Multidisciplinary

Life history and seasonal distribution of the small salmon arab *Colotis amata* (Fabricius, 1775) on its larval host plant *Maerua apetala* in the eastern ghats of Andhra Pradesh - India

K. V. Bhagyasree[1] and S. P. Venkata Ramana[2]

[1] Research Scholar, Department of Zoology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

[2] Associate Professor, Department of Zoology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

Correspondence Author: K. V. Bhagyasree

Received 17 May 2025; Accepted 2 Jul 2025; Published 15 Jul 2025

Abstract

The small salmon Arab butterfly, *Colotis amata* (Fabricius, 1775), showed a seasonal distribution in the Kadapa district and Palakondalu region (14º25'37.65"N 78º52'29.646"E), as observed through field studies of eggs, larvae, and pupae on the larval host plant *Maerua apetala*, along with laboratory research on their development. It was identified as multivoltine, reproducing throughout the year with increased frequency under optimal environmental conditions. All life stages were recorded from January to December, with the highest abundance during the rainy season from June to October. Eggs were laid in clusters on delicate leaves and hatched within 3 to 4 days. The larvae went through five instars, completing development in 15 to 17 days. Pupation lasted for 5 to 7 days. The entire life cycle, from egg to adult, spanned 24 to 28 days. The success rate of development from egg, larva, and pupa to adult ranged from 78% to 95%. The stages of development, from egg to adult, of *Colotis amata* on *Maerua apetala* are examined and detailed in this study.

Keywords: *Colotis amata*, Life history, *Maerua apetala* and Multivoltine

Introduction

Butterflies are vital bioindicators of environmental health, playing a key role in ecological balance through pollination and their participation in food webs (Bonebrake *et al*., 2010) [1]. The family Pieridae, commonly known as the whites and yellows, is widespread in tropical and subtropical areas, showing considerable diversity across the Indian subcontinent (Varshney & Smetacek, 2015) [9]. The genus *Colotis* is prominent in arid and semi-arid regions, where many species are closely associated with the family Capparaceae as their primary larval host plants. The small salmon Arab, *Colotis amata* (Fabricius, 1775), is a medium-sized pierid butterfly found throughout South Asia. It exhibits notable seasonal fluctuations in population and is often abundant during the monsoon seasons when host plants are thriving. Despite its common presence, detailed life history studies of *C. amata* and its larval host plants are scarce, particularly in the Kadapa district and Palakondalu hill ranges within the Eastern Ghats biodiversity region of Andhra Pradesh.

Research on the life history of butterflies is essential for understanding their voltinism, survival strategies, and ecological needs (Kunte, 2000) [4]. This information provides insights into how species react to environmental changes and is important for developing conservation plans. This study examines the developmental biology of *C. amata* on its larval host plant, *Maerua apetala*, which belongs to the Capparaceae family. Field and laboratory observations were carried out to document seasonal distribution, voltinism, oviposition behavior, larval instars, pupation, and success rates of emergence. It provides a detailed overview of the life cycle of *C. amata*, emphasizing its multivoltine characteristics, survival rates, and seasonal abundance patterns. These findings enhance the overall understanding of Pierid butterfly ecology in semi-arid tropical environments.

Materials And Methods

Study Area

The research was conducted in the Palakondalu area of Kadapa district, Andhra Pradesh, India (14º25'37.65"N, 78º52'29.646"E) (Figures 1 & 2). These regions lie in the semi-arid tropical zone of the Eastern Ghats, characterized by hot summers, mild winters, and monsoon rainfall from June to October. The flora mainly consists of dry deciduous and scrub forests, with patches of *Maerua apetala* (Capparaceae), which is the known larval host plant of *Colotis amata*.

