Studies on external genitalia of seven Indian species of the genus *Spilarctia* Butler (Lepidoptera: Arctiidae: Arctiinae) along with the description of a new species

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Abstract: Seven species i.e., *Spilarctia mona* (Swinhoe), *S. castanea* (Hampson), *S. bifascia* Hampson, *S. coorgensis* sp. nov., *S. obliqua* (Walker), *S. casigneta* (Kollar) and *S. todara* (Moore) have been taxonomically treated from the Western Ghats of India. The external male and female genital structures of these species have been described and illustrated in detail. A key to the studied species is also given.

Keywords: Arctiidae, Arctiinae, Lepidoptera, new species, Spilarctia, Western Ghats

INTRODUCTION

Genus *Spilarctia* was established in 1875 by Butler on the type species *Phalaena lutea* Hufnagel, 1766, from Germany. This genus was synonymised under *Spilosoma* Stephens, 1828, by Hampson in 1894. However, in 1901, Hampson described the genus *Diacrisia* Hübner, 1819, in a broader concept and synonymised 31 genera under it which also included both the genera i.e., *Spilarctia* Butler and *Spilosoma* Stephens. Seitz (1910) introduced the division of the family Arctiidae into eight subfamilies and transferred the genus *Spilarctia* Butler under Spilosominae. Later, Daniel (1943) followed this division in spite of the fact that Strand (1919) treated Spilosominae as a synonym of Arctiinae. Arora & Chaudhary (1982) and Arora (1983) followed the classification given by Seitz (1910). Holloway (1988) used *Spilosoma Curtis (=Spilosoma Stephens) as a valid generic name. Koda (1988) brought out an important publication on the generic classification of subfamily Arctiinae of the Palearctic and Oriental regions based on the male and female genitalia. He re-characterized the genus *Spilosoma* Curtis and *Spilarctia* Butler and provided suitable status to both these genera in this publication. Kirti & Singh (1994) studied the genitalic structures of four Indian species i.e., *Spilarctia multiguttata* Walker, *S. casigneta* Kollar, *S. obliqua* Walker and *S. comma* Walker.

In the present study a large sample of 43 representatives were collected from different localities of Western Ghats of India. On close examination of morphological characters, seven species were separated. Out of these, six species were identified from the relevant literature and by comparison with the collections preserved in different national museums viz., Indian Agricultural

 Abbreviations: 1 A - First anal vein; 2A - Second anal vein; AED - Aedeagus; AMP+HRP - Ampulla & Harpe (fused); ANT.APO - Anterior apophyses; CO - Costa; CRN - Cornuti; CRPB - Corpus Bursae; CU - Cucullus; CU1 - First cubital vein; CU2 - Second cubital vein; DU.BU - Ductus Bursae; DU.EJ - Ductus Ejaculatorius; FEN - Fenestrae; JX - Juxta; M1 - First median vein; M2 - Second median vein; M3 - Third median vein; PAP.A - Papilla Analis; PO.APO - Posterior apophyses; R1 - First radial vein; R2 - Second radial vein; R3 - Third radial vein; R4 - Fourth radial vein; R5 - Fifth radial vein; RS - Radial Sector; SA - Saccus; SC - Subcosta; SC+R1 - Stalk of SC + R1; SIG - Signum; SL - Sacculus; TG - Tegumen; UN - Uncus; VES - Vesica; VIN - Vinculum; VLA - Valvula; VLV - Valva.

Abstract: Seven species i.e., *Spilarctia mona* (Swinhoe), *S. castanea* (Hampson), *S. bifascia* Hampson, *S. coorgensis* sp. nov., *S. obliqua* (Walker), *S. casigneta* (Kollar) and *S. todara* (Moore) have been taxonomically treated from the Western Ghats of India. The external male and female genital structures of these species have been described and illustrated in detail. A key to the studied species is also given.

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In the present study a large sample of 43 representatives were collected from different localities of Western Ghats of India. On close examination of morphological characters, seven species were separated. Out of these, six species were identified from the relevant literature and by comparison with the collections preserved in different national museums viz., Indian Agricultural
Research Institute (IARI), New Delhi, Forest Research Institute (FRI), Dehradun and Natural History Museum (NHM), London. One species could not be identified from these sources. This species is described here as new to science.

