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## Life cycle of nilgiri clouded yellow *Colias nilagiriensis* C. & R. Felder [Lepidoptera: Pieridae] Udhagamandalam, the Nilgiris, Tamil Nadu

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### Abstract

The life cycle of Nilgiri Clouded Yellow butterfly *Colias nilagiriensis* C. & R. Felder, larval performance and life cycle on its new host plant *Trifolium repens* L. family Fabaceae was recorded and described for the first time. The study was carried out during post monsoon in the year 2016 at Udhagamandalam, the Nilgiris district, Tamil Nadu. Fresh eggs of Nilgiri Clouded Yellow were collected from its host plant. *Colias nilagiriensis* completed its life cycle from egg to adult in 55-62 days. The larvae stage lasted 24-26 days followed pupa stage which lasted for 20-25 days.

**Keywords:** Life cycle, *Colias nilagiriensis*, *Trifolium repens*, Udhagamandalam, Nilgiris

### 1. Introduction

The genus *Colias* Fabricius, 1807 is usually difficult to reach a taxonomic decision on phenotypic difference<sup>[1]</sup>. *Colias nilagiriensis* C. & R. Felder Nilgiri Clouded Yellow belongs to the whites and yellows family Pieridae and sub-family Coliadinae. It is a small butterfly endemic to Southern Western Ghats of India at an elevation 1,900 m above<sup>[2]</sup>. It is more than 100 years the earliest annotated faunistic checklist of butterflies from the Palni Hills<sup>[3]</sup>. In Genus *Colias* there are three species which occur in India. *Colias nilagiriensis* Nilgiri Clouded Yellow, *Colias fieldii* Dark Clouded Yellow and *Colias erate* Pale Clouded Yellow<sup>[4]</sup>. It has a rapid flight and comes to low-growing flowers close to the ground almost throughout the year<sup>[5]</sup>. *Trifolium* species is one of the larval food plants for *Colias fieldii* Dark Clouded Yellow which is distributed across the Himalayas from Jammu Kashmir to Arunachal Pradesh between 1000 to 3660 m<sup>[6]</sup>. The larvae of *Colias* species use a variety of herbaceous in family Fabaceae, particularly *Trifolium* species as host plant in North America, Canada and Columbia<sup>[7-9]</sup>. *Medicago sativa* an exotic host for a number of California butterflies includes *Colias eurytheme*<sup>[10, 11]</sup>. *Colias* species from higher elevations have greater wing solar absorptive and thoracic fur thickness to enable body temperature for flight even under winter conditions<sup>[12-14]</sup>.

### 2. Objective

To identify the larval host plants of *Colias nilagiriensis* butterfly in Upper Nilgiris.

### 3. Materials and methods

#### 3.1 Study area

The Western Ghats of India, one of the eight hot spots of the world is well known for its rich biodiversity. Udhagamandalam, also the district headquarters is situated in Nilgiris district of Southern Western Ghats, Tamil Nadu, 11°25'23 N and 76°41'23 E at an elevation of 2354 m. The higher regions of the Nilgiris have tropical warm temperature, and the low temperature being mainly due to the high altitude.

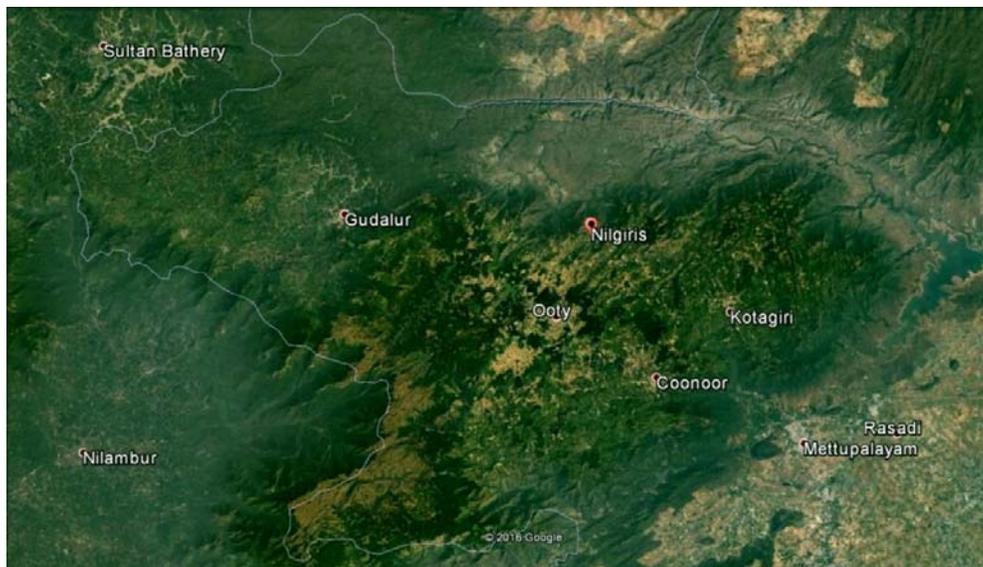
The present investigation was taken to assess the *Colias nilagiriensis* C. & R. Felder Nilgiri Clouded Yellow with larval host plant in the Nilgiri district (Fig.1). Extensive field visits were conducted to enumerate this butterfly species and host plant in upper Nilgiris district, Tamilnadu during the year 2016. The Butterfly species was identified directly by sighting with the help of standard identification keys, Kunte (2000)<sup>[4]</sup> and common English names after Wynter-Blyth (1957)<sup>[30]</sup>. Fresh eggs were collected from the host plant of *Trifolium repens* L. Magnifier and macro camera lens were used to study the structure of eggs, larvae, pupae and adults.

