https://doi.org/10.33307/entomon.v48i1.838
Entomon 48(1): 1-10 (2023)
Article No. ent. 48101

A new subspecies of *Caltoris* Swinhoe, 1893 (Lepidoptera, Hesperiidae) from the Malabar Coast, Kerala, India

Kalesh Sadasivan[1,2*], Dipendra Nath Basu[3] and Krushnamegh Kunte[4*]

[1]*Travancore Nature History Society, 65, Jyothis, Mathrubumi Road, Vanchiyoor, Thiruvananthapuram, Kerala 695035, India.*
[2]*Greeshmam, BN439, Bapuji Nagar, Medical College Post, Thiruvananthapuram, Kerala, India.*
[3]*National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bellary Road, Bengaluru, Karnataka 560065, India.*
[4]*National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bellary Road, Bengaluru, Karnataka 560065, India.*
Email: kaleshs2002in@gmail.com, dipendra1989@gmail.com, krushnamegh@ncbs.res.in

ABSTRACT: The Indo-Australian genus *Caltoris* has over 15 species distributed from India through south China and SE Asia into New Guinea and Solomon Islands. Based on wing colouration, characters of male genitalia, and early larval stages on the host plant *Phragmites karka*, a new subspecies of *Caltoris bromus* (Leech, 1894), *C. b. sadasiva* **ssp. nov.**, is described from the coastal lakes and mangrove associated swamps of Kerala, southern India on the western slopes of the Western Ghats. This is the first record of *C. bromus* from Western Ghats and Peninsular India. This extends the distribution range of the species from NE India to south-western India, adding it to the butterfly fauna of the Western Ghats.

KEYWORDS: Taxonomic descriptions, Baorini, new taxa, life cycle, mangrove, distribution range

INTRODUCTION

The genus *Caltoris* Swinhoe, 1893 (Lepidoptera, Hesperiidae, Hesperiinae, Baorini), with over 15 species, ranges widely over the Indo-Australian Region, from Sri Lanka, India and China to Solomon Islands (Evans, 1949; Vane-Wright and de Jong, 2003). It is represented in India by the following taxa as per Evans (1949): *C. aurociliata* (Elwes and Edwards, 1897) in E. Himalaya and NE India, *C. bromus bromus* (Leech, 1894) in NE India, *C. brunnea caere* (de Nicéville, 1891) in NE India, *C. cahira cahira* (Moore, 1877) in Andaman and Nicobar Islands; *C. cahira austeni* (Moore, [1884]) in E. Himalaya and NE India; *C. canaraica* (Moore, [1884]) in Western Ghats and adjoining areas; *C. confusa* (Evans, 1932) in E. Himalaya and NE India; *C. cormasa* (Hewitson, 1876) in NE India; *C. kumara kumara* (Moore, 1878) in Western Ghats, *C.* (*kumara*) *moorei* (Evans, 1926) in E. Himalaya and NE India; *C. plebeia* (de Nicéville, 1887) in E. Himalaya and NE India; *C. sirius sirius* (Evans, 1926) in NE India, *C. tulsi tulsi* (de Nicéville, [1884]) in E. Himalaya and NE India, and *C. philippina philippina* (Herrich-Schäffer, 1869) in Western Ghats, NE India.

Rearing of a series of reed-feeding hesperiid larvae from 2005 to 2015 from southern Kerala yielded a

* Author for correspondence

taxon that differed from all other known *Caltoris* from the region. Further comparison of museum specimens revealed that the taxon is similar to *C. bromus* in external morphology as well as the male genitalia but slightly and consistently differentiated from other known subspecies of *C. bromus*, which is described as a new subspecies. This extends the distribution range of the species from NE India to south-western India, adding it to the butterfly fauna of the Western Ghats.

MATERIALS AND METHODS

Early stages of *C. bromus* reared in the lab, with leaves of the larval host plant *Phragmites karka* (Retz.) Trin. and maintaining them in plastic boxes. Some of the newly eclosed butterflies were preserved as vouchers, as a combination of specimens pinned as dry for taxonomic work, and stored wet in 100 per cent molecular grade ethanol for phylogenetic work. These specimens are preserved in the Biodiversity Lab Research Collections at the National Centre for Biological Sciences (NCBS), Tata Institute of Fundamental Research, Bengaluru (http://biodiversitycollections.in). Male genitalia of paratypes were dissected after dissolving extraneous abdominal tissue with 10 per cent KOH overnight and photographed using a Leica digital camera MC 120 HD mounted onto a Leica S8APO stereomicroscope (Leica Microsystems, Germany). Multiple images were taken and stacked to improve the depth of field with CombineZM. The dissections were preserved in 0.5 ml vials containing anhydrous glycerol at room temperature in an air-conditioned room (22–26°C). These specimens were compared with the historical collections, including type specimens, at the Natural History Museum, London (NHMUK). At both the research collections, museum specimens were photographed using Canon EOS 7D and 1200D DSLR cameras, Canon 50 mm macro, 60 mm macro, and 100 mm macro lenses, and Canon 420EX flashes (Canon Inc., Japan) fitted with photographic umbrellas. The specimens (adults and early stages) in the field were photographed using a Canon EOS 70D DSLR camera body with a 100 mm f 2.8 macro lens.

