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New hosts for the Andaman Great Duffer butterfly, *Discophora timora andamanensis* Staudinger (Nymphalidae) in an Island Ecosystem

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Abstract

The present paper depicts the new hosts for the Andaman Great Duffer butterfly, *Discophora timora andamanensis* Staudinger (Nymphalidae) in an island ecosystem. Seven Bamboo spp. viz *Bambusa bambos, Bambusa ventricosa, Bambusa vulgaris, Dendrocalamus asper, Dendrocalamus giganteus, Gigantochloa nigrociliata, Schizostachyum andamanicum* are recorded as new hosts. The life history traits (egg, larva, and pupa stage) of this Andaman Great Duffer butterfly observed and trapped on these bamboo species are described in great detail for the first time. During field study it was observed that the population of this butterfly is very rare and its larvae recorded as a minor pest in the natural habitat of the bamboo species. The over exploitation of the bamboo for various activities will further decline the population of this endemic butterfly as well as the host species in the Andaman and Nicobar Islands, India.

Key words: *Bambusoidae; Butterfly; Conservation; Herbivory; Nymphalidae.*

Introduction

Bamboo is a giant woody grass belongs to the sub family Bambusoidae of Poaceae. It is naturally distributed in subtropical and tropical regions across the world except Antarctica and Europe (Akinlabi *et al.,* 2017; Wu *et al*., 2020). It is well known for its potential immense resources since immemorial times. It is used mainly in construction (flooring, roofing designing, and scaffolding), furniture, food, biofuel, fabrics, cloth, paper, pulp, charcoal, ornamental garden planting and environmental characteristics, such as a large carbon sink and good phytoremediation option, improving soil structure and soil erosion. Taxonomically, it is considered as one of the most difficult group of plants and first time appeared in literature dates back to 300 BC in a letter from Alexander the Great to Aristotle. Thereafter, it has been recorded and studied by various workers. Approximately 123 genera and over 1500 species of bamboo have been recorded worldwide (Vorontsova *et al*., 2016; Ahmad *et al.,* 2021).

In India the sub family Bambusoidae is represented by *ca.* 148 species and 6 varieties under 33 genera (Kumari 2019). It is distributed throughout the country, most of the diversity is confined to north eastern region, Western Ghats and ANI. Twenty-two species have been recorded from ANI (Garbayal *et al.,* 2008) and distributed throughout the islands. The sub family Bambusoidae is known to offer larval food for Lepidoptera: Nymphalidae) butterfly. Other group of plants also recorded as larval host plants for Lepidopteran butterflies (Purti *et al.,* 2022, 2023). Butterfly communities of bamboo forest show low butterfly diversity owing to low plant diversity in bamboo forest (Vu and Vu 2011). Most of the Satyrinae larvae have a very close complicated host plant relationship and dominance within the bamboo forest (Singer and Ehrlich 1991, Barlow *et al.,* 2008). The cause of the lower butterfly diversity in bamboo forest provides a relatively homogeneous habitat with low diversity of ground vegetation (Vu *et al.,* 2015). The bamboo forest butterfly community highlights the need for distinction between forest habitat types when studying the ecological

and conservation requirements for butterflies and other tropical insects (Vu *et al.,* 2015).

Various workers have recorded larval host plants for *Discophora* spp. in India (Moore 1893; Pant and Chatterjee 1950; Wynter-Blyth 1957; Kalesh and Prakash, 2015; Karmakar *et al.,* 2018; Robinson *et al.,* 2010). Except for notable exceptions like *Dinochloa scandens* (Bl. ex Nees) O.K., there is no report on Bambusoidae as a larval host plant for *Discophora* spp. from ANI *(*Veenakumari *et al.,* 1997). Seven Bamboo spp. viz *Bambusa bambos*, *Bambusa ventricosa*, *Bambusa vulgaris*, *Dendrocalamus asper*, *Dendrocalamus giganteus*, *Gigantochloa nigrociliata*, *Schizostachyum andamanicum* are recorded here as new host for Andaman Great Duffer butterfly, *Discophora timora andamensis* Staudinger (Nymphalidae) from ANI, India for the first time. The members of the genus *Discophora* are confined to India, China and Southeast Asia.

