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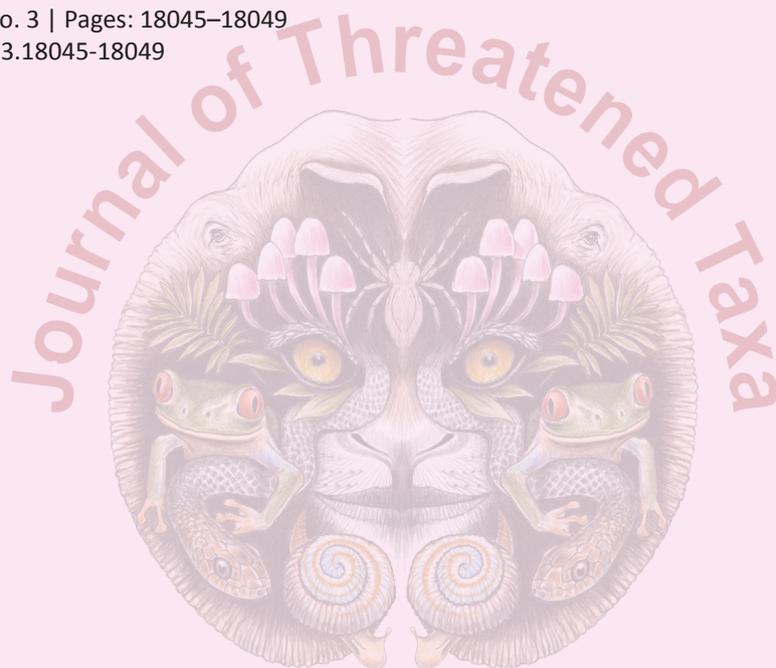
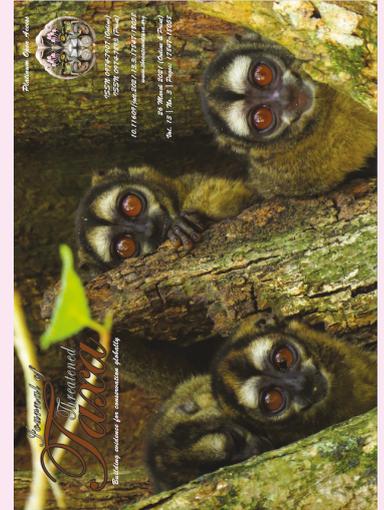
NOTE

HABITAT ASSOCIATION AND HYBRIDIZATION IN WOODBROWNS (*LETHE NICETAS*, *L. SIDONIS*, & *L. DAKWANIA*) (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE) IN KEDARNATH MUSK DEER RESERVE, WESTERN HIMALAYA

Arun Pratap Singh & Tribhuwan Singh

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Habitat association and hybridization in woodbrowns (*Lethe nicetas*, *L. sidonis*, & *L. dakwania*) (Lepidoptera: Nymphalidae: Satyrinae) in Kedarnath Musk Deer Reserve, western Himalaya

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The ‘woodbrown’ group of the genus *Lethe* (Nymphalidae: Satyrinae: Satyrini: Lethina) occurs as five species in western Himalaya. The most common and widely occurring species is the Common Woodbrown *Lethe sidonis* (Hewitson, 1863) (45–60 mm) which occurs from Chamba, Himachal Pradesh up to Arunachal Pradesh and Shan states in Myanmar from April to October at 975–3,352 m. Its larva is known to feed on Hill Bamboo *Arundinaria falcata* Nees. A similar looking and lesser known species is the White-wedged Woodbrown or the Garhwal Woodbrown *Lethe dakwania* Tytler, 1939 found in Garhwal. Specimens of both the sexes of this little known species were collected by H.C. Tytler during August 1914 from Dakwani, eastern Garhwal (2,700m) in northern India. Another species that occurs along with these two is the Yellow Woodbrown *Lethe nicetas* (Hewitson, 1863) (48–55 mm) which is distributed from Kangra in Himachal Pradesh up to Arunachal Pradesh in the Himalaya, northeastern India and northeastern part of Myanmar. It occurs at 1,700–2,620 m with a flight period from May to November and is ‘not rare’ in its distribution range. This species is more common in June–October (900–1,800 m) in Kumaon region of the western Himalaya. The fourth species is the Himalayan

Barred Woodbrown *Lethe maitrya maitrya* de Nicéville, [1881] (45–55 mm) which occurs from Kullu in Himachal Pradesh up to Sikkim and Bhutan where it is ‘not rare’ at 2,500–3,800 m in April–October. The fifth species is the Scarce Woodbrown *Lethe siderea siderea* Marshall, 1881 (48–55mm) that is distributed from Garhwal to northeastern India & northern Burma where it is ‘rare’ and occurs between 2,000–2,620 m from May–October (Mackinnon & Nicéville 1899; Hannyngton 1910; Evans 1932; Wynter-Blyth 1957; Smith 1989, 2006; Varshney & Smetacek 2015; Singh & Sondhi 2016; Kehimkar 2016; Gasse 2013).

