

New distribution record of *Nicobar rustic*, *Cupha erymanthis nicobarica* Felder (Lepidoptera: Nymphalidae) from northern India and its biology on newly recorded host plant, *Populus deltoides* Bartr. ex Marsh.

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Research Article

Keywords: *Populus deltoides*, Salicaceae, insect pests, new record, defoliator, *Cupha erymanthis*, *Nicobarica*, poplar

Posted Date: November 30th, 2023

DOI: <https://doi.org/10.21203/rs.3.rs-3262443/v1>

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Version of Record: A version of this preprint was published at International Journal of Tropical Insect Science on November 12th, 2025. See the published version at <https://doi.org/10.1007/s42690-025-01641-1>.

Abstract

Populus deltoides, commonly known as poplar, has gained immense significance in the domain of agro-forestry due to its versatile applications. Consequently, farmers in Northern India have increasingly adopted its cultivation. However, poplars worldwide, including India, face a serious challenge in the form of infestations by insect pests. The spectrum of insect pests affecting poplar encompasses various species reported from India. The present study was undertaken at Forest Entomology Division, Forest Research Institute, Dehradun, Uttarakhand, India. The study revealed that leaf defoliator named *Cupha erymanthis nicobarica* Felder was identified on *P. deltoides* for the first time in India. This is the first record of *C. erymanthis nicobarica* from northern region of the country. The observations revealed that the presence of this insect was recorded between April and July. This species complete its biology into 28 to 31 days at $27 \pm 0.5^{\circ}\text{C}$ and $70 \pm 5\%$ RH on *P. deltoides* leaves. The research delved into studying the biology, seasonal occurrence, and the nature of damage caused by this particular insect pest on poplar trees for the first time in India.

INTRODUCTION

Populus deltoides Bartr. ex Marsh. is an exotic species of poplar, commonly known as Eastern cottonwood. The production of cottony seeds gives the name cottonwood to *P. deltoides*. *Populus* are fast growing, wind pollinated, early successional species that can rapidly colonise disturbed sites, often owing to the ability for asexual reproduction or production of massive numbers of seeds (Philippe *et al.*, 2007). Due to these reasons, poplar are preferred by farmers and has become a major tree in the agro-forestry systems. *P. deltoides* is an exotic species introduced from USA and Australia during 1960s by Forest Research Institute, Dehradun, Uttarakhand. Poplar occupy an important place among fast growing agro-forestry species due to their multiple uses as raw materials for match factory, pencil, packing cages, plywood, pulp and paper industries. *P. deltoides* is cultivated on approximately 2.7 lakh hectares of land in Punjab, Haryana, Uttar Pradesh, the foothills and valleys of Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Bihar, utilizing block plantations and various agroforestry models. It is the most popular exotic species, offering promising economic returns with potential income of up to 1.5 lakh rupees per hectare per year (Anonymous, 2019; Kishwan and Kumar, 2013). The vibrant plywood, board, match, and paper industries heavily rely on poplar wood as a valuable resource. Additionally, the cultivation of *P. deltoides* reduces pressure on natural forests and provides significant ecological and environmental benefits (Kumar and Singh, 2012).

The commercial viability of *Populus deltoides*, coupled with its wide range of applications in various industries, has positioned it as a highly sought-after agroforestry species in India. Its fast growth rate, adaptability to diverse climates, and versatile wood properties make it an attractive choice for farmers and industries alike. The cultivation of *P. deltoides* not only serves as a lucrative source of income but also contributes to sustainable land management practices, reducing deforestation and promoting ecological conservation.

Owing to their fast growth, short rotation cycle, lifespan, large sizes, sessile lifestyles and ecological dominance, poplars are subject to interactions with a wide variety of insect herbivores throughout their natural range (Whitham *et al.*, 1996). The fast growth of *P. deltoides* favors to variety of insect pest for hosting, and since introduction about 65 insect pests were recorded infesting *P. deltoides* in India (Singh *et al.*, 2004; Ahmad and Faisal, 2012; Kumar *et al.*, 2021). Due to the climate change scenario forestry species are periodically becoming more sensitive to the biological factors and periodically new insect pests are being recorded infesting *P. deltoides*. In this contexts investigation was undertaken to find out the insect pest of *P. deltoides* and a newly recorded insect was reared in on *P. deltoides* and its biology was studied.