Fig 1: Study area of Palakondalu - Kadapa

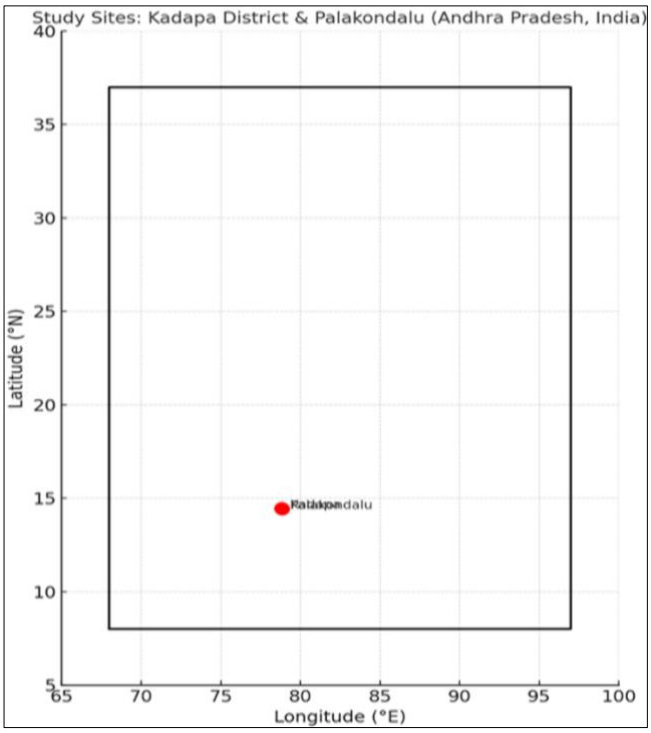


Fig 2: Study area of Palakondalu – Kadapa in latitude and longitude

Field observations

Field visits were conducted every two weeks from January to December 2023. We identified *Colotis amata* eggs, larvae, and pupae on *M. apetala* through visual search methods. Seasonal abundance was recorded by noting the presence of different developmental stages during the rainy (June–October), winter (November–February), and summer (March–May) seasons.

Laboratory rearing

Field visits were carried out biweekly from January to December 2024. Visual search techniques identified the eggs, larvae, and pupae of *Colotis amata* on *M. apetala*. Seasonal abundance was evaluated by recording the occurrence of different developmental stages during the wet (June–October), winter (November–February), and summer (March–May) seasons. Field photographic documentation was used to capture oviposition, larval instars, and pupation sites.

Maerua apetala in the Palakondalu region (14º25' 37.65"N, 78º52' 29.646"E) yielded fresh *Colotis amata* eggs. The eggs were then moved to paired petri dishes in the entomology laboratory of the Department of Zoology, Yogi Vemana University, Kadapa. The experiment was conducted in semi-natural conditions from January to December 2023, with temperatures ranging from 23°C to 27°C and relative humidity between 50% and 65%. Upon emergence, the larva ruptured its eggshell and was placed onto fresh leaves. We replaced the decayed leaves with fresh ones every twelve hours. Numerous instars were observed through molting during the developmental period. Observations on the instars were recorded.

Data analysis

The voltinism of *C. amata* was evaluated based on the number of generations observed within a year. Seasonal differences in developmental success were described descriptively. The survival rate at each life stage was expressed as the ratio of individuals that successfully reached the next stage to the total number observed.

Results

Seasonal distribution

Colotis amata was consistently observed at the research sites throughout the year, showing notable seasonal variations in population density. The highest numbers were recorded during the rainy season (June–October), coinciding with the growth peak of the larval host plant *Maerua apetala.* Lower population figures were noted during the dry summer months (March–May).

Life cycle

Egg stage

The small salmon Arab butterfly, *Colotis amata*, lays clusters of eggs (8-15 eggs) on both surfaces of the juvenile leaves of *Maerua apetala*. Daytime courtship and copulation occur, with pairs lasting 2 to 3 hours. The female deposits her egg clusters on the undersides and upper sides of juvenile leaves or, more often, on the spines of the host plant. During an egg-laying event, between four and ten clusters are laid on different leaves or spines of *Maerua apetala*. Most ovulation happens between 1100 and 1400 hours.