During the course of several surveys carried out in Kedarnath Musk Deer Reserve (KMDR) in 2006–2019, observations were recorded and random samples collected of the *Lethe* genus of the group ‘Woodbrown’ at various locations representing different altitudes and vegetation types. Analysis of photographs, specimens and male genitalia revealed the occurrence of only three species of woodbrowns in KMDR out of five known from western Himalaya. These were: *L. sidonis*, *L. dakwania*, & *L. nicetas* (Image 1, 2, 3, 5, 6 & 7). The species have been earlier reported from Mandal and Kanchula Kharak areas inside KMDR as “common” (Singh & Sondhi 2016).

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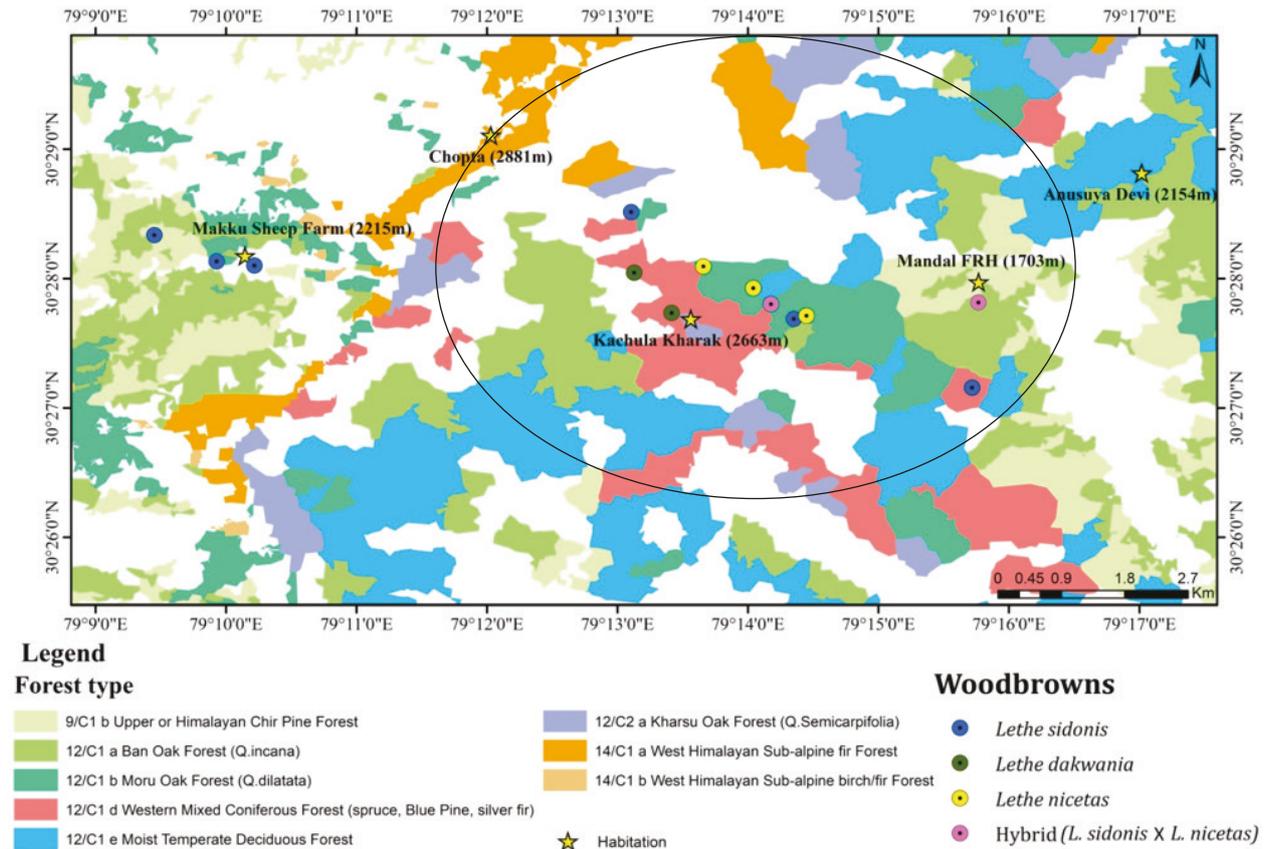


Figure 1. False colour composite satellite imagery showing the forest sub-types associated with the three species of Woodbrowns (*Lethe nicetas*, *L. sidonis*, & *L. dakhwania*) in Kedarnath Musk Deer Reserve, western Himalaya along with prominent locations inside the forest habitats (star markings).

