island, Lesser Sunda Archipelago (Lepidoptera: Erebidae: Arctiinae: Arctiini)

Genus	Species	Distribution*	Reference to the records from Flores
Euchromia Hübner, [1819]	*E. horsfieldi* (Moore, 1859)	Sumatra, Java, Borneo, Bali, Lesser Sundas, and Christmas Island	Present study
Amerila Walker, 1855	*A. astreus* (Drury, 1773)**	India and Sri-Lanka over Nepal, continental China, Taiwan, the Philippines to Indo-China, Indonesia and New Guinea	Present study (recorded from Flores and Kanawa Islands)
Utetheisa Hübner, [1819]	*U. palla* (Röber, 1891)	Lesser Sundas: Sumbawa, Flores, Lembata (former Lomblen), Adonara, Pura and Alor	De Vos (2007); Dubatolov (2010, 2012)
	U. pulchelloides Hampson, 1907	China, Japan, islands of the Indian Ocean, Pakistan, India, Sri-Lanka, Indochina, Malaysia, Indonesia, Philippines, Australia, Vanuatu, New Caledonia, Norfolk, and New Zealand	Present study (recorded from Kanawa Island)
Nyctemera Hübner, [1820]	*N. scalarium regalis* Roepke, 1954	Flores	Roepke (1954); Dubatolov (2010, 2012); De Vos (2015)
	N. baulus Boisduval, 1832	Sundaland to North Australia and Samoa	Roepke (1954); present study
	N. coleta (Stoll, 1781)	Japan, Oriental Region to New Guinea	Roepke (1954)
	Nyctemera distincta Walker, 1854	Java and Flores	Present study: in collections of BMNH and RMNH (De Vos, pers. comm.)
	N. maculata variamacula De Vos, 2002	Bali, Lombok, and Flores	De Vos (2002)
	N. pagenstecheri Pagenstecher, 1898	Pulau Laut (South Borneo), Lombok, Sumbawa, and Flores	Holloway (1988); Dubatolov (2010, 2012)
	N. simulatrix Walker, [1865]	Sulawesi and Lesser Sundas	Roepke (1954); Dubatolov (2010, 2012)
	N. tripunctaria lombokiana (Swinhoe, 1903)	Lombok, Sumba, Sumbawa, Flores, and Alor	Roepke (1954); Dubatolov (2010, 2012)
Aloa Walker, 1855	*A. cardinalis danau* **ssp. nov.**	West Flores	Present study
	A. c. luteomarginata (Rothschild, 1910)	East edge of Flores (Larantuka), Timor, and Maluku	Rothschild (1910); Dubatolov (2004)
	A. lactinea (Cramer, [1777])	India and Japan over continental China, Taiwan and the Philippines to Sundaland and Lesser Sundas	Rothschild (1910); Dubatolov (2010, 2012)

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TABLE 1.

Hollowayana Dubatolov & Kishida, 2006	*H. landaca* (Moore, [1860])	Java to Flores	Dubatolov and Kishida (2006)
Aethalida Walker, 1865	*A. owadai floresiensis* Spitsyn & Bolotov, 2016	West Flores; nominative subspecies is known from the Selayar Island near South Sulawesi	Spitsyn et al. (2016)
Orhantarctia Dubatolov & Kishida, 2005	*O. cymbalophoroides* (Rothschild, 1910)	Flores	Rothschild (1910); Dubatolov and Kishida (2005); Dubatolov (2010, 2012)
Creatonotos Hübner, [1819]	*C. gangis* (Linnaeus, 1763)**	Middle East (Oman, the United Arab Emirates and Iran), China and Oriental Region to Australia	Present study
Lemyra Walker, 1856	*L. everetti* (Rothschild, 1910)	Flores	Dubatolov (2010, 2012)
	L. maculifascia (Walker, 1855)	China, Oriental Region to Australia	Present study
	L. floresina Černý, 2014	Flores	Černý (2014)
Spilarctia Butler, 1875	*S. mikeli* **sp. nov.****	Flores	Present study

*Based on Hampson (1900), Rothschild (1910), Holloway (1988), De Freina (2007), De Vos (2007, 2015), Dubatolov (2010, 2012), and Černý (2011) with our additions. **Reference COI sequences are available in NCBI GenBank.

obtained from these sources. For phylogenetic analyses of *Spilarctia* spp., we collected a sequence data set with 26 unique COI haplotypes (658 bp in length). As an out-group, a haplotype of *Theretra natashae* Cadiou, 1995 was used (Table 2). The lacking sites were treated as missing data. The best models of sequence evolution as suggested the corrected Akaike Information Criterion of MEGA6 (Tamura et al. 2013) were as follows: 1st codon of COI: GTR+G (G = 0.85), 2nd codon of COI: TN93+G+I (G = 0.41; I = 0.40), and 3rd codon of COI: HKY. Phylogenetic relationships were reconstructed based on Bayesian inference implemented in MrBayes v. 3.2.6 (Ronquist et al., 2012). The analyses were performed using the following parameters: nchains = 4, nruns = 2, samplefreq = 1000, temp = 0.1; 10% of the sampled trees were discarded as burn-in (pre-convergence part). Runs were conducted for 3 million generations. Convergence of the MCMC chains to the stationary distribution was checked visually based on the plotted posterior estimates using a MCMC trace analysis tool (Tracer v1.6; Rambaut et al., 2014). Calculations were performed at the San Diego Supercomputer Center through the CIPRES Science Gateway (Miller et al., 2010).