The genus *Discophora* Butler (1877) is represented by 11 species worldwide (Moinudheen *et al.,* 2022). In India, it is represented by four species *viz. Discophora deo, D. sondaica, D. timora,* and *D. lepida.* (Varshney and Smetack, 2015). *D. timora* is represented by two sub species *D. t. andamanensis* Staudinger, 1887 which is distributed in Andaman Islands and *D. t. timora* Westwood, [1850] which is distributed from Sikkim to N.E. India

Discophora timora andamanensis Staudinger (Nymphalidae) is recorded from ANI. The Andaman Great Duffer butterfly is endemic to ANI. The ANI is one of the richest and most unique regions of plant diversity in India with a high number of endemic species and widely recognized as one of the hotspots of plant diversity (Singh *et al.,* 2014; Singh *et al.,* 2020a, 2020b; Singh *et al.,* 2021a, b; Singh and Misra 2020; Singh and Ranjan 2021). This investigation aimed to record the bamboo host plants, detail the life history traits (morphology of the egg, larva and pupa stage) of *D. timora andamanensis* and assess its impact on Bamboo host species.

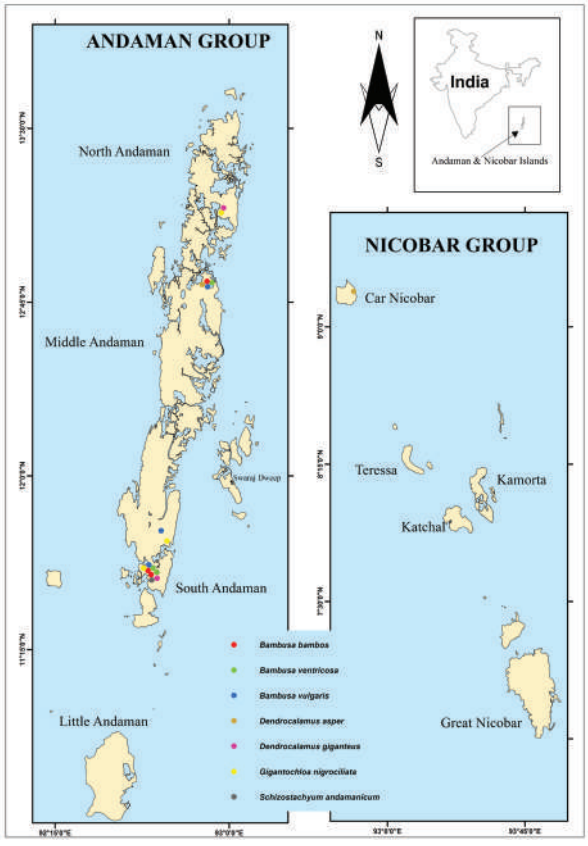

Fig.1. Distribution and study localities of Bamboo species in the present study.

Table 1: Bamboo taxa recorded for Discophora spp.

S. No	Host plant	Sub family	Butterfly	Place where reported	References
1	*Bambusa bambos* (L.) Voss.	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
2	*Bambusa* spp.	Bambusoidae	*Discophora sondaica* Boisduval, 1836	India	Karmakar *et al*., 2018
3	*Bambusa* spp.	Bambusoidae	*Discophora lepida lepida* (Moore, [1858])	India	Moore 1893; Pant & Chatterjee 1950; Robinson *et al*., 2010; Nitin *et al*., 2018
4	*Bambusa ventricosa* Mc Clure	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
5	*Bambusa vulgaris* Schrad. ex J. C. Wendl.	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
6	*Dendrocalamus asper* (Schult. & Schult.f.) Backer	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
7	*Dendrocalamus giganteus* Munro	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
8	*Dendrocalamus strictus* (Roxb.) Nees	Bambusoidae	*Discophora lepida lepida* (Moore, [1858])	India	Wynter-Blyth 1957; Nitin *et al*., 2018
9	*Gigantochloa nigrociliata* (Buse) Kurz	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**
10	*Ochlandra scriptoria* (Dennst.) C.E.C. Fisch.	Bambusoidae	*Discophora lepida lepida* (Moore, [1858])	India	Kalesh & Prakash 2015; Nitin *et al*., 2018
11	*Ochlandra travancorica* (Bedd.) Gamble.	Bambusoidae	*Discophora lepida lepida* (Moore, [1858])	India	Kalesh & Prakash, 2015
12	*Schizostachyum andamanicum* M. Kumar & Remesh	Bambusoidae	*Discophora timora andamanensis* Staudinger 1887	Andaman Islands (India)	**Present study**