MATERIALS AND METHODS

The present study was undertaken at New Forest campus, Forest Research Institute, Dehradun which lies at lat 30° 20' 31.56" N and long 77° 59' 50.28" E. Poplar plants grown in the nursery were observed weekly after leaf emergence from the month of March for insect pest infestation. The nature of damage of this insect pest was recorded in the field and laboratory. The insect stages recorded in the field were collected and brought to the biosystematic laboratory, Forest Entomology Discipline, Forest Protection Division, FRI, Dehradun and reared for their biology study at $27 \pm 0.5^{\circ}\text{C}$ and $70 \pm 5\%$ RH on natural food. Young leaves of poplar were brought from the field daily and their petiole was rolled with cotton and put into conical flasks filled with water for maintaining the turgidity of the leaf. The leaf was changed daily and larvae were fed on the leaves upto pupation. The adults were kept in the wooden caged of size 60 x 60 x 75 cm lined with nylon mesh from three side and transparent glass from the front. The adults were fed with 10% sugar solution and honey mixture. A leaf twig of poplar with four leaves was provided to the adult pair for mating and oviposition. After hatching, the neonates were transferred to new tender leaves using camel hair brush. During the course of study, egg incubation period, larval period, pupal period, adult longevity and total life cycle of the butterfly was recorded. The adult insect was identified upto species level using published literature and keys of Kehimkar (2008) followed by type collection study at NFIC-FRI, Dehradun up to sub species level. Photography of different stages of the insect was done using DSLR camera and microscope fitted camera.

RESULTS AND DISCUSSION

The studied insect was identified as *C. erymanthis nicobarica* Felder which was first time recorded from the study area. This insect also known as Nicobar rustic butterfly belong to the superfamily Papilionidea and family Nymphalidae (brush- footed butterflies). Present study revealed *P. deltoides* is a new host of *C. erymanthis nicobarica*. The incidence of this insect was recorded during April to July, 2022. The neonate larvae start feeding just after hatching on soft tissues of leaf resulting in defoliation, remaining undersurface of the leaves. Later instars devour the leaf completely except the midrib and cause its defoliation.

The female rustic butterfly laid eggs singly on the underside of the host plant. The eggs were globular in appearance and yellow in colour (Fig. 1). Hatching took place after 4–5 days of incubation period and neonate larvae feed on egg shell as its first meal. The neonates’ body was cylindrical, light creamy or greenish, covered with branched spike and the frontal portion of the head black in colour. The second instar was green in colour and body covered with branched spike. The branched spike in the third instar was black and body acquired with white band on the dorsal surface and the undertone changed to reddish with a green base. Prominent black-coloured eye spots appeared on the head and remained upto last instar. Fourth instar appeared dark brownish and it was similar to fifth instar except numerous white spots on lateral body surface. About 12 hours before pupation, the caterpillar stopped feeding and turned light yellow and eventually green. Before pupation larvae searched for darker site and pupation took place on the undersurface of the leaf. The pupal dorso-lateral surface was covered with five spiracles, which had silvery base followed by red with black tip. Silver patch along the wing pad was also seen. After 3 days, the pupa turned brownish yellow and eventually translucent white. The egg incubation period was 4–5 days and larvae feed for 12–13 days and turn in to pupa. The pupal period was recorded to be about 3–4 days and adult longevity was about 6–7 days (Table 1).