The eggs have longitudinal ridges from the apex to the base, with a smooth surface and a light yellowish mustard color. They measure 0.85-0.87 mm (0.89 ± 0.02 mm) in length and 0.34-0.36 mm (0.36 ± 0.01 mm) in width. The incubation lasted three to four days after laying. The larvae go through five instars (Figure 3).

Larval stage

Instar I: It lasted for two to three days. The length varies from 2.71 to 6.23 mm (6.16 ± 0.07 mm), and the width ranges from 0.58 to 0.65 mm (0.62 ± 0.03 mm). The thoracic region had hairy features. At hatching, the body was cream-colored; by the end of the first day, it had changed to green. Upon emergence, the larva's head first turns black before becoming green. The diameter of the round head was between 0.7 to 0.9 mm (0.87 ± 0.03 mm) (Figure 3).

Instar II: It lasted for 2 to 3 days. The size varies from 6.24 to 9.24 mm (9.28 ± 0.04 mm), and the width ranges from 0.66 to 1.12 mm (1.15 ± 0.03 mm). The head diameter ranges from 0.9 to 1.15 mm (1.17 ± 0.02 mm). The mid-dorsal line becomes visible; the body turns green, hairy, and gritty in texture (Figure 3).

Instar III: It lasted for 2 to 3 days. Its length ranged from 9.24 to 14.32 mm (14.43 ± 0.11 mm), and the width ranged from 1.15 to 1.38 mm (1.33 ± 0.05 mm). The head diameter varied from 1.17 to 1.32 mm (1.28 ± 0.04 mm) (Figure 3).

Instar IV: It lasted for three to four days. The length varied

between 14.43-19.15 mm (19.24 ± 0.09 mm), while the width ranged from 1.32-1.98 mm (2.02 ± 0.04 mm). The body clearly showed a segmented structure. The cylindrical head features a prominent orange patch on the dorsal side, with a diameter of 1.32-1.4 mm (1.42 ± 0.02 mm). The dorsal and ventral surfaces of the body shift to a deep green hue (Figure 3).

Instar V: It lasted for three to four days. Once fully grown, the larva had a distinctive green coloration, measuring 19.16–22.45 mm (22.57 ± 0.12 mm) in length and 2.03–2.85 mm (2.98 ± 0.13 mm) in width. The head diameter ranged from 1.4 to 1.45 mm (1.47 ± 0.02 mm). No changes were made to the remaining characteristics (Figure 3).