Material and Methods

Observed live plant and butterfly specimens through four field trips to localities where natural populations occur (Karmatang IX, Karmatang10, DEGCA) throughout 2022-2023. Eggs and larvae of *D. t. andamensis* were collected from the infested Bamboo sp., *Bambusa bambos, Bambusa ventricosa, Bambusa vulgaris, Dendrocalamus asper, Dendrocalamus giganteus, Gigantochloa nigrociliata, Schizostachyum andamanicum.* Field surveys were conducted to quantify the impact of *D. t. andamanensis* herbivory naturally occurring plants in type localities (Fig.1). All the collected voucher specimens of Bamboo and *D. t. andamanensis* have been deposited in the herbarium of BSI, ANRC (PBL). GPS (Garmin Montana 680) coordinates of the localities of wild population were recorded. *D. t. andamanensis* eggs along with the host plants were placed in a separate sterile labeled plastic box. The droppings of the larva were cleaned periodically and fresh young leaves of the host plants were replaced. The larval stages of *M. v. andamana* were monitored daily, documented and photographed under a stereomicroscope (Olympus SZ 61) at the ANRC, BSI.

Observations and Result

Taxonomic Notes on Bambusoidae host plants

Bambusa bambos (L.) Voss in Vilm. Blumengartn., ed. 3.1: 1189. 1895.

*Distinguishing features***:** It is recognized by tall, heavily branched, closely growing culms bright-green colored with spines. It grows upto 35 m in height. Culms thick walled with a diameter of 8-18 cm with 1-3 spines at branch node. Thin, linear, leaves up to 20 cm in length. Culms bright green to brownish green. Branches spread out from the base. Length of internode ranges between 15 – 46 cm and diameter 3.0-20 cm. culm sheath elongated, cylindrical and dark brown when mature. Blackish brown hairs present on upper surfaces of the sheath and hairs absent in lower surface. Inflorescence spikelets in dense globular clusters, slightly 2- cleft, each upto 2 cm long, with upto 7 fertile florets.

Distribution /Locality selected for in-situ Observations: Distribution recorded in India, Bangladesh, Sri Lanka and Indo China. During the present study host plants were recorded in Memyo, Nayasahar, Karmatang (Fig.1).

*Habitat***:** mixed moist deciduous forests

Common Name: Thorny Bamboo

Conservation status: During the present study the population of this bamboo species was found to be declining due to over exploitation for developmental activities and land degradation due to anthropogenic pressures.

Bambusa ventricosa McClure in Lignan Sci. J. 17: 57. 1938.

Distinguishing features: It is recognized by swollen internodes. Stems jointed cylindrical with persistent leaf sheaths. Leaves linear lanceolate grow to 7 inch long. Culms upto 10 m high with internodes around 30 cm long. Leaf sheaths have short ligule and auricles with few curved setae. A narrow band of pale hairs on the lower culm sheath scars above and below them. Dominant many side branches with 3 on mid culm nodes. Deciduous ribbed culm sheaths with small ligule and unequal auricles with setae.

Distribution/Locality selected for in-situ observations: Distribution recorded in china (Guangdong) to Vietnam. Its distribution is confined to gardens and parks. Distribution recorded in DEGCA, Manglutan and Karmatang (Fig.1).

Habitat: Sub tropical

Common name: Kalash Bamboo

Conservation status: Its population is very few, being confined to gardens with very few individuals, therefore it can be assessed as rare.

Bambusa vulgaris Schrad. ex J. C. Wendl.in Coll. Pl. 2: 26. 1808.

Distinguishing features: It is recognized by erect culms glossy green, yellow, or yellow with green stripes. Internodes glabrous smooth 20 – 45 cm long, oblique swollen nodes. Culm sheath triangular, deciduous, covered with black hairs. Auricles with plain bristles, along the edges. Young shoot covered with black hairs. Leaf blade 6-30 cm long, glabrous with subentire ligule; auricles small rounded lobes, with few bristles. Inflorescence pseudospikelets at the nodes borne on leafless culm.

Distribution/Locality selected for in-situ observations: Its distribution recorded in China to Indo China. During the present study its population was recorded in Manglutan, Mannarghat, Karmatang (Fig.1).