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Plant material were identified with the local floras, taxonomic revisions and monographs by using identification keys (Gamble and Fischer, 1915-1936) [15], *Flora of Nilgiris and*

*Pulney Hill-Tops* (Fyson, 1920-1975) [16] and *Flora of Palni Hills* (Matthew, 1999) [17]. Photographs were made using Canon 18-55mm and Nikon 90mm.



**Fig 1:** Map showing study area – The Nilgiris District, Tamil Nadu

#### 4. Results and Discussion

Nilgiri Clouded Yellow *Colias nilagiriensis* was active in bright sunlight between 0900 – 1100 hours and 1400-1600 hours, mostly seen in lower ground adjoining the larval host plant *Trifolium repens* which also helps in nectar food. Mating and ovipositing takes place during 1000-1200 hours.

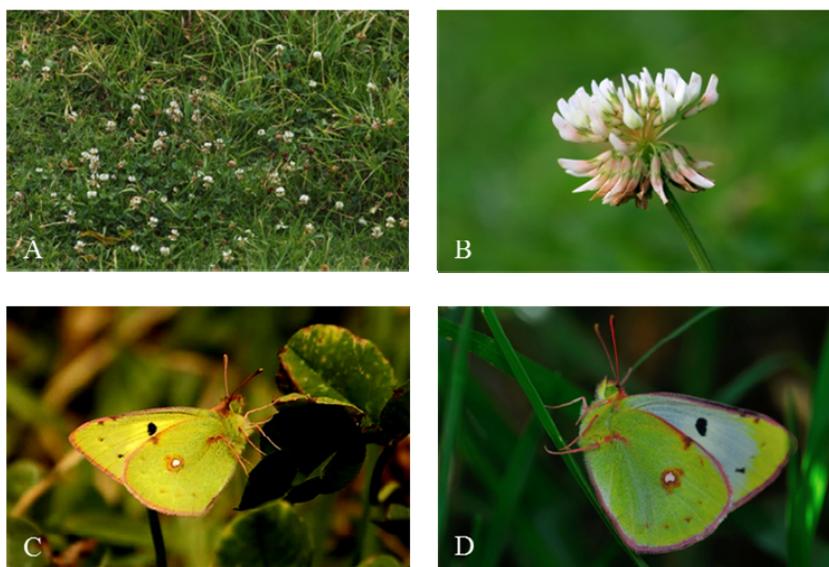
##### 4.1 Larval Host Plant

*Trifolium repens* L., native to Europe and belongs to the family Fabaceae is widely spread in wet areas and waste lands above 2000 m msl [16]. It was perennial herb, glabrous; stems 10-30 cm, prostrate, rooting on nodes. Leaves long petiole, tri-foliolate; stipules ovate, veins greens; petiole 1-1.5 mm; leaflets ovate, base cuneate, apex emarginated to rounded. Flowers 20-50, in terminal, globose 1.5-3.5 cm, bracts

lanceolate; Calyx 3-5 mm. Corolla white 5-12 mm, fragrant, elliptic. Ovary sessile; ovules 3. Legume linear; seeds 2-4, ovoid. Flowering occurs in monsoon, post monsoon and winter to continuing summer (Fig. 2. A and B).