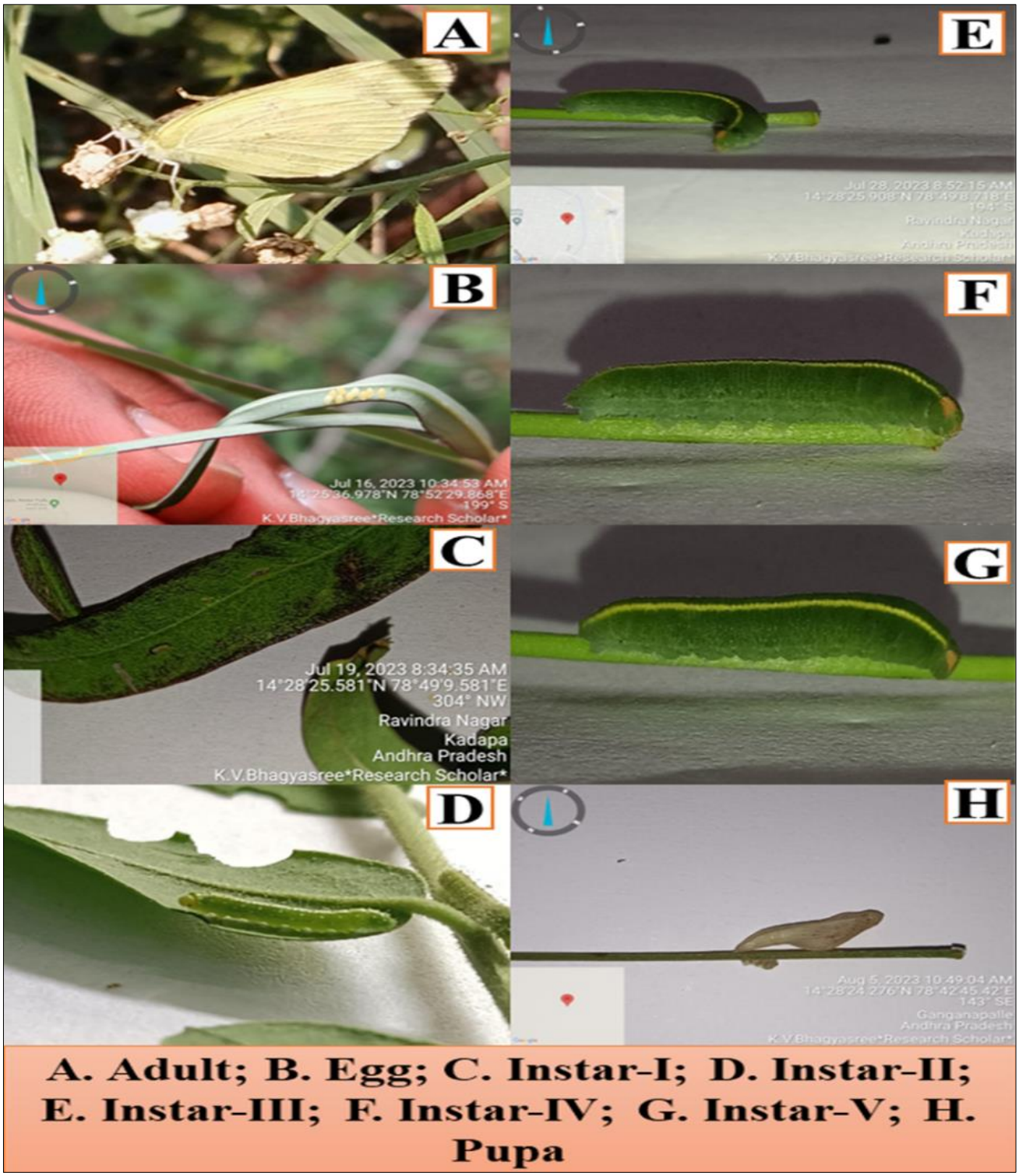


Fig 3: Life cycle of *Colotis amata*

Pre-pupa

The fully matured fifth instar stopped feeding and retracted its body in preparation for pupation. The thickening and shortening process continued for one day.

Pupal stage

The pre-pupa transforms into the pupal stage on the same day. It measures 14.97–15.02 mm (15.07 ± 0.04 mm) in length and 5.49–5.61 mm (5.64 ± 0.03 mm) in width in the wider region.