Habitat: Wet tropical forest

Common name: Yellow bamboo

Conservation status: Its status is assessed as threatened. Due to over exploitation and due to anthropogenic activities, its habitat is declining.

Dendrocalamus asper (Schult. & Schult.f.) Backer in K. Heyne, Nutt. Pl. Ned. -Ind., ed. 2, 1: 301. 1927.

Distinguishing features: It is recognized by large woody culms 15-30 m, 8-20 cm in diameter with thick walls 11-20 mm. Aerial roots are present on the nodes of lower culms. Culm internodes are pale green covered with brown hairs re about 40-50 cm long. Clustered branches usually occur from ca. 9th node. Lance-shaped leaf-blades between 15–30 cm long and 10–25 mm wide.

Distribution / Locality selected for in situ observations: Distribution recorded in Bangladesh to Taiwan and Malesia. The species is also native to the Andaman

Islands. During the present study the host plants were recorded from Karmatang, Nicobar. (Fig.1).

Habitat: Wet tropical forest

Common name: Pole Bamboo

Conservation status: During present field surveys found that some of the natural populations is under great threat due to habitat loss by developmental activities and anthropogenic pressure. It is assessed here as under threat in these islands.

Dendrocalamus giganteus Munro in Trans. Linn. Soc. London 26: 150. 1868.

Distinguishing features: It is recognized by tall straight culms grayish green to brownish green with smooth surface and grows upto 30 m. Blackish purple young shoots, internode 25–40 cm width 10–35 cm. Culm sheath green to dark brown, large and broad, triangular blade with top rounded. Small crisped auricle, stiff brownish hairs on upper surface of the sheath and glossy lower surface with no hairs.

Distribution / Locality selected for in situ observations: Distribution recorded in India and China. In Andaman group of islands, during the present study the planted clumps were found in Nabagram and under *ex-situ* conservation at DEGCA. The populations of bamboo were observed to be infested by larvae Andaman Great Duffer butterfly (Fig.1).

Habitat: Wet tropical forest

Common name: Burma Bamboo

Conservation status: During present field surveys found that some of the planted populations are found at DEGCA, Nabagram with few clumps. It is assessed here as under threat in these Islands.

Gigantochloa nigrociliata (Buse) Kurz in Natuurk. Tijdschr. Ned.-Indië 27: 226. 1864. (Syn. *Gigantochloa andamanica* (Kurz) Kurz).

Distinguishing features: It is recognized bydensely clumped erect habit drooping above, stem dark green or yellowish green with prominent nodal rings, and branching in triplets, upto 50 cm long internodes, culm sheaths deciduous, brown, elongated, shorter than internodes, sheath withbrownish black hair on outer surface, ciliate atupper margin; imperfect blade, lanceolate, shorter than sheath proper, pubescent within, deciduous; auricles elliptical, pointed, glabrous; ligule entire. Leaves upto 16 per twig, broadly lanceolate, rounded to attenuate at base, acuminate at apex, glabrous, at times sparsely hairy on upper surface; midrib prominently raised, Spikelets oval lanceolate, 3-flowered, bisexual, fruit caryopsis, elongate, golden brown, with persistent style.

Distribution / Locality selected for in situ observations: Distribution recorded in India; ANI Myanmar, China, Hongkong, W. Malaysia (Ohrnberger 1999; Vorontsova *et al*., 2016). In Andaman group of islands, it grows in the wet tropical forested areas of Memyo, Manipur Parvat National Park, Kalpong, and under *ex-situ* conservation at DEGCA. The population of these areas was observed to be infested by Andaman Great Duffer butterfly (Fig.1).

Habitat: Wet tropical forest

Common name: Chattai Bamboo

Conservation status: During present field surveys found that some of the natural populations is under great threat due to habitat loss by developmental activities and anthropogenic pressure. It is assessed here as under threat in these Islands.

Schizostachyum andamanicum M.Kumar & Remesh in Blumea 48: 187. 2003.