MATERIALS AND METHODS

The material for the present study i.e., the adult moths of family Arctiidae were collected exclusively from fluorescent lights during night hours from different localities in the Western Ghats of India. The collected moths were killed with ethyl acetate vapors in the killing bottle. The freshly killed specimens were pinned and stretched on adjustable wooden stretching boxes. The pinned specimens were dried for 2-3 days in the improvised drying chambers. The properly dried specimens were then preserved in air tight wooden boxes, containing naphthalene balls as fumigants. To study wing venation permanent slides of fore and hind wings were made. For this, the methodology given by Common (1970) and advocated by Zimmerman (1978) was followed. For the study of external male and female genitalia, the entire abdomen of the preserved moths was removed, as cutting only the last few segments often damages constituent parts of male and female genitalia (Robinson 1976). The detached abdomen was put in 10% KOH for 12-14 hr. in order to soften chitin and dissolve muscles and other soft parts. The KOH treated material was washed in distilled water and residual traces of KOH for 12-14 hr. in order to soften chitin and dissolve muscles and other soft parts. The KOH treated material was washed in distilled water and residual traces of KOH were later removed by putting it in 1% glacial acetic acid. The abdomen was dissected in 50% alcohol for taking out the genitalia and adhering unwanted material was cleared in the subsequent grades. After proper dehydration, the material was cleared in clove oil and preserved in a ratio of 3:1 alcohol and glycerol. The diagrams were drawn with the help of a graph eye piece fitted in a zoom binocular.

GENUS *SPILARCTIA BUTLER*


**Type species:** *Phalaena lutea* Hüfnagel, 1766, Germany: Berlin; type deposited in Natural History Museum (NHM), London, subsequent designation by Kirby 1877 in Rye Zoo. Rec. 12 : 431.

**Distribution:** India; China; Korea; Japan; Nepal; Bhutan; Cambodia and Malaysia.

**Diagnosis:** Labial palpi porrect or porrectly rostriform. Antennae bipectinate in males, ciliated in females. Forewing with vein R1 arising from cell; R2, R3, R4 and R5 from a common stalk; M1 from upper angle; M2 from or slightly beyond lower angle of cell. Hindwing with vein Sc+R1 originating towards base of cell; Rs and M1 from upper angle; M2 from lower angle or towards middle of discocellulars. Hind tibia with two pairs of spurs. Male genitalia with uncus moderately long, broad at base and gradually narrowing towards tip; acrotergite well developed; femur absent; saccus present; valvae simple with costa narrow and linear, sometimes produced at proximal end; saccus present, valvula and cucullus not clearly differentiated; juxta trapezoid; aedeagus moderately long and broad; vesica membranous with irration of small spines; ductus ejaculatorius entering subapically. Female genitalia with corpus bursae membranous, signum present or may be absent; ductus seminalis entering ductus bursae.

*Spilarctia mona* (Swinhoe) comb. nov. (Figure 1)

*Spi洛soma mona* Swinhoe, 1885, female, type locality Mahabaleshwar, type depository NHM, London and examined by the junior author.

*Spi洛soma mona* (Swinhoe) Hampson, 1894, *Fauna Br. Ind. Moths*, 2: 5.


**Female genitalia:** Corpus bursae rounded, membranous, three signa present; ductus bursae long and broad, well sclerotized; ductus seminalis entering corpus bursae; anterior apophyses shorter than posterior apophyses; papilla analis fringed with moderately long setae.

**Wing expanse (Half):** Female 26-30 mm.

**Material examined:** 1 female, 08.x.2005, Mahabaleshwar, Maharashtra, 1320m; 1 female, 05.x.2005, Matheran, Maharashtra, 690m.

**Remarks:** Only three female specimens of *mona* Swinhoe were collected in 1885 by Swinhoe from Bombay and Mahabaleshwar. Till date, no male representative of this species was studied and associated for *mona* Swinhoe except Kaleka (2005). It seems that this Indian worker has wrongly identified the above said species collected from northeastern India, because, in the female genitalia of *mona* Swinhoe three signa are present whereas, Kaleka (2005) has mentioned that the signum is missing in this species. Kaleka (2005) not only shifted it under genus *Thanatarctia* Butler on the basis of external male and female genitalic structures, but also provided wrong information in his publication that the species *mona* Swinhoe was studied by Koda (1988) under the genus *Spilarctia* Butler.