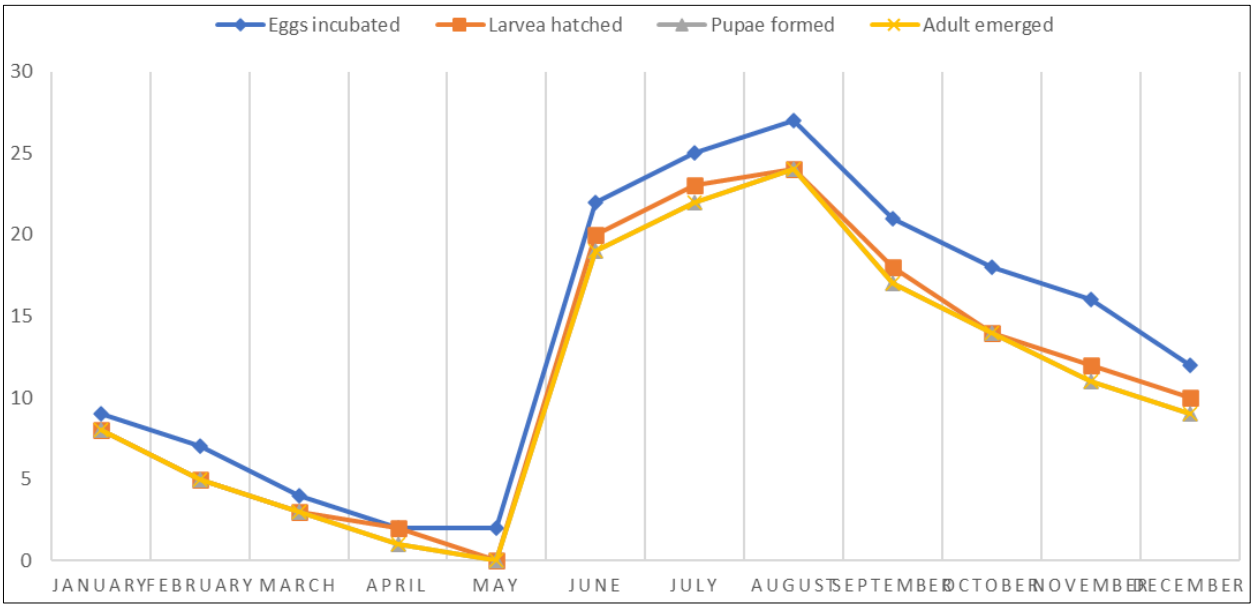
It attaches to the substrate with its entire body. This phase lasts for 7 to 9 days. It is a light brown shade. The posterior section is tapered (Figure 3).

Hatching, pupal, and adult development success

We incubated all eggs collected throughout the year in the laboratory to assess the success of the subsequent stages, including larvae, pupae, and adults. The hatching success rate for the year was 78%, the larval development rate was 98%, and the pupal development rate was 100% (Table 1; Graph 1).

Table 1: Hatching rate, Pupal, and adult development success of *C. amata* in laboratory conditions

Life cycle stage	J	F	M	A	M	J	J	A	S	O	N	D
Eggs incubated	9	7	4	2	2	22	25	27	21	18	16	12
Larvae hatched	8	5	3	2	0	20	23	24	18	14	12	10
Pupae formed	8	5	3	1	0	19	22	24	17	14	11	9
Adult emerged	8	5	3	1	0	19	22	24	17	14	11	9



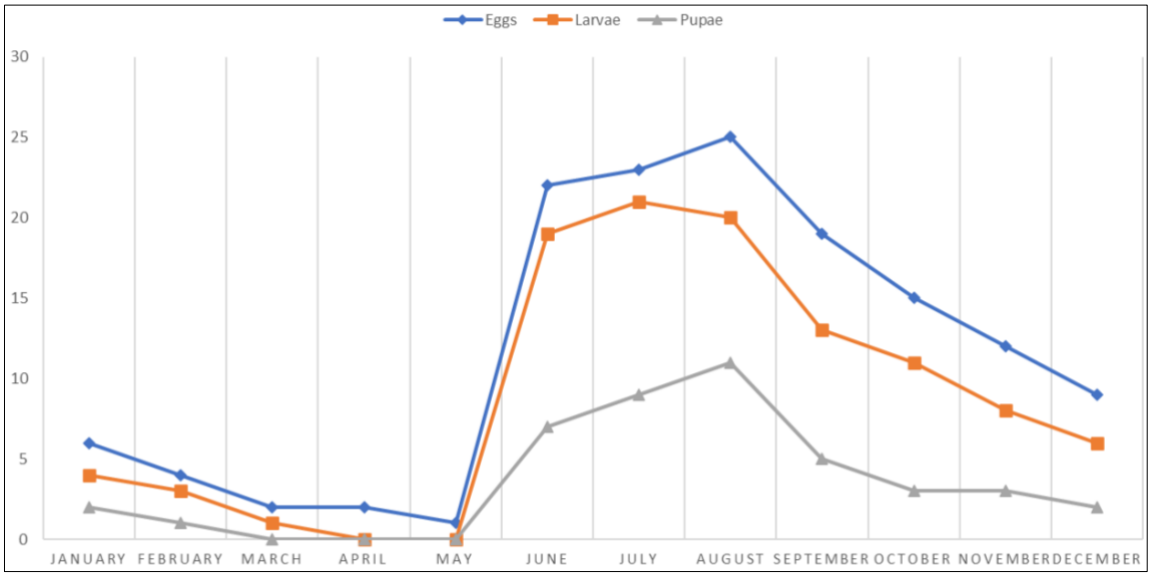
Graph 1: Growth success of different life stages of *Colotis amata* in the laboratory