Systematics

Family Erebidae Leach, [1815]

Subfamily Arctiinae Leach, [1815]
Tribe Arctiini Leach, [1815]

***Euchromia horsfieldi* (Moore, 1859)**
Fig. 2A

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: south of the town of Labuan Bajo by the road to Gorontalo, secondary forest, 8º32’22”S, 119 º52’39”E, 16-18 January 2015, 1♀, Bolotov leg. (RMBH, voucher no. SPH0723).

Table 2. List of COI sequences examined in this study.

Species	Collecting locality	Sample code	BOLD IDS or GenBank acc. no.	Reference
Amerila astreus (Drury, 1773)	Indonesia, Kanawa Island near West Flores	SPH693	MG735263	Present study
A. astreus (Drury, 1773)	Indonesia, West Flores, Sano Ngoang Lake	SPH694	MG735264	Present study
A. astreus (Drury, 1773)	Malaysia, Pahang	BIOUG06552-B02	LEPMY015-13	BOLD IDS
A. astreus (Drury, 1773)	Malaysia, Pahang	BIOUG06552-B03	LEPMY016-13	BOLD IDS
A. astreus (Drury, 1773)	Malaysia, Pahang	BIOUG06552-B04	LEPMY017-13	BOLD IDS
A. astreus (Drury, 1773)	Taiwan, Taidong County	AYK-04-0590-08	LTOLB248-09	BOLD IDS
A. astreus (Drury, 1773)	Taiwan, Taidong County	AYK-04-1280-03	LTOLB1140-11	BOLD IDS
Creatonotos gangis (Linnaeus, 1763)	Indonesia, West Flores, Labuan Bajo	SPH592	KY683800	Present study
C. gangis (Linnaeus, 1763)	Indonesia, West Flores, Sano Ngoang Lake	SPH594	KY683801	Present study
C. gangis (Linnaeus, 1763)	Nepal, Trisuli Valley	JDF0010	HQ682748	GenBank
C. gangis (Linnaeus, 1763)	Pakistan, Kashmir	NIBGE MOT-01788	KX863293	GenBank
C. gangis (Linnaeus, 1763)	India	ERI-RH-M004	KJ156506	GenBank
C. gangis (Linnaeus, 1763) (=*C. omanirana* De Freina, 2007)	Oman, Jabal Akhdar-No-Auslaeufer, Oase Nakhl	JDF0011	HQ682749	GenBank
Spilarctia mikeli **sp. nov.**	Indonesia, West Flores, Sano Ngoang Lake	SPH695	MG735265	Present study
S. luteum (Hufnagel, 1766)	Finland, South Karelia	MM01036	LEFIA113-10	BOLD IDS
S. seriatopunctata (Motschulsky, [1861])	Taiwan, Taidong County	AYK-04-1013-03	LTOLB416-09	BOLD IDS
S. xanthogaster (Thomas, 1994)	Pakistan, Azad Kashmir, Muzaffarabad	NIBGE MOT-00927	MAMOT927-10	BOLD IDS
S. semperi (Rothschild, 1910)	Malaysia, Pahang	BIOUG14394-E04	LEPMY1208-14	BOLD IDS
S. bifasciata Butler, 1881	Japan, Chubu, Shizuoka-ken	AYK-04-5086	LTOLB329-09	BOLD IDS
S. obliqua (Walker, 1855)	Pakistan, Punjab, Islamabad	NIBGE MOT-00697	MAMOT697-10	BOLD IDS
S. sumatrana (Swinhoe, 1905)	Malaysia, Pahang	BIOUG14383-E07	LEPMY1116-14	BOLD IDS
S. strigatula (Walker, 1855)	Malaysia, Pahang	BIOUG08681-G10	LEPMY557-13	BOLD IDS
S. punctata Daniel, 1943	Malaysia, Pahang	BIOUG14383-H10	LEPMY1155-14	BOLD IDS
S. obliquizonata (Miyake, 1910)	Japan, Chubu, Shizuoka-ken	AYK-04-1013-02	LTOLB325-09	BOLD IDS
S. groganae (Holloway, 1976)	Malaysia, Sabah	BIOUG12331-A04	LPMLY384-14	BOLD IDS
S. nobilis (Turner, 1940)	Australia, Queensland	10ANIC-01153	ANICE156-10	BOLD IDS
S. postrubidum (Wileman, 1910)	Malaysia, Sabah	BIOUG12331-H06	LPMLY470-14	BOLD IDS
Spilosoma erythrozona (Kollar, [1844])	Pakistan, Kashmir	NIBGE MOT-01685	MAMOT1780-12	BOLD IDS

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TABLE 2

S. dubia (Walker, 1855)	United States, North Carolina, Craven County	05-NCCC-731	LNC731-06	BOLD IDS
S. congrua Walker, 1855	Canada, Ontario, Pukaskwa National Park	08BBLEP-00630	LPSOD848-09	BOLD IDS
S. vagans (Boisduval, 1852)	Canada, British Columbia	CNCNoctuoidea13694	RDNME166-07	BOLD IDS
S. urticae (Esper, 1789)	Germany, Bavaria, Oberbayern	BC ZSM Lep 36661	GWOSA795-10	BOLD IDS
S. lubricipedum (Linnaeus, 1758)	United Kingdom, England, Hertfordshire	UKLB3D11	CGUKA233-09	BOLD IDS
S. latipennis Stretch, 1872	Canada, Ontario, Grey County	PPBP-1729	LPSOB730-08	BOLD IDS
S. vestalis Packard, 1864	United States, California, San Diego County	BIOUG06805-D01	LOCBF1295-13	BOLD IDS
Ardices curvata (Donovan, 1805)	Australia, New South Wales	BIOUG00951-B08	NSWHM589-11	BOLD IDS
A. glatignyi (Le Guillou, 1841)	Australia, Tasmania	06-TASB-00640	LOTSB640-07	BOLD IDS
A. canescens (Butler, 1875)	Australia, Australian Capital Territory, Canberra	BIOUG02106-A03	PHLCD1164-12	BOLD IDS
Spilaethalida erythrastis (Meyrick, 1886)	Australia, Queensland	10ANIC-01152	ANICE155-10	BOLD IDS
Theretra natashae Cadiou, 1995*	Indonesia, West Flores, Sano Ngoang Lake	SPH581	MG735266	Present study

*An outgroup.