In the present study only two female representatives were collected from Mahabaleshwar and Matheran, which clearly point out that geographically the species is very much restricted. The detailed study of morphological and female genitalic structures of species under reference confirms that it is better to place it under the genus *Spilarctia* Butler rather than under *Thanatarctia* Butler or *Diacria* Hübner. Hence, the proper status of *mona* Swinhoe has been provided in the present work.
Figure 1. *Spilarctia mona* (Swinhoe) comb. nov. A - Forewing, B - Hindwing, C - Female genitalia
**Spilarctia castanea** (Hampson) comb. nov.  
(Figure 2)

*Spilosoma castanea* Hampson, 1893: 9, male, type locality Sri Lanka, type depository NHM, London and examined by the junior author.


**Male genitalia:** Uncus moderately long and broad, sickle shaped, curved, setose with small setae, well sclerotized; acrotergite well developed; fenestra absent; tegumen longer than uncus, u-shaped; vinculum shorter than tegumen, broad u-shaped; saccus well developed. Valvae with costa narrow, produced to a small plough like structure, sclerotized; acrotergite well developed; fenestra absent; tegumen longer than uncus, u-shaped; vinculum shorter than tegumen, broad u-shaped; saccus well developed. Valvae with costa narrow, produced to a small plough like structure, sclerotized; acrotergite well developed; fenestra absent; tegumen longer than uncus, u-shaped; vinculum shorter than tegumen, broad u-shaped; saccus well developed. Valvae with costa narrow and weakly sclerotized; saccus

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**Spilarctia coorgensis** sp. nov.  
(Figure 4)


**Material examined:** 3 males, 25.xi.2003, Bhagamanadala, Karnataka, 900m; 1 male, 12.ix.2004, Vallakkadava, Kerala, 780m.

**Remarks:** The above said species *bifascia* Hampson was shifted under genus *Diacrisia* Hübner as a ‘form’ of *Diacrisia obliqua* Walker by Hampson in 1901. But the detail examination of genitalic structures like shape of uncus, juxta, valvae and aedegus of *bifascia* Hampson clearly conform that it is better to place this taxa under genus *Spilarctia* Butler. Therefore, the original status of this species has been revived in the present work and male genitalic structures are discussed and illustrated in detail for the first time.

**Spilarctia bifascia** Hampson comb. rev.  
(Figure 3)

*Spilarctia bifascia* Hampson, 1891: 8, male, type locality India (Nilgiri Hills); type depository NHM, London and examined by the junior author.


**Male genitalia:** Uncus strongly built, sickle shaped, setose with fine setae, sclerotized, tip pointed; acrotergite well developed; fenestra absent; tegumen longer than uncus, u-shaped; vinculum shorter than tegumen, v-shaped; saccus well developed. Valvae with costa narrow and weakly sclerotized; saccus

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**Spilarctia coorgensis** sp. nov.  
(Figure 4)

Head with frons and vertex ochreous. Antennae bipectinate in males; scape and pedicel ochreous; shaft and branches dark brown. Eyes fuscus green with black spots or patches. Labial palpi porrect; laden with crimson scales; third segment brown.

Thorax, collar and tegula ochreous, thorax with a small black streak. Forewing with ground colour ochreous, slightly irrorated with crimson scales; costa suffused with crimson scales; a basal black spot; antemedial spot on vein 1A; a black speck at end of cell; an oblique series of postmedial spots on both sides of veins, not reaching costa; traces of submarginal series of black spots; underside with irroration of crimson scales; a black spot at end of cell; fringe ochreous; vein R₁ from cell; R₂, R₃, R₄ and R₅ from a common stalk; M₁ from upper angle; M₂ slightly beyond angle; M₃ from angle of cell; Cu₁ near angle of cell; Cu₂ from middle of cell. Hindwing with ground colour ochreous; inner margin suffused with crimson scales; a black spot at end of cell; more or less complete series of submarginal spots; underside same; fringe ochreous; vein Sc+R₁ originating before middle of cell; Rs and M₁ from upper angle; M₂ towards middle of discocellulars; M₃ and Cu₁ from lower angle; Cu₂ from middle of cell. Legs black brown; coxae and trochanter suffused with crimson scales; hind tibia with two pair of spurs.