Distinguishing features: it is recognized by straggling culms forming large bushes by arching over neighboring plants. Thin-walled hollow internodes, yellowish green to golden yellow covered with minute silky hairs. Nodes swollen. smooth and spongy ring. Culm sheath greyish green with purplish orange tinge, covered with few brown hairs. Auricles dark brown up to 2 mm high with white bristles coiled. Culm sheath blade linear lanceolate 5–7 cm long, up to 0.8 cm wide with outer surface glabrous. Ligule up to 2 mm long, linear lanceolate leaf blade, attenuate broad base, glabrous. Leaf sheath glabrous, margin serrulate, auricle small, 1 mm high with few bristles. Inflorescence terminating leafy branches,

Spikelets arranged clusters at each node, thin, up to Caryopsis with basal part globular and a slightly bent beak.

Distribution/Locality selected for in situ observations: The native range of this species is Andaman Islands. It is a bamboo and grows primarily in the wet tropical biome (Fig 1).

Habitat: Hilltop stunted evergreen forests

Common name: Straw Bamboo

Conservation status: It is assessed as threatened. During the present study the population was confined to be very sparse in distribution with few clusters due to anthropogenic pressure and habitat loss.

Notes on the *Discophora timora andamanensis* Staudinger, 1887 as pest of Bambusoidae *D. t. andamanensis* is distributed in the Andaman Islands (Mohanraj and Veenakumari 2011; Varshney and Smetack, 2015). The endemic species is very rare in occurrence in North, Middle and South Andamans. The butterfly flies during pre and post monsoon months in the Andamans

Morphology and Description (Fig.3).

The Andaman Great Duffer caterpillars resemble that of moth caterpillars. These caterpillars feed on bamboo leaves. The adult butterfly is elusive in nature and stays in thick shaded vegetation. The underside of the wing shows cryptic coloration and camouflages well with the surrounding.

The male upperside is purple brown, proximal four-fifth dark indigo blue in both wings. The upper forewing with two sub apical ochraceous white spots, 4 or 5 sub marginal spots similar to sub apical spots sub apical and sub marginal spots obscure. The upper hindwing is uniform except for the dark discal band which forms a rounded oval patch at lower angle of cell not reaching v.2 and filling basal part of area 3 edge on v.2 of about 7 mm from upper to lower and about 6 mm across on the median. The underside is very dark, the proximal area ochraceous and light submarginal markings only prominent.

Female upperside is light purple brown outer margins of both wings narrowly yellow; forewing with sub apical broad yellow bar, curving downwards and ending in 2 or 3 triangular detached spots, 2 discal spots below middle bar, and 3 sub marginal large lunular spots. The hindwing with diffused yellow obscure spots on the anterior distal half. Underside is lighter and brighter ochraceous with less defined marking on both wings.

Description of immature stages

Life history of ***D. t. andamanensis*** (Fig. 2).

Egg - The adult female butterfly lays eggs on the underside of the leaf lamina of the Bamboo host plant. The eggs are laid in clusters of 10-13 in numbers. The eggs are pale white in colour. After 3-4 days, the larva hatches out from the egg. The eggs hatch out in 3-4 days.

1st instar stage – The larva measures 4 mm in length. The larva is pale yellow in colour with black head with white setae all along the body. After the emergence, the larva consumes up the egg shell and later move towards the margin of the leaf and start eating the leaf from the underside of the lamina with head pointing downwards. The first instar stage last 4 days.

2nd instar stage - The larva is brown in colour with black head and white setae all along the body. Two white stripes run parallelly from head to the tail. The larva grows upto 14 mm in length. The second instar stage last till 5 days.

3rd instar stage – The larva is black in colour with black head with setae all along the body. Two white stripes run from head to the tail. The instar last till 3 days.

4th instar stage – The larva is black colour with two white stripes running parallel from head to tail. The head shows yellow markings. Two black horn like protuberances also seen at the tail end. The larva grows upto 30 mm. The instar stage lasts upto 8 days.

5th instar stage – The larvae is brown in colour with brown setae all along the body. White stripes are present which extend from head to the tail end. Two black white horn like protuberances also seen at the tail end. The instar stage lasts upto 9 days.