The terminology used for wing patterns, the numerical system of wing venation, and the male genitalia, in the description below, follows Evans (1949) and Kunte *et al.* (2019). Wing-length measurements follow methods by Van Hook *et al.* (2012). The following abbreviations are used in the text: OD: original description, ssp.: subspecies, FW: forewing, HW: hindwing, UpF: dorsal side of the forewing, UpH: dorsal side of the hindwing, UnF: ventral side of the forewing, UnH: ventral side of hindwing, NHMUK: Natural History Museum, London.

RESULTS AND DISCUSSION

Taxonomic description

***Caltoris bromus sadasiva* Sadasivan & Kunte ssp. nov. (Figs. 1–6)**

Holotype: Voucher code IBC-AD633. Male. Aakulam Lake (8°31'13.79" N; 76°54'21.64" E) in suburbs of Thiruvananthapuram City, Thiruvananthapuram District, Kerala, India. Ex larva, collected by Krushnamegh Kunte, 14 March 2015. Preserved dry, pinned, and deposited in the Biodiversity Lab Research Collections at the National Centre for Biological Sciences, Bengaluru, India (Fig. 1A).

Paratypes: IBC-PX683 (male), IBC-AD639 (male), IBC-AD631 (female, allotype), IBC-PX690 (female), and, IBC-PZ148 (female). Collection data same as the holotype. Preserved dry, pinned, and deposited in the Biodiversity Lab Research Collections (Figs. 1 B–F).

Description of the Holotype (Fig. 1A)

Forewing length: 19 mm. Antenna: 10 mm, including the apiculus.

FW Dorsal side: Dark brown with pale semi-transparent spots. Two spots in the cell, the upper one is triangular, and the lower one is more rounded. Spots in spaces 2, 3, and 4, the spot in 2 is the largest and quadrate, spots in 3 and 4 decreasing in size. A spot in 1b present. Three subapical spots in 6–8, that in 6 slightly shifted out. Ventral side: Paler rusty-brown compared with the dorsal surface. Spotting pattern same as described for the dorsal surface, but the spot in 1b is almost twice as large.