Abdomen crimson; dorsal and lateral series of black spots; underside and tuft ochreous. Male genitalic with...
Figure 2. *Spilarctia castanea* (Hampson) comb. nov. A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Uncus with Tegumen (dorsal view), G - Uncus with Tegumen (lateral view), H - Juxta (enlarged)
Figure 3. *Spilarctia bifascia* Hampson comb. rev.  A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Uncus with Tegumen (dorsal view), G - Uncus with Tegumen (lateral view), H - Juxta (enlarged)
Figure 4. *Spilarctia coorgensis* sp. nov. A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Uncus with Tegumen (dorsal view), G - Uncus with Tegumen (lateral view), H - Juxta (enlarged)
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uncus strongly built, curved towards distal end, setosed with small setae, well sclerotized, tip pointed; acrotergite present; fenestrula absent; tegumen as long as uncus, broad u-shaped; vinculum longer than tegumen, v-shaped, well sclerotized; saccus developed. Valvae simple with costa produced to an outgrowth towards proximal end; saccus differentiated; harpe + ampulla simple plate like; cucullus and valvula not distinct; tip of valvae setosed with short setae. Transtilla sclerotized; juxta well developed; aedeagus long and broad, curved; carina penis absent; vesica membranous with irroration of small spines; ductus ejaculatorius entering subapically.

**Wing expanse (Half):** Male 15mm.

**Material examined:**
- Paratype: 2 males, 15.ix.2004, Vithura, Kerala, 10°00’N & 76°25’E, 120m, coll. N.S. Gill, PUPZOO/MUS-078a, PUPZOO/MUS-078b, Zoology Museum, Dept. of Zoology, Punjabi University.

**Remarks:** Morphologically the species under reference is closely allied to *obliqua* Walker. But the perusal of external male genitalic structures reveals that it is a different species. Its distinct male genitalic characters like shape of vinculum, juxta and valvae justify its status.

**Etymology:** The name of the species belong to the district of its type locality i.e., Coorg (Kodagu).

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**Spilarctia obliqua** (Walker) (Figure 5)

*Spilosoma obliqua* Walker, 1855: 3, female, type locality Japan, type depository NHM, London and examined by the junior author.

**Material examined:** 2 males, 27.ix.2005, Waghai, Gujarat, 180m; 1 male, 28.vii.04, Madikeri, Karnataka, 1100m; 1 male, 19.vii.2004, Ganeshgudi, Karnataka, 480m; 1 male, 28.ix.2003, Gudalur, Tamil Nadu, 900m; 3 males, 6.ix.2004, Rani, Kerala, 40m; 6 males, 4.ix.2004, Vithura, Kerala, 120m; 1 male, 7.ix.2004, Vadasserikkara, Kerala, 30m.

**Remarks:** The species has been discussed in considerable detail by many previous authors like Koda (1988) and Kirti & Singh (1994). Hence, the description is being omitted in the present study, whereas the illustrations are given for the sake of comparison.

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**Spilarctia casigneta** (Kollar) (Figure 6)

*Euprepia casigneta* Kollar, 1844: 4, male, type locality India, type depository NHM, London and examined by the junior author.

**Material examined:** 2 males, 19.iv.2003, Kodai Kanal, Tamil Nadu, 2133m; 1 male, 2.x.2003, Coonoor, Tamil Nadu, 1880m; 1 male, 13.ix.2004, Devikulum, Kerala, 1620m.

**Male genitalia:** Uncus strongly built, beak shaped, sclerotized, setosed with fine setae, tip pointed and slightly curved; acrotergite present; fenestrula absent; tegumen longer than uncus, broad u-shaped, corrugated at junction of uncus and tegumen; vinculum shorter than tegumen, v-shaped, well sclerotized; saccus developed. Valvae with costa linear, weakly sclerotized; cucullus rounded; harpe + ampulla double ridged with suffusion of long setae; valvula simple. Transtilla membranous; juxta well developed; aedeagus long and moderately broad, curved; carina penis represented by a strong sclerotized spine; vesica membranous with a well formed patch of spines; ductus ejaculatorius entering subapically.

**Wing expanse (Half):** Male 24-26 mm.

**Material examined:** 2 males, 19.iv.2003, Kodai Kanal, Tamil Nadu, 2133m; 1 male, 2.x.2003, Coonoor, Tamil Nadu, 1880m; 1 male, 13.ix.2004, Devikulum, Kerala, 1620m.

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**Spilarctia todara** (Moore) comb. rev. (Figure 7)

*Spilosoma todara* Moore, 1872, Sex : Female, Type locality : India, Type depository NHM, London and examined by the Junior Author.

**Material examined:** 2 males, 27.ix.2005, Waghai, Gujarat, 180m; 1 male, 28.vii.04, Madikeri, Karnataka, 1100m; 1 male, 19.vii.2004, Ganeshgudi, Karnataka, 480m; 1 male, 28.ix.2003, Gudalur, Tamil Nadu, 900m; 3 males, 6.ix.2004, Rani, Kerala, 40m; 6 males, 4.ix.2004, Vithura, Kerala, 120m; 1 male, 7.ix.2004, Vadasserikkara, Kerala, 30m.

