



## ***Argynnis hyperbius hybrida* (Nymphalidae) the Nilgiri Fritillary: A life cycle record from the Nilgiris, Southern Western Ghats, India**

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**ABSTRACT:** *Argynnis hybrida* Evans (1912) the Nilgiri Fritillary belongs to the family Nymphalidae, sub-family Heliconiinae. It belongs to an extremely heterogeneous group. This unique and endemic race, 'hybrida' is found only in the Nilgiri Hills of South India, while the other race 'castetsi' is found in the hills South of Nilgiris. The life cycle on its host plant *Viola pilosa* Blume is being reported after thirty years from the Nilgiris. The stages from egg to adult take 60-64 days at 26°C. The taxonomic description, distribution, larval performance with host plant and ecology are also discussed.

**Keywords:** Biology, Nilgiri Fritillary, Argynnini, *Viola pilosa*, Nilgiris.

### **INTRODUCTION**

The genus *Argynnis* were placed into two groups, the first group with four species normally larger in size and the second group with seven species which are generally called the smaller fritillaries (Wynter Blyth, 1957). The four species of genus *Argynnis* are *A. hyperbius*, *A. childreni*, *A. kamala* and *A. laodice*. According to Larsen (1987), the species *Argynnis hyperbius* is a Palaearctic butterfly that has managed to colonise the montane zones of Ethiopia, South India, Sri Lanka, Malaysia, Sumatra, Sulawesi and New Guinea. Larsen also opines that, this feat is quite unique in the butterfly world but it is reminiscent of several genera of plants (e.g. *Impatiens*). Possibly the wide range is due to the migratory capacity of the species which may breed on the plains of India during winter.

The genus *Viola* serves as a host plant for several fritillary butterflies of Nymphalid family in worldwide, such as *Boloria bellona*, *B. selene*, *Speyeria aphrodite*, *S. atlantis*, *S. cybele*, *Argynnis pandora* and *A. paphia* (Hesselbarth *et al.*, 1995; Simonsen *et al.*, 2006). Species such as *Viola tricolor* L and *Viola arvensis* Murr are common larval host plants for *Issoria lathonia* L. commonly known as Queen of Spain Fritillary in Europe (Zobar and Genc, 2008). The host plants used

by *Clossiana euphrosyne* are various *Viola* species (Bingham, 1905; Henriksen and Kreutzer, 1982; Willund, 1984; Norberg *et al.*, 2002).

In the Nilgiris, the genus *Viola* is found throughout the year, however, confined to the moist grasslands and open patches of the sholas. *Viola* species is not found in lower elevations (Wynter-Blyth, 1957; Larsen, 1987).

**Objective:** To enumerate the life biology of Nilgiri Fritillary from the Lectotype.

### **MATERIALS AND METHODS**

During our field studies in 2017 at Dodabetta (11°24'02 N & 76°43'53 E) at 2560± meters msl, the Nilgiris District, Tamil Nadu, an interesting species of brush footed butterfly egg, under genus *Argynnis* was collected in its host plant of *Viola pilosa* L. (Gamble and Fischer, 1915-1936; Fyson, 1920-1975). Egg with host leaves were kept in petridish and plastic containers at 26 ± 1°C. The larvae length and width for each instar were measured. All the stages of *Argynnis hyperbius hybrida* were examined and photographed with Canon 18-55 mm, 60mm macro and Nikon 90mm macro. The measurements were taken by using Lecia Qwin image analyser and Digimixer image software.

## RESULTS AND DISCUSSION

In India *Argynnis hyperbius* occur in the hills of Nilgiris and to the south of them, Trichinopoly, Mount Abu, Saurashtra, Bombay, Pachmarhi Hills, Baluchistan, Lucknow, The Himalayas as far west as Chitral, Hills of North East India and North Burma. Of the two South Indian races, *Argynnis hybrida*, the Nilgiri Fritillary is found only in the Nilgiri Hills as reported by Evans in 1912. The Nilgiri population is sedentary to the extent that even strays from the plateau are never met with at lower levels (Larsen, 1987). The species is observed throughout the year. It is found mostly active in bright sunlight and prefers high altitude with tropical montane wet evergreen forest and grasslands as their habitat. The larval host plant is

mostly spread in marshy areas and forest fringes in the under storey of shola forest.

### Larval Host Plant

The larval host plant of the species is *Viola pilosa* Blume which belongs to the family Violaceae (Fig.1.A-D).