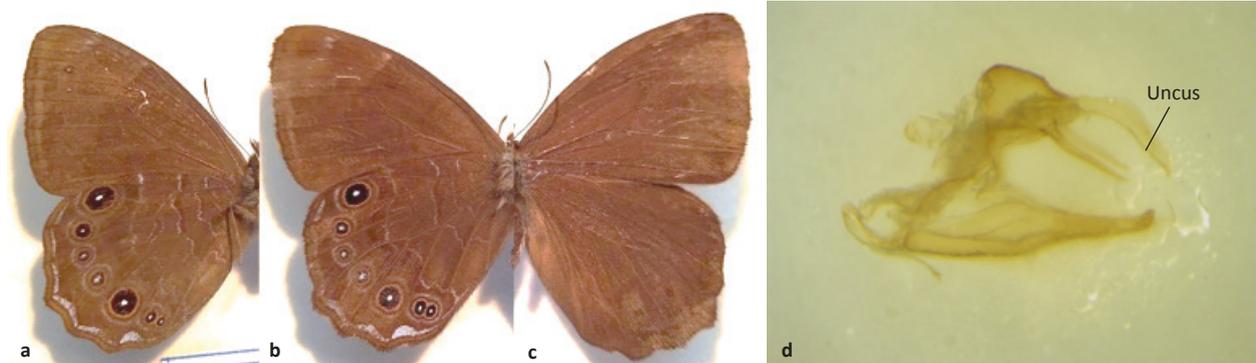


Image 1 a–c. Common Woodbrowner *Lethe sidonis* (Hewitson, 1863) collected on 26.ix.2006 from Kedarnath Musk Deer Reserve, Garhwal: a & b—underside | c—upperside | d—male genitalia. © Arun Pratap Singh

Upon examination, these species showed distinct male genitalia. In *L. sidonis*, the uncus, as seen from the side is distinctly raised, and higher and thicker in the middle, and then sharply bent downwards (Image 1 a–c). In *L. dakhwania* the uncus is evenly curved and not thicker and raised in the middle, or suddenly bent downwards (Image 2 a–c) (Tytler 1939). In *L. nicetas* (Image 3 a–c) the uncus

is bent sharply downwards in the beginning without being thicker or raised in the middle. While in *L. maitrya* (specimen collected from Mussoorie, Garhwal) the uncus is not bent at all but straight and held horizontally in front (Image 4 a–b). Two specimens collected from KMDR seemed morphologically quite similar to *L. nicetas* but were distinct as they had yellow markings on the under



Image 2 a–c. White-wedged Woodbrown/Garhwal Woodbrown *Letho dakwania* Tytler, 1939 collected on 28.vii.2006 from Kedarnath Musk Deer Reserve, Garhwal: a & b—underside | c—upperside | d—male genitalia. © Arun Pratap Singh

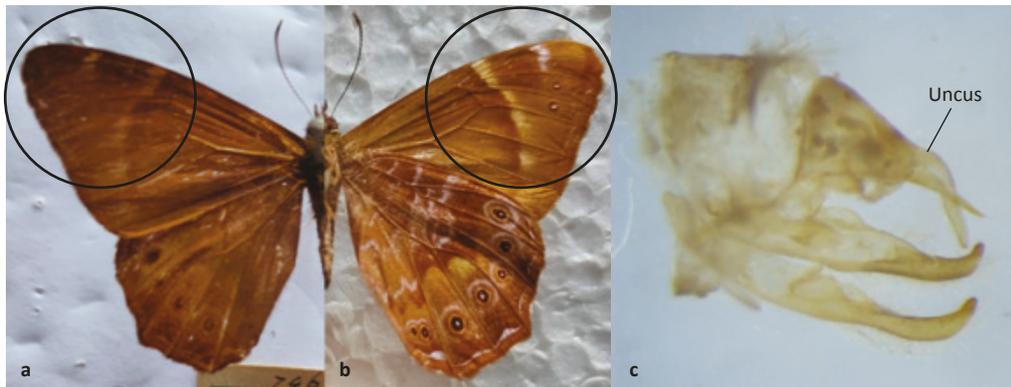


Image 3 a–c. Yellow Woodbrown *Letho nicetas* (Hewitson, 1863) collected from 24.x.2017 from Kedarnath Musk Deer Reserve, Garhwal: a—underside | b—upperside | c—male genitalia. © Arun Pratap Singh