Distribution: Sumatra, Java, Borneo, Bali, Lesser Sundas, and Christmas Island (Table 1).

Remarks: First record from Flores. The lengthened dark yellow spot below the cell on the forewing of our female specimen is separated by large black triangular inclusion (vs. continuous dark yellow spot with only a minute black inclusion in specimens from Java and Borneo: Moore, 1859; Holloway, 1988).

***Amerila astreus* (Drury, 1773)**
Figs. 2C-2D

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, geothermal site, primary mountain rainforest, 8º43’1”S, 120 º0’10”E, 23 January 2015, 1♀, Bolotov leg. (RMBH, voucher no. SPH0694); Kanawa Island, scarce forest of *Ziziphrus jojoba*, 8°29'31"S, 119°45'27"E, 26 April 2011, 1♂, Bolotov leg. (RMBH, voucher no. SPH0693).

Distribution: India and Sri-Lanka over Nepal, continental China, Taiwan, the Philippines to Indo-China, Indonesia and New Guinea (Table 1).

DNA barcoding: Two sequenced specimens from Flores share two unique COI haplotypes with *p*-distance of 0.3%. Their nearest neighbors were from Malaysia (*p*-distance from 0.2 to 0.6%) and from Taiwan (*p*-distance from 1.1 to 1.4%) (Table 2) that indicates rather recent dispersal of the species from Sundaland to the Lesser Sundas.

Remarks: First record from Flores and its small offshore island (Kanawa).