##### 4.2 Nectar feeding

Nilgiri Clouded Yellow is an inhabitant of open hill area grasslands, Shola forest fringes and surroundings. It feeds on lower plants including *Trifolium repens* L., *Taraxacum javanicum* Soest, *Neanotis indica* (DC.) Lewis, *Parochetus communis* Buch.-Ham., *Viola pilosa* Blume, *Oxalis corniculata* L., *Indigofera pedicellata* Wight & Arn., *Emilia ramulosa* Gamble. There are phenological changes in the composition and abundance of nectar flowers due to climatic conditions.



**Fig 2:** A. Habitat - *Trifolium repens* L., B. Flower, C. Male butterfly, D. Female butterfly

### 4.3 Life stages

#### Egg

Eggs were laid singly on upper surface of the leaf and on young shoots of the *Trifolium repens* L. (Fig.3.1). The eggs were spindle shaped, standing on one end and strongly ridged longitudinally and striated finely transversely, cream white in colour on 3<sup>rd</sup> to 5<sup>th</sup> day, it turned to orange blotched with red and purple as mature. The larvae hatched on 6<sup>th</sup> day and the first feed was the egg shell.

**Instar I:** The caterpillar was pale yellow with head black in colour, which lies on mid vein of leaves. Larvae were rounded with ventral lines and head in black colour spherical with white hairy substance, almost a clove shaped. This stage lasts for four days up to 10<sup>th</sup> day and feeds one partial leaf per day (Fig.3.2).

**Instar II:** This stage lasts for five days, from 11<sup>th</sup> to 15<sup>th</sup> day; it was green in colour with circular rings and head turned to green. The feeding increased by one to two fresh leaves per day (Fig.3.3).

**Instar III:** This stage lasted for six days from 16<sup>th</sup> to 21<sup>st</sup> day. Hairs are arranged in six longitudinal rows in anterior-posterior direction and 12 rows horizontally. There appears a slender white streak on mid-dorsal surface of the body (Fig.3.4).

**Instar IV:** This stage starts from 22<sup>nd</sup> day, lasts for five to six days. The white streak extended to bold and light yellow appears along with it. The head was green with black spots and hairs. It feeds two to three mature leaves per day (Fig.3.5).

**Instar V:** This stage lasted for five days from 28<sup>th</sup> day. It was dull-greenish in colour with minute black dots, each emitting a short pale bristles spread to all the segments ventrally. The colour was dull green dorsally. There was sub-lateral yellowish-white streak and the spiracles were very conspicuous with black border. The head was submerged with greenish colour with presence of white hairs (Fig.3.6).

**Pupal stage:** The larvae stopped feeding on 33<sup>rd</sup> day and pre-pupal stage lasted for two-three days and shortened its length (Fig.3.7). White streak turned pale yellow with black spots in dorsal surface. The body contracted before pupation on 37<sup>th</sup> day. Pupal stage lasted for twenty days from 38<sup>th</sup> to 58<sup>th</sup> day (Fig.3.8). The pupae colour pattern was light green to dark green for three to four days. The abdomen was light yellow with four black spots. Formation of greenish white in humped portion and wing pattern appears on 48<sup>th</sup> day. Pupae turned greenish to yellow and red markings start appearing in hump and wing curves on 55<sup>th</sup> day (Fig.3.9). The black portion is enlarged to upper hindwings is visible in pupae on 60<sup>th</sup> day and adult eclosion takes place on 62<sup>nd</sup> day (Fig.3.10).

#### 4.4 Adult

Male, upperside lemon-yellow. Forewing with the basal third and costal space thickly dusted with black scales, a large black oval spot at the end of the cell, exterior black border broad in one-third of the wing; starting from sub-apical area arching the marginal area and reducing and ending towards the tornus; five to six spots of the ground colour across middle of black border from apex towards tornus; fairly uniform in size. Hindwing with black dusting spreading all over the wing dark at the base and gradually paling outwards, the black exterior marginal border fairly thick at the apex, narrowing down to the torunus. Underside much pale yellow. Forewing with costal line dark pink-orange, with sub apical dark spots towards the tornus faded to dark towards tornus, a large black oval cell spot. Hindwing pale yellow with greenish scales, a white spot surrounded with pink-orange border at end cell sometimes seen with another smaller spot adjacent, cilia in margin and coast of both wings are pink-orange. Female, upperside white, forewing marked as in the male. Underside markings also similar, the Forewing more whiter in colour; the hindwing has more of the greenish scales than the male. (Fig.2. C & D). Body stout, thorax and head very hairy, eyes greenish, palpi short, laterally compressed and densely hairy beneath, antenna rather short, stout with a gradually thickened elongated in blunt club, legs pinkish-red and tarsus without appendages.