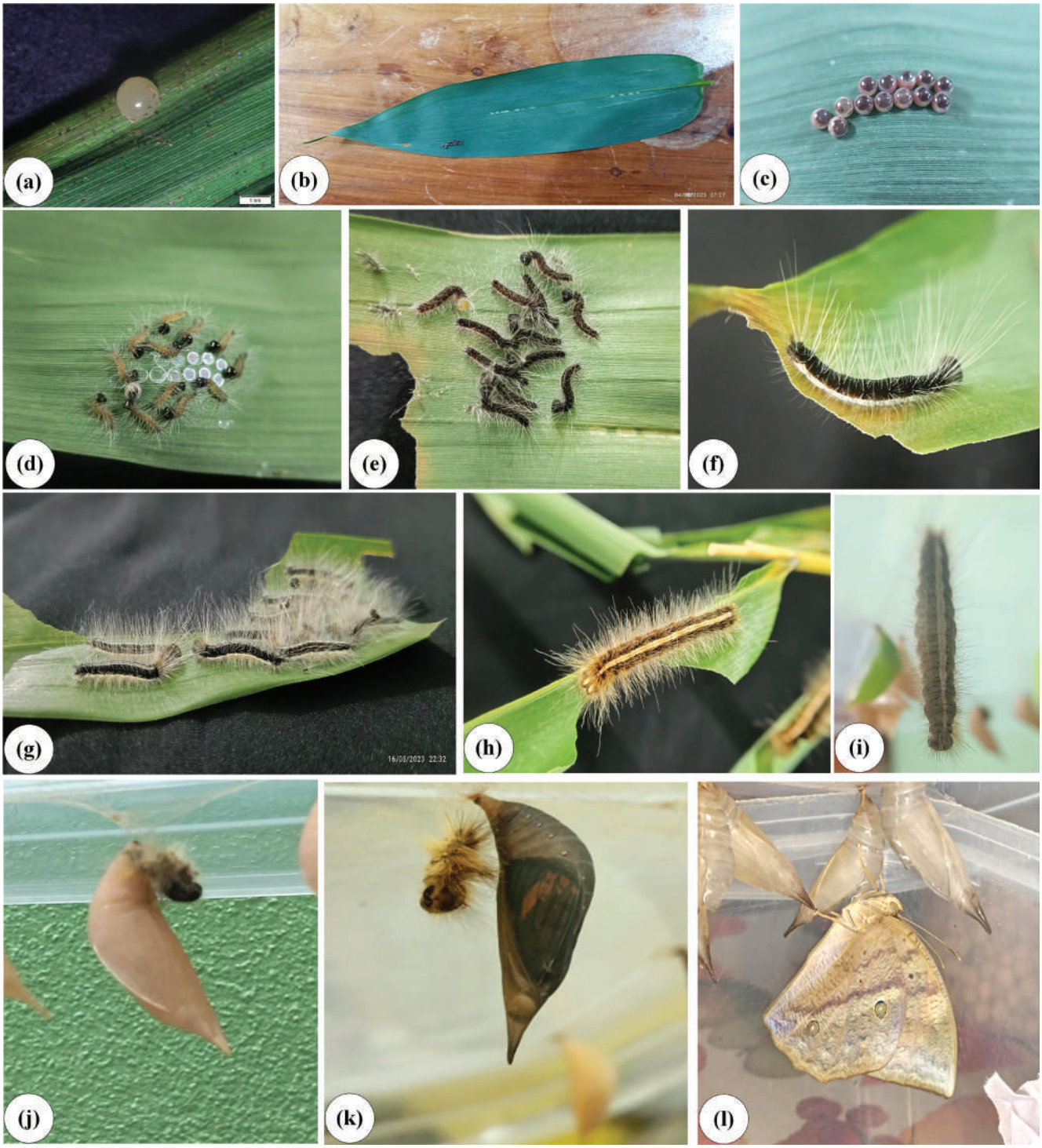

Fig. 2. Life history of Discophora timora andamanensis. (a) close view of egg. (b) cluster of eggs laid on underside of leaf lamina. (c) view of egg before hatching of larvae. (d) first instar larva. (e) second instar larva. (f) third instar larva. (g) fourth instar larva. (h) fifth instar larva. (i) pre pupa. (j) pupa. (k) view of pupa before hatching. (l) adult butterfly.