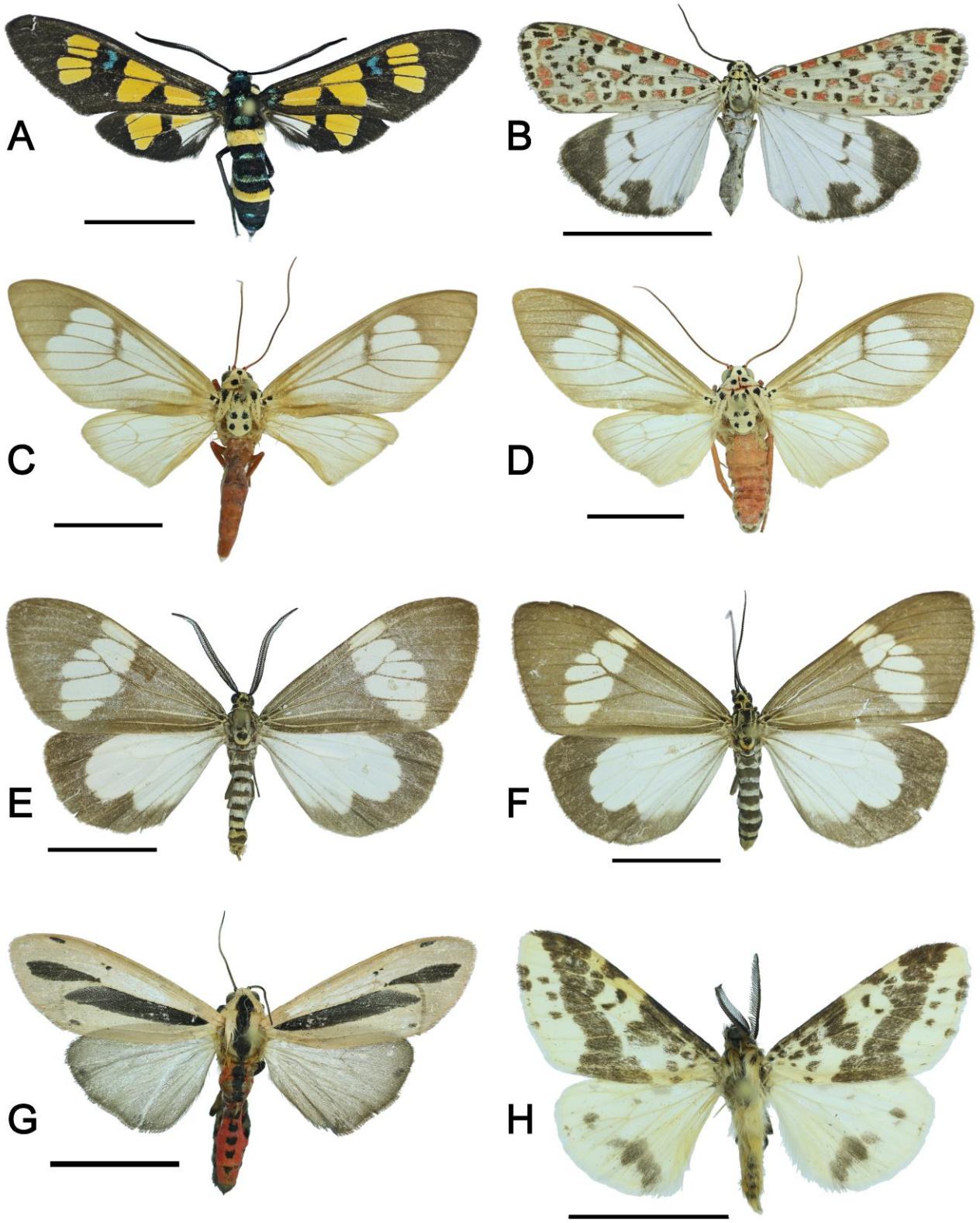

Figure 2. Examples of Arctiini species from Flores Island, Lesser Sundas, Indonesia: **A**) *Euchromia horsfieldi* (Moore, 1859), ♀ (Sph0723); **B**) *Utetheisa pulchelloides* Hampson, 1907, ♀ (RMBH, voucher no. Sph0717); **C**) *Amerila astreus* (Drury, 1773), ♀ (RMBH, voucher no. Sph0694); **D**) *A. astreus*, ♂ (RMBH, voucher no. Sph0693); **E**) *Nyctemera baulus* (Boisduval, 1832), ♂ (RMBH, voucher no. Sph0720); **F**) *N. baulus*, ♀ (RMBH, voucher no. Sph0721); **G**) *Creatonotos gangis* (Linnaeus, 1763), ♂ (RMBH, voucher no. Sph0595); **H**) *Lemyra maculifascia* (Walker, 1855), ♂ (RMBH, voucher no. Sph0722). Scale bar: 10 mm. Photos: Vitaly M. Spitsyn.

***Utetheisa pulchelloides* Hampson, 1907**
Fig. 2B

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Kanawa Island: scarce forest of *Ziziphrus jojoba*, 8°29'31"S, 119°45'27"E, 21 January 2012, 1♂, 1♀, Bolotov leg. (RMBH, voucher nos. SPH0717 and SPH0718).

Distribution: Pakistan, north India, Sri-Lanka, south China, Japan, islands of the Indian Ocean, Indochina, Malaysia, Indonesia, Philippines, Australia, Vanuatu, New Caledonia, Norfolk, and New Zealand (Table 1).

Remarks: First record from a small offshore island of Flores.

***Nyctemera baulus* (Boisduval, 1832)**
Figs. 2E-2F, 5A-5B

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, geothermal site, primary mountain rainforest, 8º43’1”S, 120 º0’10”E, 23 January 2015, 1♀, Bolotov leg. (RMBH, voucher no. SPH0721); Labuan Bajo, garden and native grassland on the seacoast, 8º31’21”S, 119º52’16”N, 13-20 January 2015, 2♂, Bolotov leg. (RMBH, voucher nos. SPH0719 and SPH0720).

Distribution: Widespread from Sundaland to North Australia and Samoa (Table 1).

***Aloa cardinalis danau* Bolotov, Kondakov & Spitsyn ssp. nov.**
Figs. 3, 5D-5E

Type material. Holotype male, INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, camp site, secondary mountain forest with old nutmeg trees on a hill slope, 8º42’33.50”S, 119 º59’51”E, 21-22 January 2015, Bolotov leg. (RMBH, voucher no. SPH0724). Paratypes, INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, camp site, secondary mountain forest with old nutmeg trees on a hill slope, 8º42’33.50”S, 119 º59’51”E, 21-22 January 2015, 2♂, 2♀, Bolotov leg. (RMBH, voucher nos. SPH0725- SPH0727). Labuan Bajo, garden and native grassland on the seacoast, 8º31’21”S, 119º52’16”N, 13-20 January 2015, 1♂, 1♀, Bolotov leg. (RMBH, voucher no. SPH0728 and SPH0729).

Etymology: Danau = lake in Bahasa Indonesia as the new subspecies was discovered on the shore of the Sano Ngoang Lake.

Diagnosis: The females of West Flores’s subspecies differs from *A. c. cardinalis* (Butler, 1875) from the Philippines and *A. c. celebensis* (Rothschild, 1910) from Sulawesi by the lack of submarginal spots or presence of 1-2 small, elongated spots on the hindwing (vs. large black submarginal patches); from *A. c. reducta* (Rothschild, 1910) from the Tomea Island (Tukangbesi Archipelago) by the lack of submarginal spots or presence of 1-2 small, elongated spots on the hindwing (vs. 3 black submarginal spots); and from *A. cardinalis luteomarginata* (Rothschild, 1910) from Timor, East Flores and Maluku by red coloration on costa, collar and edges of tegulae (vs. yellow). The males of West Flores’s subspecies differ by darker creamy or light brown ground color of the hindwing (vs. white).

Description. *Male morphology:* Wingspan 59-63 mm, forewing length 28-30 mm (N = 3). Labial palpi stout, upright, short (equal to eye diameter). Eyes naked. Antennae long, filiform, thinner apically. Abdomen long. *Male markings:* Head white, with red dorsal margin. Antennae black. Labial palpi dorsally black, ventrally white or yellow. Eyes gray. Thorax dorsally white. Collar white, with red margin. Tegulae white, with black dot near the base and red edge. Legs dorsally black, ventrally white or yellow. Abdomen dorsally bright red, with a row of black dots; ventral side of abdomen white; a row of large black spots is located dorsally, with two rows of smaller black spots below. Forewing white, costa red, two small black spots near dorsal margin and two small black spots in distal part of cell. Hindwing creamy up to light brown, fringe white, up to 3 small black spots near termen, large black spot in cell. Underside of both wings white, usually with similar markings with black spots as on the upperside. *Male genitalia*: Asymmetric, differs from

the nominative subspecies by a triangular recess on the apical part of the right valva and by two tubercle-like processes on the inner side of the left valva (Fig. 5C-5D).