1.Egg



2. Instar - I



3. Instar - II



4. Instar - III



**Fig 3:** Life cycle stages of *Colias nilagiriensis* – Nilgiri Clouded Yellow from Egg to Adult

Hindwing with greenish scales, an orange-red spot on the costal a little beyond the middle, yellow with black spot, cilia of both wings are orange-red, the costal line of the hindwing follows the same. Female, upperside white, forewing marked as in the male. Underside markings also similar, but the white ground colour of the wings gives them a brighter appearance. (Fig.2. C and D). Body stout, thorax and head very hairy, palpi short, laterally compressed and densely hairy beneath, antenna rather short, stout with a gradually thickened elongated in blunt club and tarsus without appendages.

Larval host plant and nectar feeding is an important aspect of butterfly ecology. *Colias nilagiriensis* is a montane species of Palaearctic element found in the butterfly fauna [18] utilizes the legume plants as larval host. There has been recorded feeding only on *Parochetus communis* [2, 5, 19]. The earlier lifecycle of *Colias nilagiriensis* was done in *Parochetus communis* Buch.-Ham., commonly known as Blue Oxalis from Pambadum Shola, Idukki District, Kerala [20]. There are 14 Clouded Yellows to be found in India, but only three species occur in higher mountains and inhabits open hill-top areas [21, 28, 29]. George Mathew [22] studied the Lepidopteran fauna of Sliant Valley, and listed *Colias nilagiriensis* as South Indian endemic and rare butterfly in Nilgiri Biosphere Reserve. Ghorpade and Kunte [23] reviewed butterflies of the Palni Hills, southern Western Ghats which includes *Colias nilagiriensis* as more than century years.

Graves and Shapiro [1] plant species such as *Trifolium repens*, *T. pretense*, *T. hybridum*, *Medicago sativa*, *M. hispida*, *M. lupulina*, *M. polymorpha*, *Phaseolus vulgare*, *Pisum sativum*, *Melilotus alba*, *M. officinalis*, *Vicia benghalensis*, *V. cracca*, *V. sativa*, *V. villosa*, *Lotus corniculatus* and *Cytisus* spp. are used as larval host for *Colias Alexandra*, *C. eurytheme*, *C.*

*harfordii*, *C. occidentalis* and *C. philodice*. Sengupta *et al.*, [24] reported *Trifolium repens* and *Indigofera* species as larval host plant for *Colias erate* and *Colias fieldii* from Upper Neora Valley National Park, Eastern Himalayas. Arun Pratap Singh [6] enumerates *Trifolium* species to *Colias fieldii* Dark Clouded Yellow as larval host but there is no report on lifecycle. Ezzeddine and Matter [25] studied the nectar flower usage of Pierid butterflies in Sub-Alpine habitat, which includes genus *Colias* follows *C. nastes*, *C. christina*, *C. meadii* and *C. philodice*. *Colias occidentalis* Intermountain Sulphur has been classified by various authors in Washington and most recent placed it as *Colias christina* in North America [26]. Warren [27] reported *Colias* species population widely feeds on *Lathyrus pauciflorus* in Washington. Cultivated Alfalfa has also been reported for *Colias alexandra* and *Colias philodice* in California [10].

## 5. Conclusion

The Nilgiri Clouded Yellow is a wide-spread species of the upper Nilgiris. It is seen practically seen everywhere, where there is open grass lands, especially adjacent to shola vegetation. The larva of this species till date was believed to feed on the traditional *Parochetus communis* Buch.-Ham., however it has come to light the species also feeds on another host plant. The present study provides first hand information on life cycle and stages of *Colias nilagiriensis*, Nilgiri Clouded Yellow in new larval host plant the *Trifolium repens* L. The host plant species itself is mainly confined to grasslands, and hence conservation of high altitude grass-lands is as important as conserving other vegetations. Future studies on high altitude butterfly species, which often nectar and forage in the grass lands along with the *Colias nilagiriensis* C. & R. Felder,

especially the Yellow Pansy (*Percis hierta*), the Grass Yellows (*Eurema* sp.) and the Nilgiri Fritillary (*Argynnis hybrida*) will bring into light more such varied feeding habits as also larval host plant dependency. An attempt has been made to enumerate the larval food plants revealed on the diversity and an adequate care should be taken to conserve both flora and fauna for the sustainable utilization of our biological resources.

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