**Remarks:** The species has been discussed in considerable detail by many previous authors like Koda (1988) and Kirti & Singh (1994). Hence, the description is being omitted in the present study, whereas the illustrations are given for the sake of comparison.
Figure 5. *Spilarctia obliqua* (Walker). A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Uncus with Tegumen (dorsal view), G - Uncus with Tegumen (lateral view), H - Juxta (enlarged)
Figure 6. *Spilarctia casigneta* (Kollar). A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Uncus with Tegumen (dorsal view), G - Uncus with Tegumen (lateral view), H - Juxta (enlarged)
Figure 7. Spilarctia todara (Moore) comb. rev.  A - Forewing, B - Hindwing, C - Male genitalia, D - Aedeagus, E - Valva (right), F - Valva (right, different view), G - Uncus with Tegumen (dorsal view), H - Uncus with Tegumen (lateral view), I - Juxta (enlarged), J - Female genitalia
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A key to all the studied species have been formulated and given below:

1. Abdomen covered with orange yellow scales .............................................. mona (Swinhoe) comb. nov.
   - Abdomen covered with crimson scales................................................................. 2
2. Frons, vertex, thorax, tegula, collar and forewing with general ground color dark brown to pale brown; male genitalia with vesica bearing two patches of spines ...................................................... 3
   - Frons, vertex, thorax, tegula, collar and forewing with general ground color white to ochreous; male genitalia with vesica bearing more or less than two patches of spines................................................................. 4
3. Hindwing with ground colour fuscus; abdomen with dorsal series of black spots; male genitalia with vinculum broad u-shaped; carina penis double spined........................... castanea (Hampson) comb. nov.
   - Hindwing with ground colour ochreous, costal and inner margin crimson; abdomen with dorsal, lateral and sublateral series of black spots; male genitalia with vinculum v-shaped; carina penis convex lens like ...................................................................................................................... bifascia Hampson comb. rev.
4. Male genitalia with tegumen as long as uncus; vesica irroration with small spines, a well formed patch of spines absent.......................................................................................................................... 5
   - Male genitalia with tegumen longer than uncus; vesica with well formed patch or patches of spines........... 6
5. Abdomen with dorsal and lateral series of black spots; male genitalia with vinculum longer than tegumen, v-shaped; costa produced to an outgrowth towards proximal end................................. coergensis sp. nov.
   - Abdomen with dorsal, lateral and sublateral series of black spots; male genitalia with vinculum shorter than tegumen, u-shaped; costa simple and linear............................................... obliqua (Walker)
6. Abdomen with black spots obsolete; male genitalia with aedeagus curved, carina penis in form of single large spine; vesica with single patch of spines............................................................................................... casigneta (Kollar)
   - Abdomen with dorsal and lateral series of black spots; male genitalia with aedeagus almost straight, carina penis absent; vesica with three patches of spines.......................................................... todara (Moore) comb. rev.

juxta well formed, dumber shaped; aedeagus long and moderately broad, almost straight; carina penis absent; vesica membranous with a sclerotization at base, comrn in form of three patches of sclerotized spines; ductus ejaculatorius entering subapically.

Female genitilia: Corpus bursae triangular, membranous, signum absent; ductus bursae moderately long and broad, sclerotized; ductus seminalis entering at junction of ductus seminalis entering ductus bursae and corpus bursae; anterior apophyses shorter than posterior apophyses; papilla analis setosed with long and short setae.

Wing expanse (Half): Male 23mm; female 24mm.

Material examined: 1 male, 26.xi.2005, Kodanadu, Tamil Nadu, 1920m; 3 males, 1.x.2003, Coonoor, Tamil Nadu, 1880m; 1 male, 2.x.2003, Kotagiri, Tamil Nadu, 2020m; 1 male, 22.xi.2005, Kotagiri, Tamil Nadu, 2020m; 1 male, 13.ix.2004, Devikulum, Kerala, 1620m; 1 male, 14.ix.2004, Devikulum, Kerala, 1620m.

Remarks: The species under reference was shifted as a ‘form’ of obliqua Walker under genus Diacrisia Hübner by Hampson in 1901. The present work deals with the detail study of its male and female genitalic structures which confirms its status as a distinct species. Hence, the original combination of todara Moore with genus Spilarctia Butler has been revived.

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