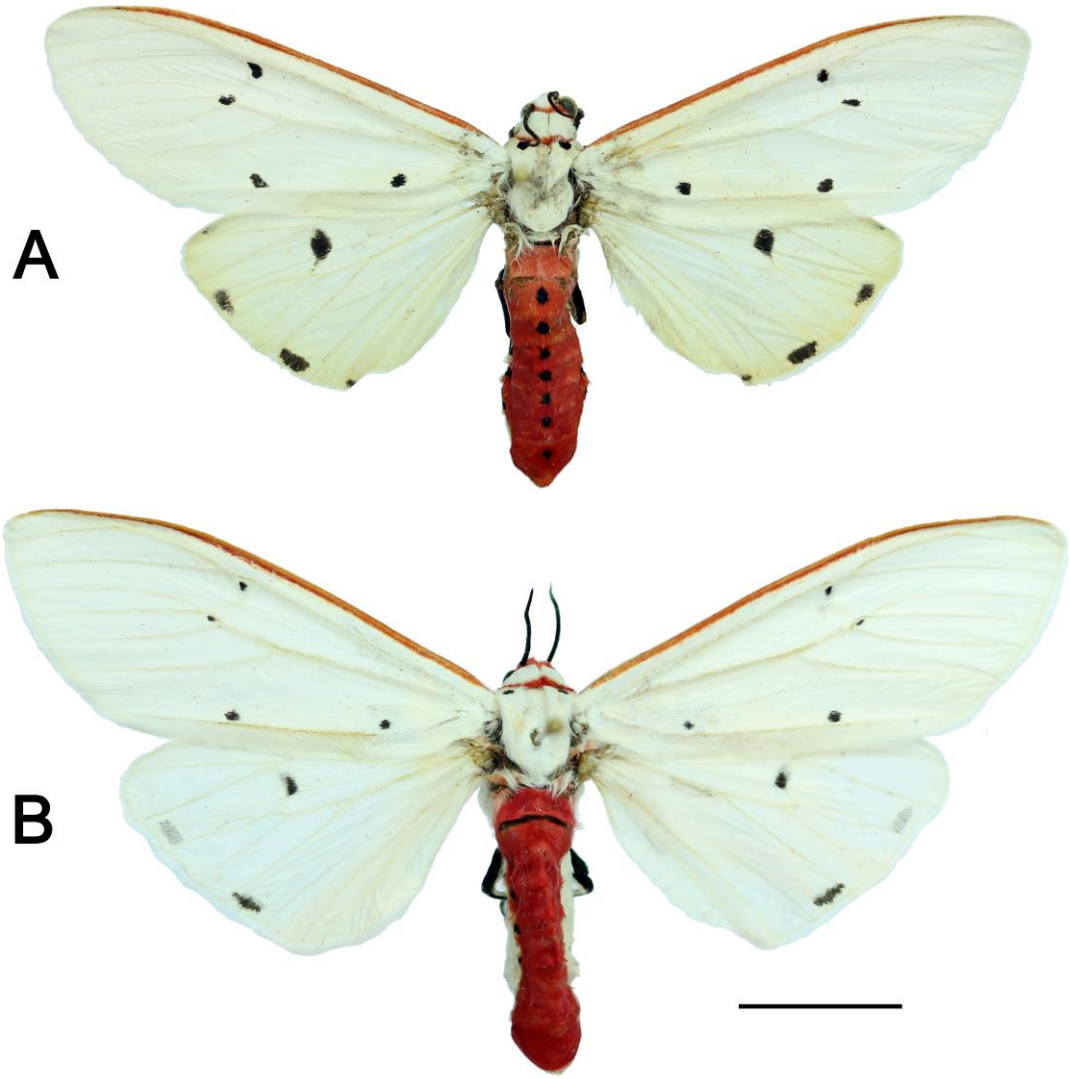

Figure 3. *Aloa cardinalis danau* **ssp. nov.** from Flores Island, Lesser Sundas, Indonesia: **A**) ♂ holotype (RMBH, voucher no. Sph0724); **B**) ♀ paratype (Sph0729). Scale bar: 10 mm. Photos: Vitaly M. Spitsyn.

Female morphology: Wingspan 65-73 mm, forewing length 30-35 mm (N = 3). Labial palpi stout, upright, short (equal to eye diameter). Eyes naked. Antennae long, filiform, thinner apically. Abdomen long. *Female markings:* Eyes gray. Head white, with red dorsal margin. Antennae black. Labial palpi dorsally black, ventrally white, yellow or pinkish. Eyes gray. Thorax dorsally white. Collar white, with red margin. Tegulae white, with black dot near the base and red edge. Legs dorsally black, ventrally white or yellow. Abdomen dorsally bright red, with a row of black dots, which may lacking, and sometimes with a few black spots on the distal part of abdomen; ventral side of abdomen white; a row of large black spots is located dorsally, which sometimes merge into a line, with two rows of smaller black spots below; end of abdomen white. Forewing white, costa red, two small black dots near dorsal margin and two small black dots in distal part of cell. Hindwing creamy, black spots near termen usually lacking but up to 2 spots sometimes present, black spot in cell. Underside of both wings white, usually marking with black spots is reduced, with exception of black spots in cell. *Female genitalia*: Not examined.

Distribution: West Flores; only known from two localities but most likely distributed across neighboring islands, e.g., Sumbawa and Sumba.

Remarks: The range of each subspecies of *A. cardinalis* is confined to a certain archipelago or island that corresponds to the allopatric speciation model (Rothschild, 1910; Dubatolov, 2004; Černý 2011). With respect to this biogeographic pattern, these isolated subspecies may actually represent several divergent species-level lineages but this hypothesis need to be checked in a future on the basis of molecular sequence data.