**Description:** Prostrate herbs, rooting at nodes. Leaves simple, mostly alternate, 3.5-6 x 3.5-6 cm, ovate, apex acute, base deeply cordate, hirsute, margins crenate; petiole to 15 cm, hairy, stipules foliaceous, 1 cm. Flowers solitary, white; pedicels to 10 cm, hairy. Sepals 7 mm, lower lanceolate, hairy. Petals 1 cm, subequal, longer one obovate, spurred at the base, 6 mm. Anthers 2 mm, oblong, connective produced above. Ovary 2 mm, ovoid, puberulus, style 2 mm, stigma lateral.



**Fig. 1.** A. Habitat of *Viola pilosa*, B. *Viola pilosa*, C & D. Leaf consumption by larvae before and after, E & F. Nilgiri Fritillary *Argynnis hybrid* (female and male).

**Distribution:** Indo-Malesia and China

**Phenology:** January to April

**Associated species:** *Viola pilosa* Blume was found growing in association with *Jucus inflexus* L., *Schoenoplectus mucronatus* (L.) Palla in Engl., *Centella asiatica* (L.) Urb., *Parochetus communis* D.Don, *Neanotis indica* (DC.) Lewis, and *Clinopodium umbrosum* (M.Bieb.) Kuntze.

#### **Life Stages of *Argynnis hybrida* Evans, 1912**

**Egg:** Egg was sugar-loaf shaped (Scudder), pale yellowish, heavy blunt, anastomosing, apex conical and knobbed, with longitudinal ridges (Fig.2.A&B). They were about 5.27 mm in length and 6.71 mm in diameter. The colour of the eggs changed from pale yellow to brownish with black at top end on 6<sup>th</sup> to 8<sup>th</sup> day, indicating maturity. On the 10<sup>th</sup> day mandibles and head of the larvae were visible through the chorion. Eggs hatched on 13<sup>th</sup> day and the first feed was the egg shell. Variation to the earlier data is that “the egg stage lasted nine days” according to Larsen (1987).

**First Instar:** The caterpillar body was translucent yellow and turned pale yellow after the first feeding. Larvae were about  $13.2 \pm 0.1$  mm and body was covered with long setae and head was hairy, colour of which turns from dark brown to black. This stage lasted for four days up to 17<sup>th</sup> day and the larva preferred to feed on young leaves of the host plant. (Fig. 2.C&D).

**Second Instar:** This stage lasted for five days, from 18<sup>th</sup> to 22<sup>nd</sup> day; larvae of  $35.84 \pm 0.4$  mm in length turned to dark brown with orange lateral band in upper portion. The spines were well developed with each segment clearly visible. Each segment had six long spines with the orange base less developed from the fifth segment. Larvae were active during day time and feeding increased by two to three leaves per day. (Fig. 2.E).

**Third Instar:** The general appearance of the third instar was similar to second, but the size enlarged exponentially upto  $65.22 \pm 0.7$  mm. Larvae turned from dark brown to black colour with orange lateral band. The spines of the segments branches out with short spines coloured black up to 4<sup>th</sup> segment and from 5<sup>th</sup> they were translucent red at base tipped with black up to 12<sup>th</sup> segment. The thoracic legs were black with well developed tarsal claws dark in colour and prolegs black at base, pale orange and hairy. This stage lasted for six days from 23<sup>rd</sup> to 28<sup>th</sup> day (Fig. 2.F).