Image 4 a–b. Himalayan Barred Woodbrown *Letho maitrya maitrya* de Nicéville [1881] collected from Mussoorie, Garhwal along with its male genitalia: a—underside | b—upperside | c—male genitalia. © Arun Pratap Singh

and upper forewing and under hindwing being 'more extensive' than in *L. nicetas* (Image 8 & circled portions of upper forewings- Image 3 & 9). These specimens were dissected for examining their genitalia but did not reveal any genital organ and were thus classified as hybrids. These specimens were collected during 2006 and then again during 2017, which suggests that the phenomenon of hybridization in an ongoing process in this part of

KMDR.

Examination of the altitudinal distributional and forest type association (Figure 1 & Table 1) of these three species in the study area revealed that *L. nicetas* is associated with 12/C1b Moru oak forest (Champion & Seth 1968) and mainly occurs in abundance at 2,260–2,402 m. On the other hand *L. dakwania* occurred at a much higher elevation at 2,729–2,765 m and showed association with



Image 5. a–c—Common Woodbrown *Lethe sidonis* (Hewitson, 1863) at Kedarnath Musk Deer Reserve, Garhwal. © Arun Pratap Singh



Image 6. White-wedged Woodbrown/Garhwal Woodbrown *Lethe dakwania* Tytler, 1939 at Kedarnath Musk Deer Reserve, Garhwal.

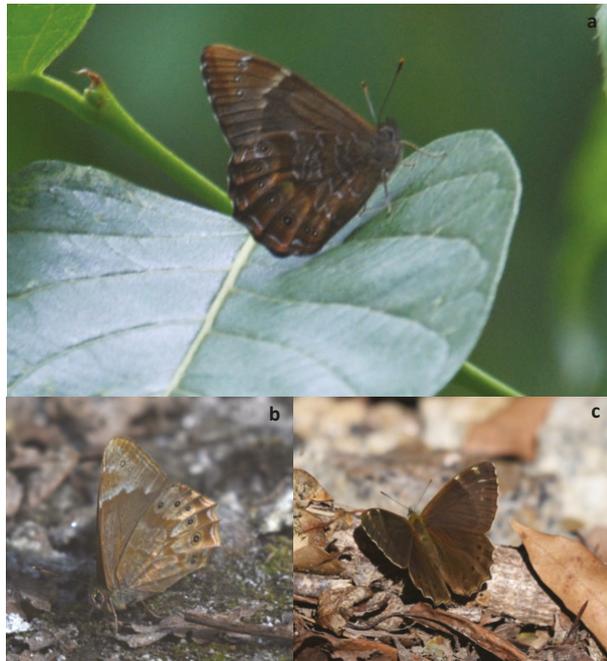


Image 7 a–c—Yellow Woodbrown *Lethe nicetas* (Hewitson, 1863) individuals recorded on 24.x.2017 in Kedarnath Musk Deer Reserve, Garhwal. © Arun Pratap Singh

mainly 12/C1d western mixed coniferous forest. While *L. sidonis* had a much wider altitudinal distribution range at 1,700–2,600 m and occurred in at least three forest types: 12/C1a Ban Oak forest, 12/C1b Moru Oak forest, and also 12/C1d western mixed coniferous forest, thus sharing common forest-type habitat with both *nicetas* and *dakwania* in KMDR, therefore having greater chances of hybridization with *L. nicetas*. The hybrids collected (Image 8 & 9) are most likely to be between *nicetas* and *sidonis*. The current findings call for more research into the matter.

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Image 8 a&b. *Lethes* hybrid (*nicetas* x *sidonis*) individuals: a—photographed on 26.ix.2006 | b—photographed on 24.x.2017 in Kedarnath Musk Deer Reserve, Garhwal. © Arun Pratap Singh