***Creatonotos gangis* (Linnaeus, 1763)**
Fig. 2G

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, camp site, secondary mountain forest with old nutmeg trees on a hill slope, 8º42'33.50"S, 119 º59'51"E, 21-22 January 2015, 1♂, 1♀, Bolotov leg. (RMBH, voucher nos. SPH0594 and SPH0595); Labuan Bajo, garden and native grassland on the seacoast, 8º31'21"S, 119º52'16"E, 13-20 January 2015, 2♀, Bolotov leg. (RMBH, voucher nos. SPH0592 and SPH0593); Labuan Bajo, hotel garden, 1 May 2011, 1♂, 1♀, Bolotov leg. (RMBH, voucher nos. SPH0590 and SPH0591).

Distribution: Widespread from Middle East (Oman, the United Arab Emirates and Iran), India and China to Australia (Table 1).

DNA barcoding: Two sequenced specimens from Flores share two COI haplotypes (GenBank acc. nos. KY683800 and KY683801) with the mean *p*-distance 0.2%. Their nearest neighbors were originated from South Asia (India, Pakistan and Nepal) and the Middle East (Oman) with the minimum *p*-distance of 1.6% (Table 2).

Remarks: First record from Flores.

***Lemyra maculifascia* (Walker, 1855)**
Fig. 2H and 5C

Material examined. INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, geothermal site, primary mountain rainforest, 8º43'1"S, 120 º0'10"E, 23 January 2015, 1♂, Bolotov leg. (RMBH, voucher no. SPH0722).

Distribution: Widespread from China and Oriental Region to Australia (Table 1).

Remarks: First record from Flores.

***Spilarctia mikeli* Bolotov, Kondakov & Spitsyn sp. nov.**
Fig. 4

Type material. Holotype female, INDONESIA, Lesser Sundas, East Nusa Tenggara, Flores Island: Sano Ngoang Lake, camp site, secondary mountain forest with old nutmeg trees on a hill slope, 8º42'33.50"S, 119 º59'51"E, 21-22 January 2015, Bolotov leg. (RMBH, voucher no. SPH0695).

Etymology: This new species is named in honor of Mr. Mikel Albarran Valle, an enthusiastic amateur naturalist, who lives on Flores Island.

Diagnosis. The new species is similar to *Spilarctia wahri* (Rothschild, 1933) from Timor, *S. mindanao* Dubatolov & Kishida, 2010 [=*S. trikenzana* (Cerný, 2011)] and *S. mollis* (Cerný, 2011) from the Philippines, but differs by reduced black markings on the hindwing, with stigma spot, postdiscal dot near the stigma, a row of a few minute postdiscal black dots, and two minute submarginal marks. The female of *S. wahri* has two black spots near the tornus and two black dots near the apex; the forewings are dark brown (Rothschild, 1933). The female of *S. mindanao* has lunular black spot in cell and three black spots in submarginal area. The female of *S. mollis* has black spot in cell and black submarginal band consisting of four partly conjoined patches.

Description. *Female morphology:* Wingspan 41 mm, forewing length 21 mm. Head with frons equal to eye diameter. Labial palpi stout, upright, short (slightly longer than eye diameter), underside ciliate (with scarce short ciliae). Proboscis small, weakly developed. Antennae long, filiform, thinner apically, with two short ciliae on each segment. Abdomen long. *Female markings:* Head and antennae brown. Labial palpi

brown with black end. Thorax dorsally brown. Underside of thorax red-brown. Legs light orange-pink. Tegulae brown. Abdomen dorsally bright rose-red with large, rounded black spots on each tergite, distal end brownish black. The ventral side of the abdomen yellow pink. Forewing light brown, with rows of small, unclear blackish spots in postbasal, postdical and postmarginal areas, and two black spots at the base of the wing. Hindwing bright rose-red, black markings strongly reduced, with rounded stigma spot, one postdiscal spot near the stigma, a row of a few minute postdiscal black dots athwart to the anal margin, and two submarginal marks. Underside of both wings orange-pink, with rows of black postdiscal and submarginal spots. Black discal spot on each wing. *Female genitalia*: Not examined.

Male is unknown.