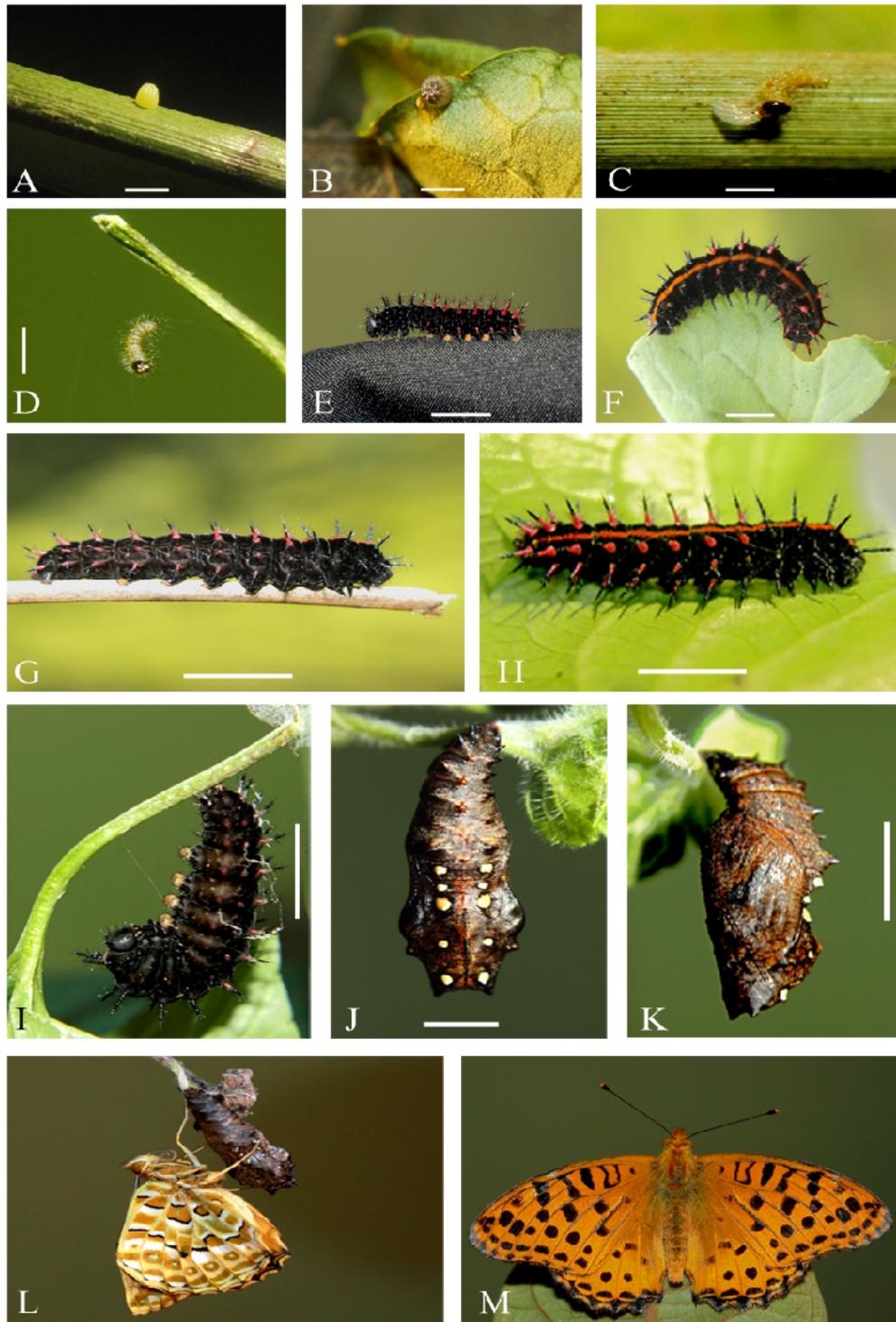
**Fourth Instar:** This stage started from 29<sup>th</sup> day and lasted for five days. The larva expanded its body length upto  $87.69 \pm 1.0$  mm. The spines extended with short sub branches with evident translucent colour at the base. The ridges of segments were well defined and clearly visible in black background of the body. The head was ashy black in colour and the mouth parts were

pale brown (Fig. 2.G). It feeds upto three to four mature leaves per day.

**Fifth Instar:** The fifth instar lasted for five days from 34<sup>th</sup> day lengthening  $86.88 \pm 0.9$  mm. The consumption of host leaves was in large quantity compared to previous stages. The mature larva was black with velvety texture and well grown long spines. The head & eyes became fully black with black hairs on the surface. The claspers were well matured and become fully grown (Fig. 2.H).

**Pupal Stage:** The mature larvae stopped feeding on 40<sup>th</sup> day and attached with the cre-master to a supportive surface. Pre-pupal stage lasted for two days and shortened its length by remaining in a crescent shape to 51.1 mm (Fig.2.I). On 42<sup>nd</sup> day, the larvae suspended down by the tail without a body band and hardened within 5 minutes. The pupae colour patterns were light brown to variable shades of dark brown with black patches. It had shiny and initially silvery white dorsal spots of 3 pairs followed with two pairs interspaced and laterally dorsal spots turned glistening golden colour. On 50<sup>th</sup> day pupae turned dark brown with black patches in hump and wing curves, and turned fully black. Spots developed bluish green tinge at base on 58<sup>th</sup> day ( $69.43 \pm 0.4$  mm ventral and  $30.59 \pm 0.2$  mm anterior posterior). The head end in two well-separated blunt points; a pair of spines in anterior, another pair in the middle, and third pair posterior on the thorax, the later being hunched and keeled; Pupal stage lasted for fifteen days from 42<sup>nd</sup> day and adult emerged on 64<sup>th</sup> day (Fig. 2.J-M).