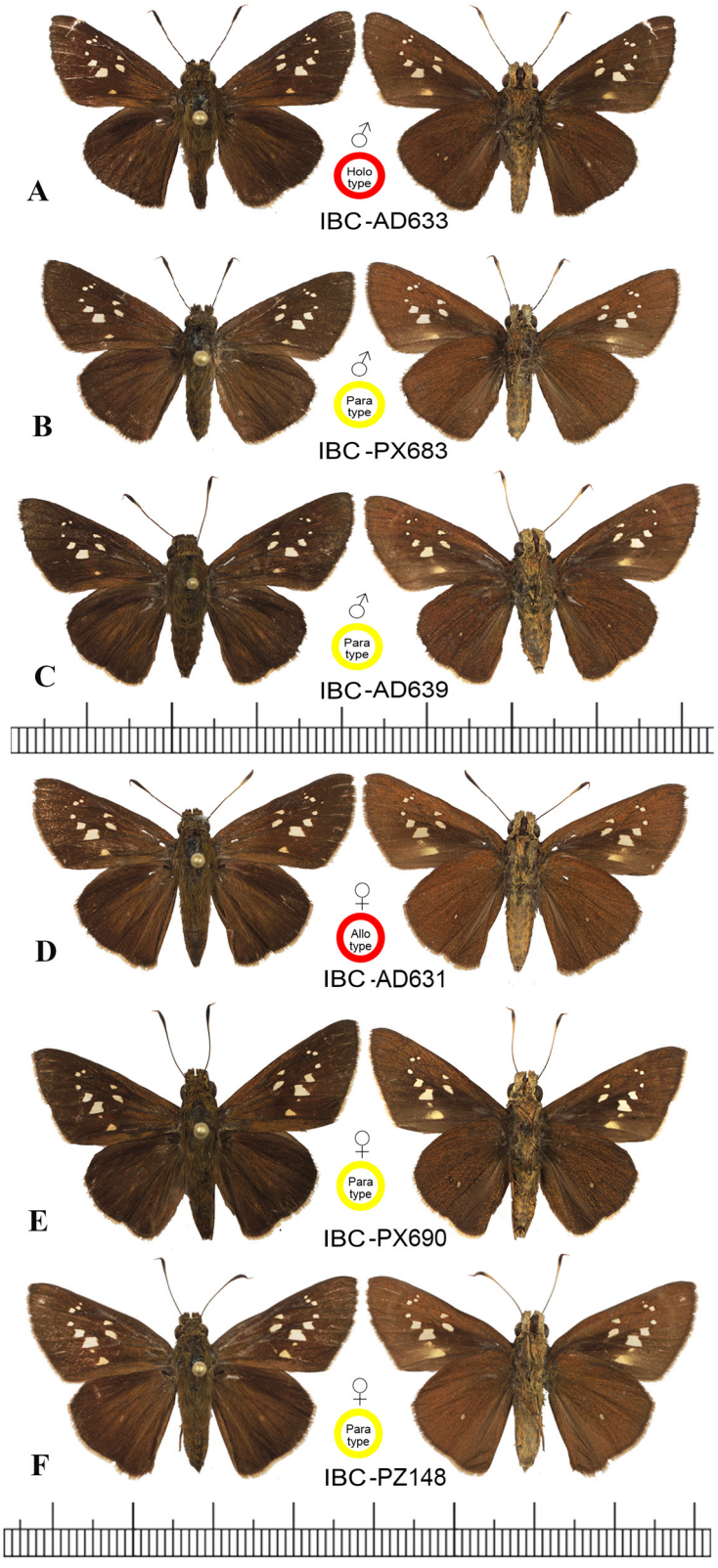

Fig. 1 Type specimens of *Caltoris bromus sadasiva* **ssp. nov.** © Krushnamegh Kunte

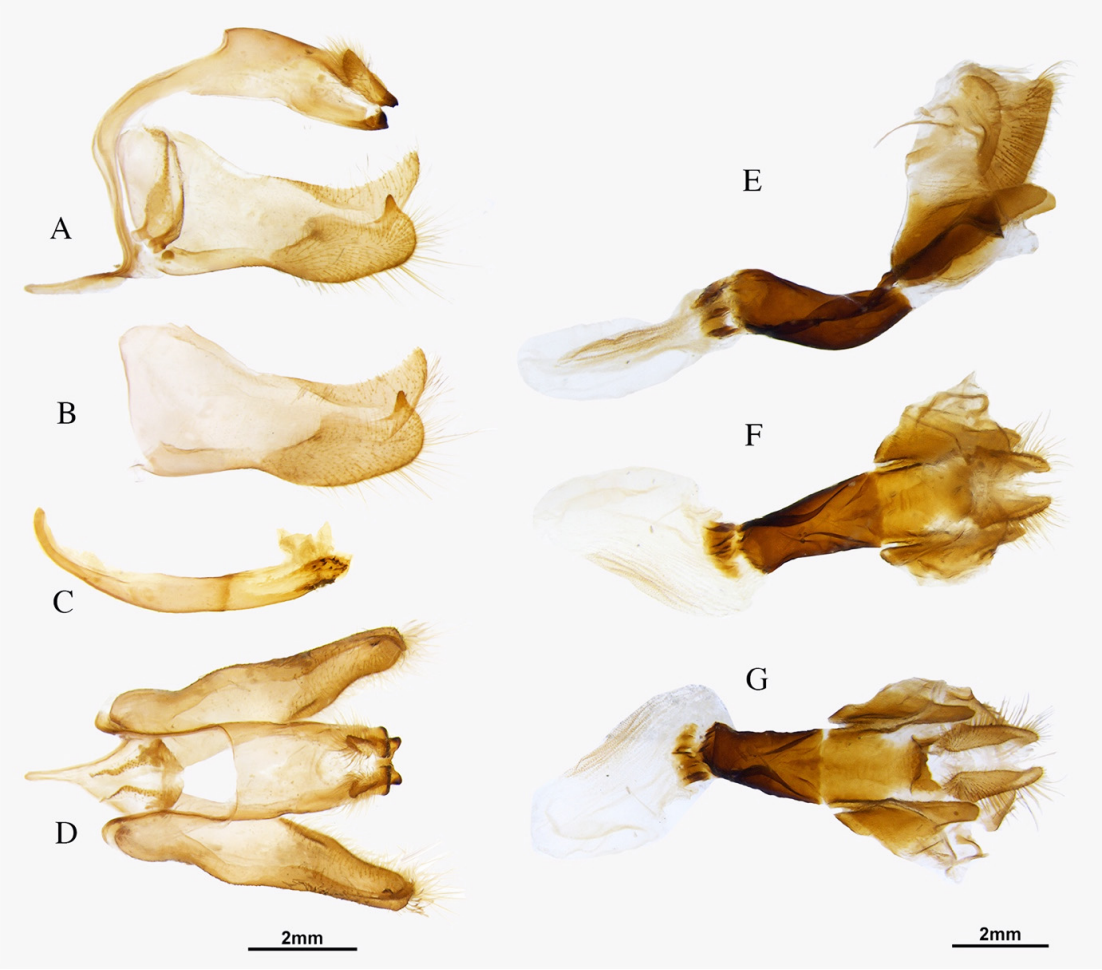

Fig. 2 *Caltoris bromus sadasiva* **ssp. nov.** A–D: Male genitalia and E–G: Female genitalia. © Dipendra Nath Basu

HW Dorsal side: Dark brown with long ochreous-brown scales, especially in space 1 and cell. A small semi-transparent dot in 2. No other spots. Ventral side: Pale rusty-brown with two yellowish-white spots in spaces 2 and 3, the one in 2 almost twice as large as that in 3. Cilia is pale brown.