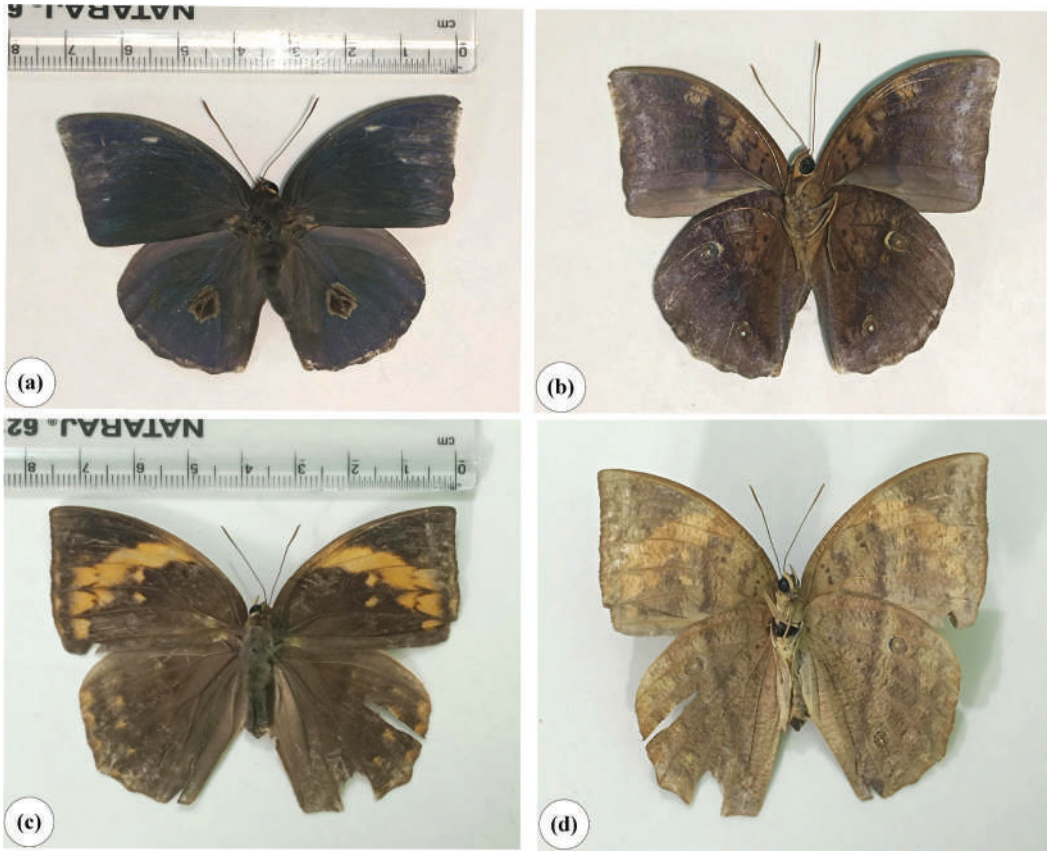

Fig. 3. ***Discophora timora andamanensis.*** **(a) male upperside. (b) male underside. (c) female upperside. (d) female underside.**

Pre-pupa stage – The larva attaches with its anal claspers and hangs out with its head pointed downwards. It takes 2 days for pupa formation.

Pupa – Green or pink colour pupa is formed. The pupation period lasts for 8-9 days. After a period of 09 -10 days the adult butterfly emerges out.

The *D. t. andamensis takes about to 43 – 44 days to complete its life cycle on the host plant.*

Impact of *Discophora Timora andamanensis* on host plants (Fig.4).

The female butterfly lays eggs in clusters of 10 – 12 undersides of the leaf lamina. After hatching of the larvae from the eggs they start consuming the leaf. The mature broad leaves of the bamboo are mostly affected as the larva stay in groups on underside of the leaf lamina. The larva devours leaves from the outer margins and move towards the inner side. The larva eats all the leaf tissue leaving behind the midrib. The impact of the larva on the host plant is minor.

Discussion

The caterpillars of *D. t. andamanensis feed on broad leaves of bamboo. As the butterfly species is very rare in the islands and* over exploitation of bamboo for various developmental purpose and due to increase in anthropogenic pressures, its habitat is declining. Habitat degradation is one of the major concerns for this butterfly, as loss of habitat and frequent anthropogenic disturbances is a threat to the butterfly. The population of this butterfly is already rare, if such over exploitation of bamboo continues then the butterfly will be not able to continue its life cycle as a result of which it may lead to extinction. Various species of Bamboo recorded as host plant for *Discophora* spp. is given in Table 1.