Table 1
Life cycle of *Cupha erymanthis nicobarica* reared on *P.deltoides* (n = 7)

S.No.	Life stages	Duration (days)	Mean	SD
1.	Egg incubation period	4–5	4.50	0.52
2.	Larval period	12–13	12.08	0.79
3.	Pupal period	3–4	3.50	0.52
4.	Adult longevity	6–7	6.42	0.51
5.	Life cycle	28–31	29.25	1.48
<i>F</i> = 1867.33; <i>p</i> -value < .00001				

Cupha erymanthis commonly known as rustic butterfly, has four subspecies found in India viz., *Cupha erymanthis maja* Fruhstorfer, *Cupha erymanthis lotis* (Sulzer), *Cupha erymanthis andamanica* Moore, and *Cupha erymanthis nicobarica* (Felder) (Kumte et al., 2023). The Himalayan Rustic, *Cupha erymanthis lotis* is called so due to its distribution in the Himalayan region of India. It has been reported from Assam (Malabika, 2011; Gogoi et al., 2016), Arunachal Pradesh (Gogoi, 2012), Manipur (Irungbam et al., 2020), Uttarakhand (Smetacek, 2012) and Western Ghats (Arun, 2000). The Sahyadri Rustic, *Cupha erymanthis maja* is reported from Kerala (Shamsudeen and Mathew, 2010; Mathew and Rahamathulla, 1993; Panicker et al., 2016, Mathew et al., 2004), Maharashtra (Pawar and Deshpande, 2016) and Tamil Nadu (Aneesh et al., 2013).The Andaman Rustic, *C. erymanthis andamanica* is distributed in Andaman Islands (Sidhu, 2023; Sivaperuman et al., 2011; Sivaperuman et al., 2021). It is endemic to the region (Rao et al., 2013; Sidhu, 2023). The Nicobar Rustic, *Cupha erymanthis nicobarica* is reported from Nicobar Islands and is endemic to the area (Chandra and Khatri, 1993; Rao et al., 2013; Sidhu 2023). In our study, the

species has been found in Dehradun district of Uttarakhand for the first time. This finding brings light to various factors which could be responsible for the dispersion of the species to the study location which includes, climate change, search of food or host, habitat shifting etc. There are no earlier record of host plants of Nicobar Rustic butterfly, though *C. erymanthis* caterpillars are reported on *Glochidion eriocarpum*, and four species of Salicaceae family i.e. *Flacourtia* sp., *F. indica*, *F. jangomas*, *F. montana* (Kawthankar et al., 2023). In our study Nicobar Rustic was found feeding on *P. deltoides* which also belongs to the Salicaceae family. This may lead to a conclusion that Salicaceae family is preferred as host by this species. We have also recorded that this butterfly remains active during pre and post monsoon period, while, Anonymous, (2022) has recorded that rustic butterfly found active only during post monsoon period. There are 65 insect species recorded on *P. deltoides* (Ahmad and Faisal 2012), while there is no earlier record of *C. erymanthis nicobarica* on this species. We have recorded *C. erymanthis nicobarica* feeding on *P. deltoides* leaves and its biology was also studied for the first time. The butterfly has completed its life cycle successfully in about one month period. We conclude that Nicobar Rustic *C.erymanthis nicobarica* recorded first time in new geographical region of Northern India. Additionally, *P.deltoides* is recorded as a new host of this butterfly for the first time and it may emerge as a pest of *P.deltoides*.

DECLARATIONS

This is the original research findings based article and here we declare that there is no conflict of interest of authorship. We also declare that the funding agency is duly acknowledged for their financial support and there is no competing interest directly or indirectly related to the financial or non financial things involved in the research findings.

ACKNOWLEDGEMENT

The authors are greatly indebted to the National CAMPA authority, Government of India for providing funding support for this study. We are also grateful to the Director General, Indian Council of Forestry Research and Education (ICFRE), Uttarakhand, India for providing necessary research facilities for this study.

FUNDING

First author is a team member of fund receiving team from CAMPA, Ministry of environment, Forest and climate change, Government of India. Second author is part of the project, experimentation of the study and manuscript writing.

CONFLICT OF INTEREST

We certify that there is no conflict of interest of any authors and there is no funding conflict too.

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Figures



Figure 1

1-9: Different stages of *Cupha erymanthis nicobarica* on *P. deltoides*. (1) Singly laid egg. (2) Damage pattern of the early instar caterpillar in the field. (3) Second instar caterpillar. (4) Third instar caterpillar. (5) Mature caterpillar. (6) Newly formed pupa. (7) Brownish yellow pupa. (8) Translucent white pupa a day before eclosion. (9) Adult: *C.erymanthis nicobarica*.