Variation in paratypes (Figs. 1A–C): Forewing length of male: 43±1 mm; forewing length of female: 44±2mm. Antennal length: 10 mm, including apiculus. A large series of individuals (19 males, 20 females) raised from caterpillars, including the voucher specimens described here as paratypes, show little variation in size, wing coloration, and spotting pattern. Forewing lower cell spots may be reduced or absent. UpH usually has no spots. UnH usually has a small spot in 2, and sometimes in both 2 and 3, but in some individuals these spots are absent. Females are similar to males in wing coloration, but they have an extra-large spot in 1b on the forewing and in some specimens a small spot in 5 UnH. There was no variation between the Aakulam-Veli and Vembanad populations.

Genitalia (Figs. 2A–D, 6C, F): The male genitalia of ***C. b. sadasiva* ssp. nov.** are similar to that of the other subspecies, *C. b. yanuca* (Fruhstorfer, 1911) (Hsu and Wang 2004) and *C. b. bromus* (Huang 2011), but valva broader and more rounded (Figs. 2A–D). The cuiller (dorsal process) is longer than valva, ventral portion of the gnathos develops into two triangular processes, the lateral angle of

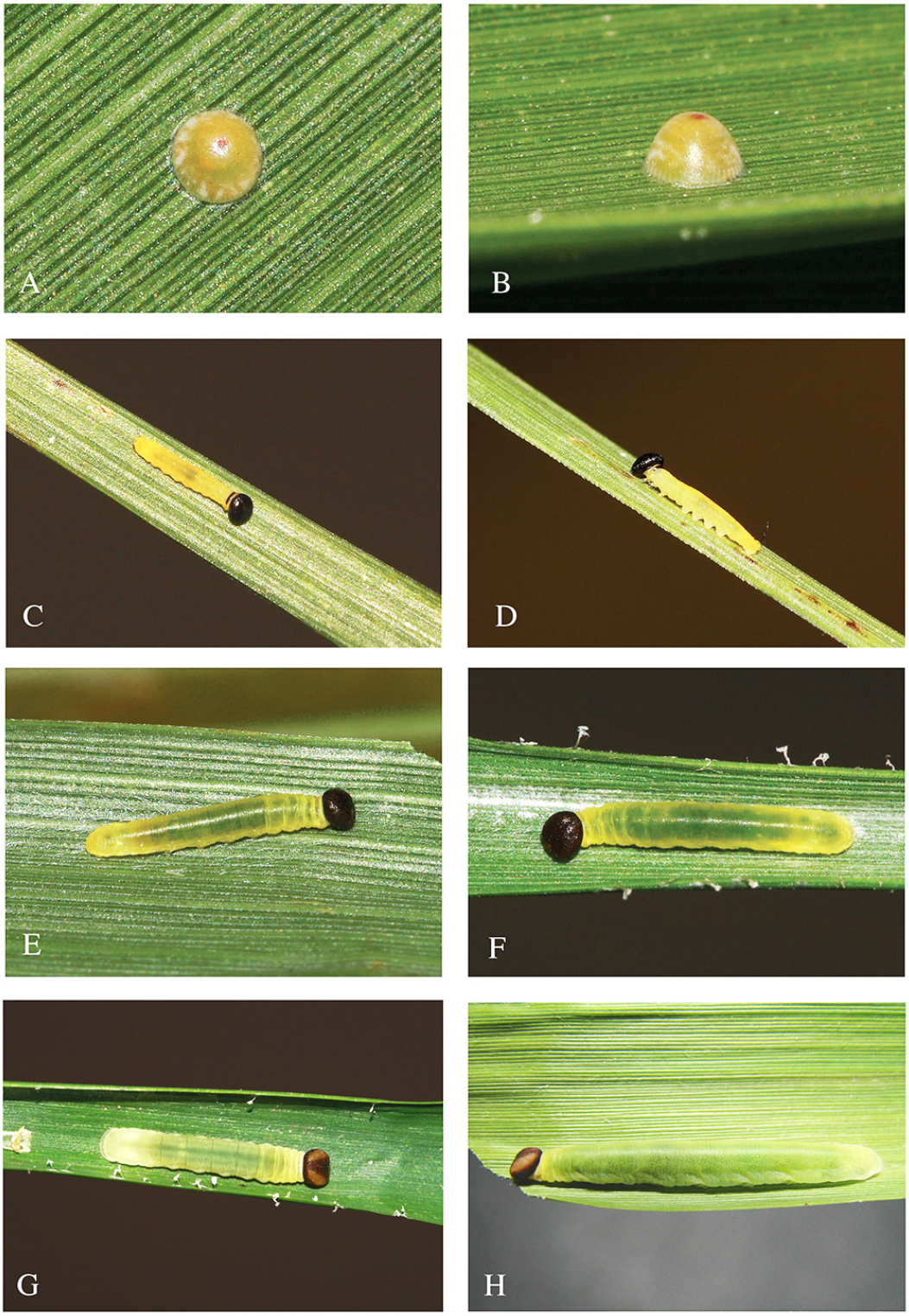

Fig. 3 *Caltoris bromus sadasiva* **ssp. nov.** Early stages. A–B: Egg, C–D: Egg Larva, E: 1st instar, F: 2nd Instar, G: 3rd Instar, H: 4th Instar. © Kalesh Sadasivan

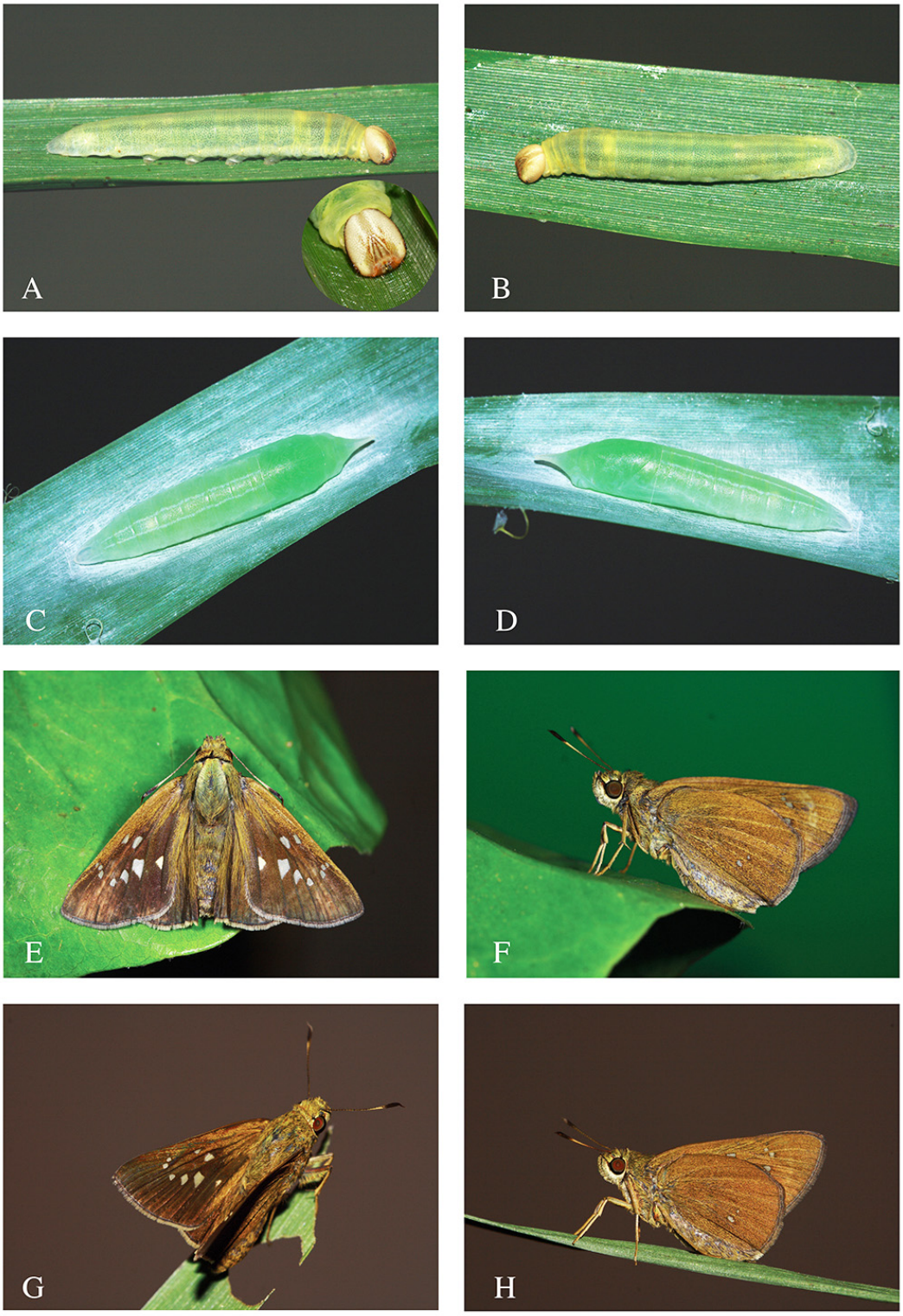

Fig. 4 *Caltoris bromus sadasiva* **ssp. nov**., Early stages, and emerged adults. A–B: Final Instar, C–D Pupa, E–F: Male, G–H: Female. © Kalesh Sadasivan