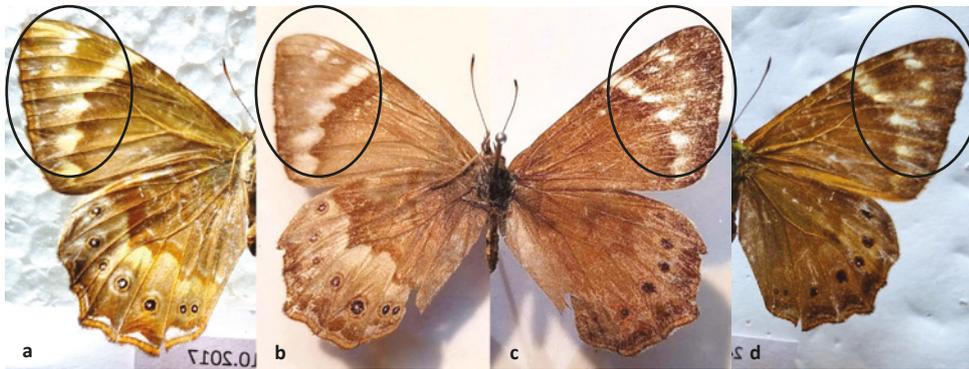


Image 9. *Lethes* hybrid (*nicetas* x *sidonis*) individuals collected on 24.x.2017 (a&d) and 26.ix.2006 (b&c) from Kedarnath Musk Deer Reserve, Garhwal: a,b—upperside | c,d—underside. © Arun Pratap Singh

Table 1. Plant species* (trees & bamboos) composition of the three different forest sub-types (Champion & Seth 1968) associated with the three species of Woodbrowns (*Lethes nicetas*, *L. sidonis*, & *L. dakhwania*) in Kedarnath Musk Deer Reserve, western Himalaya.

Associates	12/C1a Ban Oak forest (<i>Quercus leucotrichophora</i> A.Camus)	12/C1b Moru Oak forest (<i>Quercus floribunda</i> Lindl. ex A.Camus)	12/C1d western mixed coniferous forest (<i>Abies pindrow</i> (Royle ex D.Don) Royle, <i>Pinus wallichiana</i> A.B.Jacks)
a) Trees b) Dwarf Bamboos	<p>a) <i>Acer caesium</i> Wall. ex Brandis <i>Acer oblongum</i> Wall. ex DC. <i>Aesculus indica</i> (Wall. ex Cambess.) Hook. <i>Alnus nepalensis</i> D.Don <i>Betula alnoides</i> Buch.-Ham. ex D.Don <i>Boehmeria rugulosa</i> Wedd. <i>Cinnamomum tamala</i> (Buch.Ham.) T. Nees & C.H.Eberm <i>Cornus capitata</i> Wall. ex Roxb <i>Euonymus lacerus</i> Buch.-Ham. <i>Ficus auriculata</i> Lour. <i>Fraxinus micrantha</i> Lingelsh. <i>Inula cuspidate</i> (Wall. ex DC.) C.B.Clarke <i>Lindera pulcherrima</i> (Nees) Benth. <i>Litsea umbrosa</i> (Nees) Nees <i>Lyonia ovalifolia</i> (Wall.) Drude, <i>Machilus odratissima</i> Nees <i>Machilus duthiei</i> King ex J.D.Hooker <i>Marsine semiserata</i> Wallich <i>Pryrus pashia</i> Linnaeus <i>Rhododendron arboretum</i> Sm. <i>Sarcococca saligna</i> (D.Don) Müll.Arg. <i>Xanthoxylum armatum</i> DC.</p> <p>b) <i>Sinarundinaria falcata</i> (Nees) C.S.Chao & Renvoize</p>	<p>a). <i>Acer caesium</i> Wall. ex Brandis <i>Acer sterculiaceum</i> Wall. <i>Aesculus indica</i> (Wall. ex Cambess.) Hook. <i>Betula alnoides</i> Buch.-Ham. ex D.Don <i>Carpinus viminea</i> Wall. ex Lindl. <i>Eurya acuminata</i> DC. <i>Fraxinus micrantha</i> Lingelsh. <i>Ilex dipyrena</i> Wall. <i>Machilus duthiei</i> King ex J.D.Hooker <i>Rhamnus purpureus</i> Edgew. <i>Rhododendron arboreum</i> Sm. <i>Symplocos chinensis</i> (Lour.) Druce</p> <p>b). <i>Sinarundinaria falcata</i> (Nees) C.S.Chao & Renvoize</p>	<p>a). <i>Quercus semecarpifolia</i> Sm. <i>Acer caesium</i> Wall. ex Brandis <i>Acer cappadocicum</i> Gled. <i>Euonymus lacerus</i> Buch.-Ham <i>Rhododendron arboreum</i> Sm. <i>Rhamnus purpureus</i> Edgew. <i>Smilax vaginata</i> Decne. <i>Taxus wallichiana</i> Zucc. <i>Juniperus indica</i> Bertol.</p> <p>b). <i>Thalimnocalamus falconeri</i> Hook.f. ex Munro <i>Yushania anceps</i> (Mitford) W.C.Lin</p>

Identification of plant species based in the field with the help of field guide (Rai et al. 2017) and herbarium specimens collected during field surveys by the authors and identified at FRI, Dehradun Herbarium with the help of plant taxonomists.



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