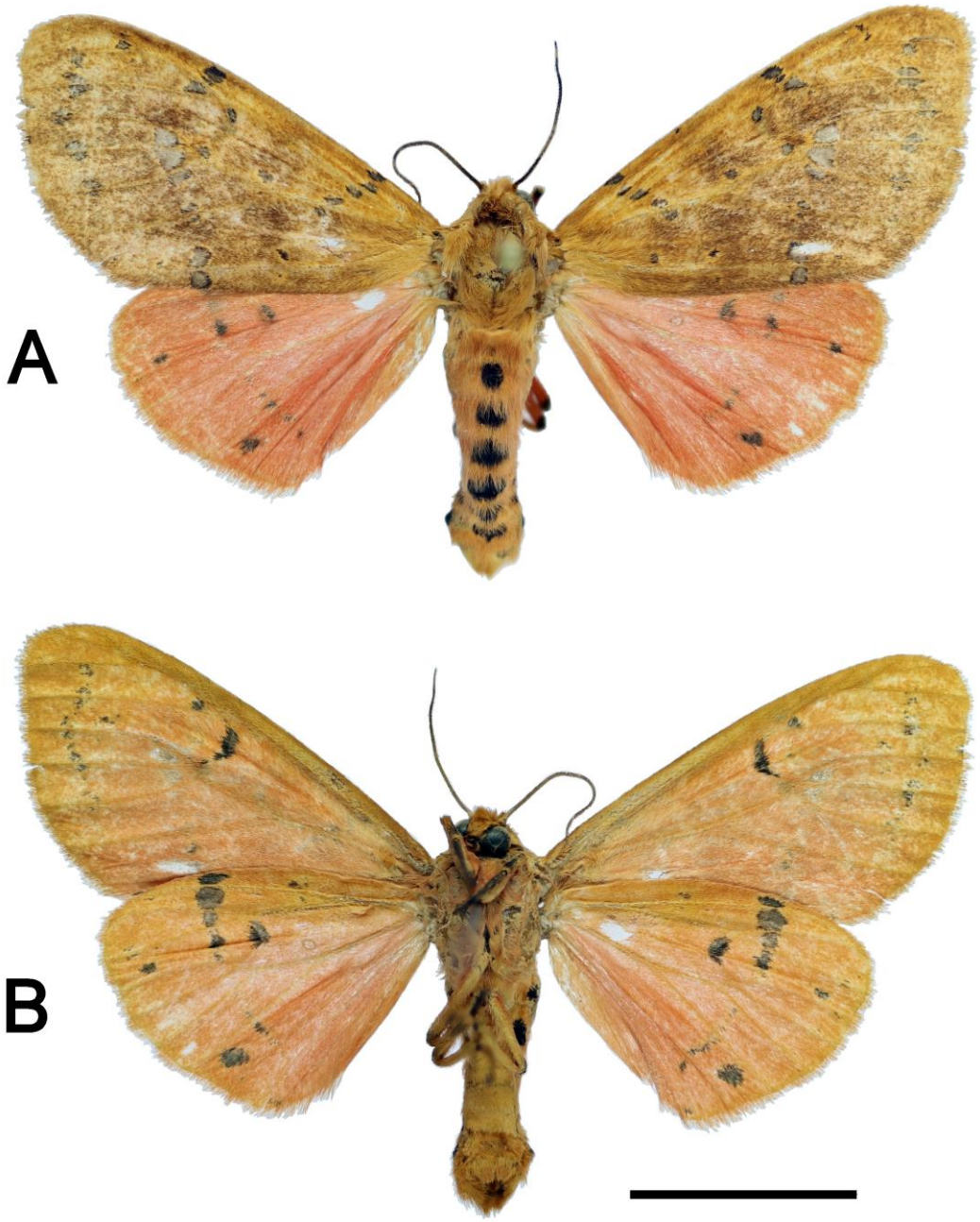

Figure 4. *Spilarctia mikeli* **sp. nov.**, ♀ holotype from Flores Island, Lesser Sundas, Indonesia (RMBH, voucher no. Sph0695): **A**) upperside; **B**) underside. Scale bar: 10 mm. Photos: Vitaly M. Spitsyn.

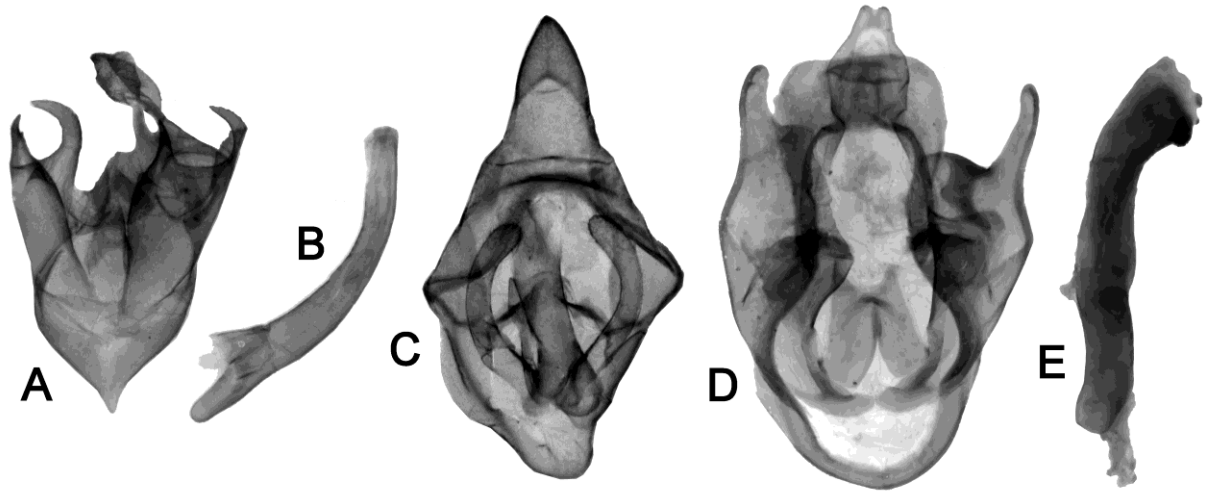

Figure 5. Male genitalia of Arctiini from Flores Island, Lesser Sundas, Indonesia: **A**) *Nyctemera baulus* (Boisduval, 1832), genitalia (RMBH, voucher no. Sph0720); **B**) *N. baulus*, aedeagus (RMBH, voucher no. Sph0720); **C**) *Lemyra maculifascia* (Walker, 1855), genitalia (RMBH, voucher no. Sph0722); **D**) *Aloa cardinalis danau* **ssp. nov.**, genitalia, holotype (RMBH, voucher no. Sph0724); **E**) *A. cardinalis danau* **ssp. nov.**, aedeagus, holotype (RMBH, voucher no. Sph0724). Photos: Vitaly M. Spitsyn.