which extends beyond the uncus. The cuiller of ***C. b. sadasiva* ssp. nov.** is broader and shorter than that of *C. b. yanuca* and *C. b. bromus*. The lower edge of the valva is angular in *C. b. yanuca* and *C. b. bromus* while it is an even curve in ***C. b. sadasiva* ssp. nov.** The aedeagus of ***C. b. sadasiva* ssp. nov.** differs from *C. b. bromus* in that the proximal narrow end is dorsally much more curved and stout, and the middle portion is nearly parallel while in the other two subspecies it expands distally. The tegumen is more slender and evenly curved in comparison with the other subspecies. The female genitalia of ***C. b. sadasiva* ssp. nov.** are also overall similar to other subspecies of *C. bromus* (Figs. 2E–G). The tip of the shoulder of the lamella post-vaginalis is rounded and variable. These are minor but seemingly constant variations, which support the treatment of ***C. b. sadasiva*** as a distinct subspecies.

Diagnosis: ***Caltoris b. sadasiva* ssp. nov.** may be differentiated from the closely related subspecies based on several external characters. Variation in spotting pattern of *C. b. yanuca* (Fruhstorfer, 1911) is considerable, ranging from spotless to being prominently spotted on both surfaces (Evans, 1949; Hsu and Wang, 2004). On the other hand, the spotting patterns of ***C. b. sadasiva* ssp. nov.** is largely constant, showing little seasonal, sexual, and individual variation. In *C. b. bromus*, UpF 1b in females always has a spot, whereas this spot is usually absent in the male (Evans, 1949; Corbet *et al.*. 1992). In ***C. b. sadasiva* ssp. nov.** both sexes usually have a spot in 1b, with females having an additional spot. Moreover, the small but constant differences between the male genitalia described above also distinguish the new subspecies from the closely similar subspecies in NE India, S. China, and Indo-China. The male and female genitalia of the three subspecies are compared (Fig. 6).

Etymology: The species is named after the first author's father who was an inspiration for the author's works in natural history.

Distribution: As far as known, ***C. b. sadasiva* ssp. nov.** is restricted to *Phragmites* reed patches growing in coastal lake systems of Aakulam-Veli in Thiruvananthapuram District and Vembanad in Kottayam District in the state of Kerala, southern India.

Status, habits and habitat: ***C. b. sadasiva* ssp. nov.** is multivoltine, flying throughout the year, although it is more common during the monsoon, from June–November. The adults may be seen flying among *Phragmites* clumps during the day, often settling low on bushes or reed leaves, and flying into thick reed clumps when disturbed. They retire to shaded undergrowth when sunlight is intense.

Reproductive behaviour and early stages: Oviposition was observed during morning hours, in overcast conditions, at dusk, and sometimes in the afternoons. Females lay a single egg at a time on the upper side of reed leaves, preferring fresh leaves of smaller plants over older leaves of robust plants. The larvae are monophagous as far as known, feeding on the reed, *Phragmites karka*. This is a gregarious reed found in coastal lakes, mangrove associated swamps and wetlands of Kerala (Fig. 5C). Two other *Caltoris*, *C. kumara* (Moore, 1878) and *C. philippina* (Herrich-Schäffer, 1869) occur on the adjoining dry lands. Their larvae typically feed on *Bambusa*, not on *Phragmites*.

The egg is dome-shaped. It appears smooth and shiny to the naked eye but has inconspicuous vertical ridges that are especially apparent at the base (Fig. 3A, B). The color of a freshly laid egg is yellow with an orange tinge, the micropyle region is red, and the basal third has suffused white patches. The egg later turns greenish, the micropyle area becoming more broadly red. It measures approx. 1.75 mm in diameter, and 0.75 mm in height.