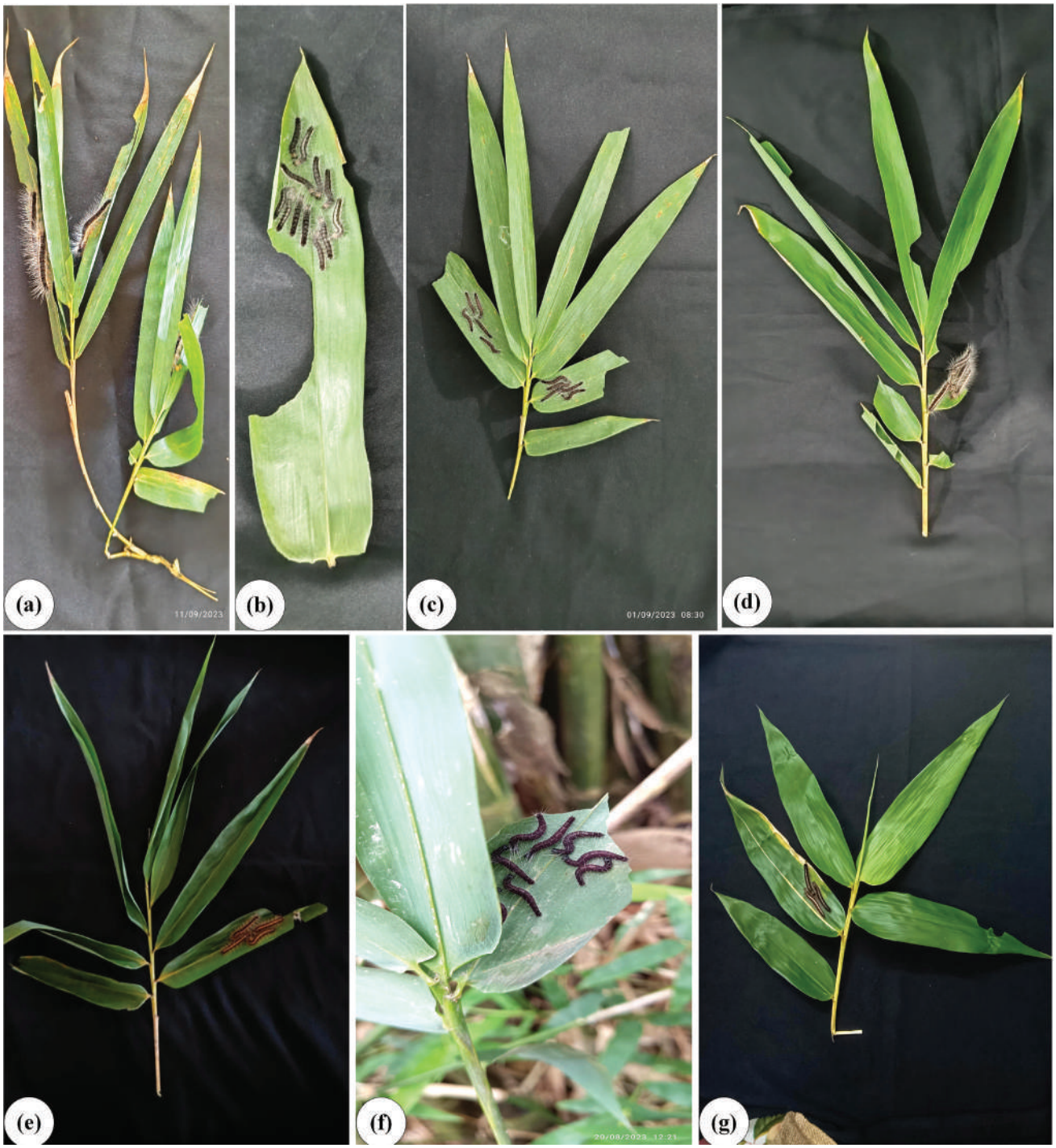

Fig. 4. Damage to Bamboo spp. caused by *Discophora timora andamanensis* herbivory. (a) *Bambusa bambos.* (b) *Bambusa ventricosa.* (c) *Bambusa vulgaris.* (d) *Dendrocalamus asper.* (e) *Dendrocalamus giganteus.* (f) *Gigantochloa nigrociliata.* (g) *Schizostachyum andamanicum.*

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