DNA barcoding: Reference COI sequence no. MG735265. There are no available nearest members in GenBank and BOLD IDS. The new species looks morphologically similar to taxa in the subgenus *Praephragmatobia* Dubatolov & Kishida, 2010, but it is genetically distant from *Spilarctia strigatula* group (Fig. 6).

Distribution: West Flores; only known from the type locality.

Remarks: A series of *Spilarctia* sp. with dark brown forewings from Timor in the collection of the Museum Witt (CMWM), München, fits well with the description of *S. wahri* (Rothschild, 1933), although De Vos and Suhartawan (2011: p. 313) assume that it may be an undescribed species.

Discussion

Based on the collection materials, we list eight new tiger moth species in the fauna of Flores. Among the novel records, *Spilarctia mikeli* **sp. nov.** and *Aloa cardinalis danau* **ssp. nov.** were described as local endemic taxa new to science. Together with published records, the Arctiini fauna of Flores comprises 22 species (Table 1), but this list is surely still incomplete. However, the fauna includes seven endemic taxa, with four possible local island species and three subspecies (Table 1). These findings indicate that the level of endemism in tiger moth fauna of the Flores Island (32% of putative endemic taxa) is rather moderate as compared with that in the Lasiocampidae, which contains ten species, including at least nine possible local endemics (90% of local endemic taxa) (Zolotuhin and Witt 2005).

The results of our selective DNA barcoding suggest that the tiger moth fauna of Flores includes relatively recent immigrants from Sundaland (e.g., *Amerila astreus* and *Creatonotos gangis*) and putative ancient relict elements (*Spilarctia mikeli* **sp. nov.**). Previously, divergent phylogenetic lineages, the range of which is confined to the Flores Island, were discovered in other groups of Lepidoptera, e.g., in the Lymantriinae (Bolotov et al., 2017). In summary, these results highlight that the Lesser Sunda Islands may harbor many unique species- and subspecies-level lineages of moths that are still waiting to be discovered. Broad-scale molecular studies of the Wallacean Lepidoptera remain necessary to estimate the true levels of endemism across different island archipelagoes and separate islands.

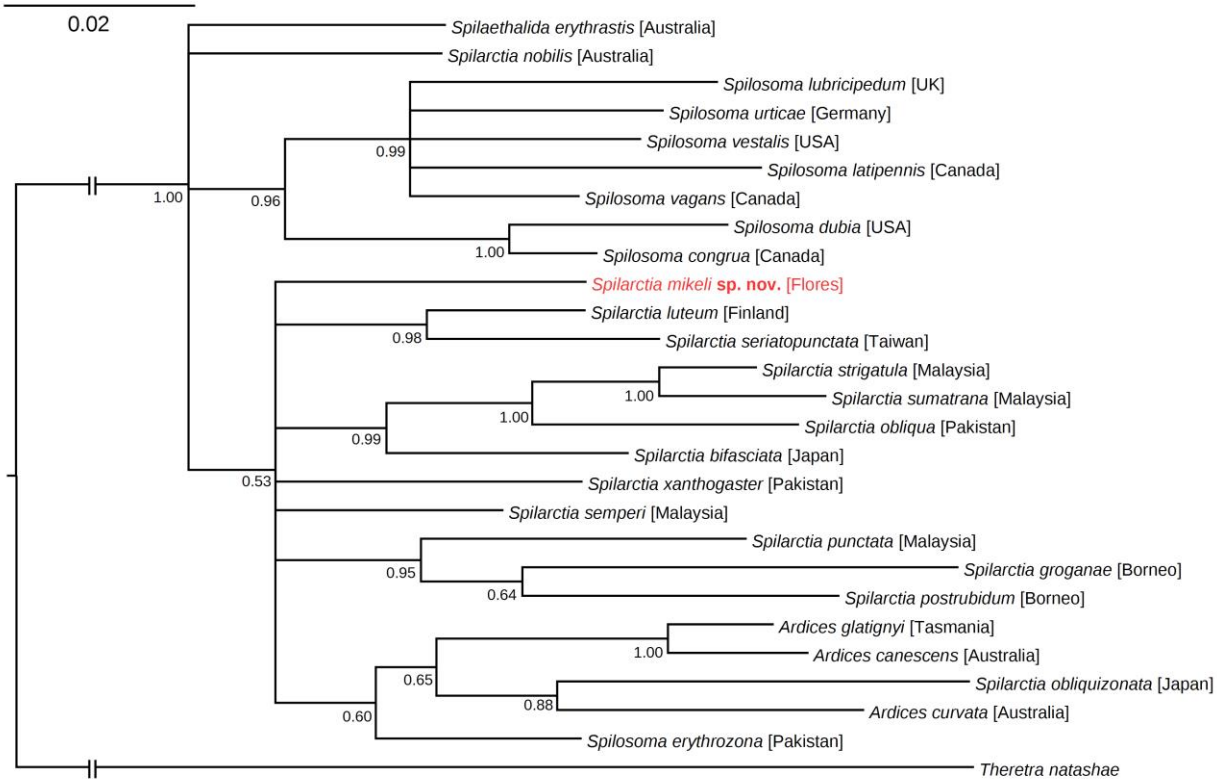

Figure 6. Fifty-percent majority-rule consensus phylogenetic tree of *Spilarctia* spp. and related taxa recovered from Bayesian analysis with 26 in-group COI haplotypes (see Table 2 for details). A haplotype of *Theretra natashae* was used as an out-group. Black numbers near branches are Bayesian posterior probabilities. The scale bar indicates branch lengths (nucleotide substitutions per site).

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