The head capsule of the egg-larva is black and vertically ovoid. The first thoracic segment has a dark brown or black collar limited to the dorsal half of the body. The anal plate is semi-circular with long anteriorly curved hairy structures. The body is translucent yellow. It measures approx. 5 mm (Figs. 3C, D). The egg-larva moves to the tip of the leaf where it makes its first evenly sutured cell by folding it longitudinally. It eats from the terminal portions of the cell (larval shelter). The first moult usually occurs 24–48 hours after hatching. In

Fig. 5 *Caltoris bromus sadasiva* **ssp. nov.** A: Larval cell, B: Egg parasitoid of the family Scelionidae (Platygastridae), C: Larval host-plant *Phragmites karka* (Retz.) Trin., from Aakulam Lake, Thiruvananthapuram. © Kalesh Sadasivan

subsequent instars the body turns progressively darker green, developing longitudinal alternative pale and dark lines in the last instar (Figs. 3, 4A, B) In successive instars the head turns paler brown, developing broad paler brown, vertical bands in the third and fourth instars, and pale yellow-white lines and bands along with tiny dark brown spots in the final instar (Fig. 4A). Testes of the male larva appear as yellow spots on the back in fourth and fifth instars. The first instar measures approx. 0.5 to 0.7 cm, second instar approx. 0.7–1 cm, third instar approx. 1.0–1.5 cm, fourth instar approx. 1.5–2.5 cm, and the final instar up to 4.5 cm. The cell of later instars is typical of *Caltoris* (Fig. 5A), it is open at both ends, made at the distal part of the leaf by folding it longitudinally, and the walls are left uneaten and intact. These instars continue to feed on leaves from the distal part of the cell. The larvae are reluctant to move from the cell even when disturbed slightly. They are intolerant to heat and direct sunlight, becoming restless when exposed. They usually feed in low light or the dark, resting in the cell motionless during the daytime.

Pupation takes place in a cell similar to the cell of the final instar larva. The floor of the pupation cell is covered in a thick mat of silk, the pupa held in place by the cremaster and a thoracic silk girdle (Figs. 4C, D). The pupa is similar in shape to that of other *Caltoris*; long, tapering at both ends, and with a characteristic down-turned process in front of the head (Figs. 4C, D). From the ventral side, the proboscis extends to the proximal part of the fourth segment distal to wing cases, almost 7 mm long. The pupa is pale grass-green with two dorsal white irregular and discontinuous thin lines that extend from the anterior end of the thorax to the second segment proximal to the tail process. Wing cases are pale translucent green, as is the rest of the ventrum. The tail and head processes are whitish. The pupa measures approx. 3.3–3.55 cm in length, and approx. 0.7–0.8 mm in width. The pupal duration is 10 days. There were no significant

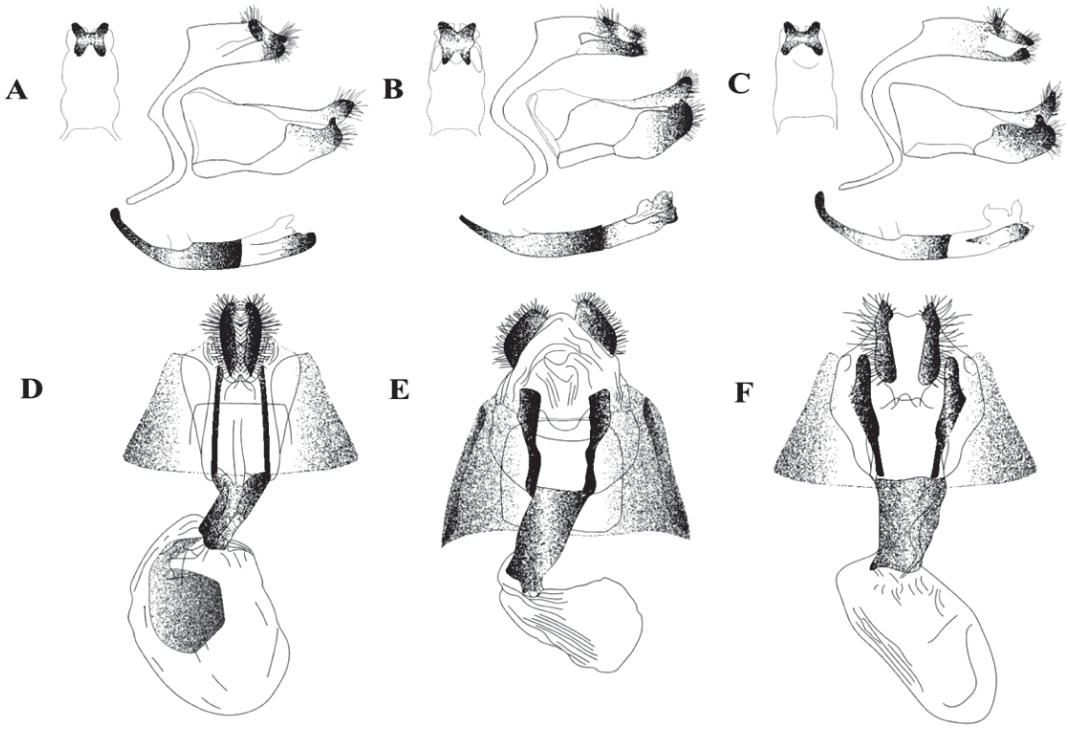

Fig. 6 *Caltoris bromus*. A–C: Male genitalia and D–F: Female genitalia. A: C. b. bromus (Leech, 1894) based on Evans (1949), B: C. b. yanuca Fruhstorfer 1911 based on Shirôzu (1960), C: C. b. sadasiva **ssp. nov,** D: C. b. bromus (Leech, 1894) based on Feng et al. (2015), E: C. b. yanuca Fruhstorfer 1911 based on Hsu and Wang (2004), F: C. b. sadasiva **ssp. nov.** Illustrations not according to scale. © Dipendra Nath Basu

morphological differences in the early stages with that of *C. bromus bromus* on comparison with images in HKLS (2011).