**Adult:** Stria has greenish tinge. Antenna clubbed, checkered with orange tip, less in female. Palpi white with light ground colour border inwardly, eyes pale greenish with dark spherical spots. Male tawny golden on UP interspersed with dark spots. UPF costa dark dashes followed by sub costal dark spots. Basal area has elongated dark bands inwards. UPH costa wavy between veins. UNF basal area as in UP followed by sub-apical dark spots in line followed by olive green spots interspersed with white spaces upto apex. Sub-marginal dark spots as in UP followed by marginal paired dark border. UNH base interspersed with dark lines bordered with white on dark ground and olive green coloured spaces. A third dark line bordered with white inwardly, running across discal area on ground coloured space, and white space outwardly with few pale tawny spots. Sub-marginal spots tawny pale dotted with white spots on pale orange space. Two white marginal lines split with dark line and bordered with dark tawny thick band inwardly followed by one bright orange line outwardly. Dark brown margin with bright orange cilia.



**Fig. 2.** A. Egg, B. Matured egg, C. First instar larva, D. Second instar larva, E&F. Third instar larva, G. Fourth instar larva, H. Fifth instar larva, I. Pre-pupal stage, J&K. Pupa (front and dorsal view), L&M. Eclosion from pupae - adult butterfly (Male- UN&UP).

Female, UPF tawny at base with elongated spots on costa followed by dark spots as in male, except a magenta tinge towards the cell area. A white thin band at the pre-apical area bordered by purplish-blue inwardly and dark purplish-blue with more bluish tint outwardly. Margin wavy with disconnected pair of white lines and cilia white. UPH as in male, marginal line florescent-blue half-way and tawny beyond towards apex, cilia white. UNF as in UP with more magenta tint at the base. The inward and outward bluish border of the white band thin and the apex and marginal area with pale disconnected lines. UNH as in male, however, ground colour more olivaceous green than tawny.

The observations made in this maiden life cycle matches with the previous literature, however, variation to what Larsen believed, "the Nilgiri species laid only on the host species of violet in contrast to the European Argynnis which lay on nearby inanimate objects (Larsen, 1987; George, 1994), it was observed that the Nilgiri species too laid eggs singly on leaves of its host plant and in some cases on the nearby weeds of marsh reeds *Juncus inflexus* L. which suggests the Nilgiri species too may go in for hibernation, confirmation of which requires further studies of the species. Variation to the duration of larval stage reported earlier is two days, where Larsen reports that the larval stage lasted forty days, and minor variation to what Larsen's observation and his quotation of pupal stage duration of sixteen days was in our study only fifteen days which is marginal and could be attributed to various reasons. The very major finding in this study is that of the description of Brigadier Evans in differentiating the race, wherein he had given four keys, the first three stands matched (forewing apex not produced in both male and female, vein 10 from cell, termen concave in middle), contrary to his observation, the fourth key that vein 2 of the male is swollen (vein 2 male unswollen) which requires major studies at the species level. Further studies are also required to confirm the exact number of broods and their reproductive behaviours and distribution of its larval host plant and associated species.

**Affinities:** This species is very closely allied to *Argynnis hyperbius castetsi* Wight (Palni Fritillary) which has to be compared to *Argynnis hyperbius hybrida* (Nilgiri Fritillary) in South India.

## CONCLUSION

The present study provides first hand information on the ovipositing, larval host plant, larval performance and the length of life cycle from egg to adult eclosion of the Nilgiri Fritillary butterfly. There is no record of the butterfly species *Argynnis hybrida* early stages and

biology reported elsewhere in India. Though *Viola sp.* (Violets) is host plant for Great Spangled Fritillary (*Speyeria cybele cybele*), Aphrodite Fritillary (*Speyeria aphroditei*), Silver-bordered Fritillary (*Boloria selene myrina*), Meadow Fritillary (*Boloria bellona*) and species such as *Viola sagittata* for Regal Fritillary (*Speyeria idalia*), *V. tricolor* for Spain Fritillary (*Issoria lathonia*) and Variegated Fritillary (*Euptoieta claudia*) in Michigan, Sweden, Turkey, Finland America and United Kingdom. *Valeriana* species plays larval host plant for Heath Fritillary butterflies *Melitaea diamina* and *Mellicta athalia* life history and ecology reported elsewhere (Warrens, 1987; Wahlberg, 1997). Therefore further research is necessary for breeding in captivity and genetic morphological behavior which is required in view of the following factors such as proper taxonomical placement of the species, migratory behaviours, if any of the species, year round occurrence of the species and confirmation of dependence of associated species, comparative life cycle study with the adjacent *castetsi* race and conservation efforts which can be adopted.

**Conflict of Interest:** The authors declare no competing interests.

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