Brood Parasitism: Many instances of egg parasitism by a wasp in the family Scelionidae (Platygastridae) were observed from September to November (Fig.4B). No larval parasitism was observed but a single instance of pupal parasitism was observed during the study period.

Key to subspecies of *Caltoris bromus* (Leech, 1894)

1) Male UpF typically unmarked. Female usually with reduced markings. Male genitalia with inferior border of the valva angular; tegumen thick; aedeagus with proximal narrowed end straighter, middle and distal parts expands caudally (Fig. 6 B) (Formosa, Okinawa)……..……. *Caltoris bromus yanuca* Fruhstorfer 1911

– Male and female with well-developed spots UpF in discal spaces 2,3,4 and apical spots in spaces 6,7 & 8……..…...…..2

2) Spot in space 1b may be absent. Female UpH with only single spot in 1b, UnH sometimes with spots in spaces 2 and 3. Male genitalia with inferior border of the valva angular; tegumen thick aedeagus with proximal narrowed end straighter, middle and distal parts expands caudally (Fig. 6A) (Malaya, Borneo, China, Indo-China, North-east India)……. *C. bromus bromus* (Leech, 1894)

– Spot in space 1b always present. Female UpH always with two spots in 1b, UnH with spots in spaces 2 and 3. Male genitalia with inferior border of the valva rounded;

tegumen thinner; aedeagus with proximal narrowed end prominently curved dorsally, middle and distal portion parallel (Fig.6C) (Southwestern India)……..... *C. bromus sadasiva* **ssp.nov**

ACKNOWLEDGMENTS

Authors thank Ravi M., Retd. Professor of Botany, S.N. College, Kollam for identification of the larval host plant, Chiba Hydeuki for taxonomic advice, Frank Hsu for comments on the *Caltoris* genitalia, and E. Kunhikrishnan and Francis Sunny for the encouragement.

REFERENCES

Corbet A.S., Pendlebury H.M and Eliot J.N. (1992) The Butterflies of the Malay Peninsula. 4th edition. Malayan Nature Society, Kuala Lumpur. 595 pp.

Evans W.H. (1949) A Catalogue of the Hesperiidae from Europe, Asia, and Australia in the British Museum (Natural History). British Museum, London. 502 pp.

Feng Y., Xiangqun Y. and Guoki X. (2015) Fauna Sinica Insecta. Vol. 55 Lepidoptera, Hesperiidae. Science Press, Beijing. 769 pp.

HKLS (2011) A photographic Monograph on Hong Kong Butterflies. Volume 4. Ed, Lee P.C., Yiu. V. and J.J. Young. Hong Kong Lepidopterists' Society, HKLS Ltd.

Hsu Y.F. and Wang S.M. (2004) Notes on immature biology of a rare skipper *Caltoris bromus yanuca* Fruhstorfer (Lepidoptera: Hesperiidae), with a discussion on the systematic status of *Parnara ranrunna* Sonan. Pan-Pacific Entomologist 80: 70–81.

Huang H. (2011) Notes on the genera *Caltoris* Swinhoe, 1893 and Baoris Moore, [1881] from China (Lepidoptera, Hesperiidae). Atlanta 42 (1–4): 201–220.

Kunte K., Basu D. and Girish K.G.S. (2019) Taxonomy, Systematics, and Biology of Indian Butterflies in the 21st Century. doi: 10.1201/9780429061400-16.

Shirôzu T. (1960) Butterflies of Formosa in Colour. Hoikusha, Osaka. 1–481 pp [In Japanese].

Swinhoe C. (1893) A List of the Lepidoptera of the Khasi Hills, Part I. Transactions of the Entomological Society of London 1893 (3): 267–330.

Vane-Wright R.I. and de Jong R. (2003) The butterflies of Sulawesi: annotated checklist fora critical island fauna. Zoologische Verhandelingen 343: 1–267.

Van Hook T., Williams E., Brower L., Borkin S. and Hein J. (2012) A Standardized Protocol for Ruler-Based Measurement of Wing Length in Monarch Butterflies, *Danaus plexippus* L. (Nymphalidae, Danainae). International Journal of Tropical Insect Science 22: 42–52.

(Received October 18, 2022; revised ms accepted February 07, 2023; published March 31, 2023)