Population index

Studies of 10 juvenile host trees for eggs, larvae, and pupae over different months showed that these developmental stages occur throughout the year, with numerical variations from month to month. The life stages were observed more often from June to October (Table 2; Graph 2).

Table 2: Population index of *Colotis amata* on *Maerua apetala* at Paalakondalu, Kadapa

Life cycle stage	J	F	M	A	M	J	J	A	S	O	N	D
Eggs	6	4	2	2	1	22	23	25	19	15	12	9
Larvae	4	3	1	0	0	19	21	20	13	11	8	6
Pupae	2	1	0	0	0	7	9	11	5	3	3	2



Graph 2: Population index of different life stages of *Colotis amata* in *Maerua apetala*

Adult description

The *Colotis amata*, had a wingspan of about 45–55 mm. It showed sexual dimorphism, with males being more vibrant and more patterned than females. The dorsal forewing of the male had a white background mixed with bright salmon-pink to red hues in the upper half. The outer edge had a distinct black border, which could sometimes be uneven. A black dot was usually seen within the cell. The hindwing was mainly white with occasional salmon tones; it featured a thin black border at the edge. The ventral forewing was white, with a faint salmon-pink tint in the tip area. The dark markings were less noticeable than those on the upper side. The hindwing ranged from yellowish-white to pale salmon, sometimes speckled with subtle gray patches. The dorsal surface of females was often lighter than that of males, with less vibrant or no salmon hue at all. The forewing had a larger, more diffuse black tip border, with a mostly white ground color. The hindwing was white with a more distinct dark fringe at the edge. The ventral side was similar to that of males but less vibrant, with more noticeable yellowish hues on the hindwing. The thorax and abdomen were covered on top with fine white hairs, while the underside was pale. The antennae were thin and dark, with white bands and a reddish club tip.

Discussion

This study confirms that *Colotis amata* is a multivoltine species, completing its life cycle in 24–28 days and producing multiple generations each year. This trend aligns with research showing that higher temperatures and resource abundance boost voltinism in butterflies (Roy *et al*., 2009; Strebel *et al*., 2024) [5, 7]. Peak abundance during the wet season (June–October) indicates that life cycle stages coincide with optimal host plant growth, a pattern also seen in other Pierids and tropical butterflies in South Asia (Devkota *et al*., 2024; Sreedevi *et al*., 2021; Dutta *et al*., 2019) [2, 6, 3]. Structural and behavioral thermoregulatory adaptations, such as wing-mediated radiative cooling, likely help *C. amata* manage the high summer temperatures of the semi-arid Eastern Ghats (Tsai *et al*., 2020) [8]. *C. amata*'s ability to thrive in arid and semi-arid areas like Kadapa and Palakondalu highlights its ecological adaptability and dependence on *Maerua apetala*, a key host plant in the Capparaceae family. Protecting this host species is essential, as changes in plant phenology driven by land use or climate shifts could directly threaten butterfly survival. Because voltinism sensitivity depends on climate factors (Roy *et al*., 2009; Yadav *et al*., 2022) [5, 10], long-term monitoring of *C. amata* populations across different regions is vital to understanding how seasonality, reproductive success, and ecological adaptations interact amid environmental changes.

Conclusion

This work offers the inaugural comprehensive examination of the life history and seasonal dynamics of the tiny salmon Arab, *Colotis amata*, on its larval host plant, *Maerua apetala*, in the semi-arid Eastern Ghats. The species was verified as multivoltine, able to complete multiple generations each year, with a total life cycle span of 24–28 days. Seasonal monitoring indicated that abundance reached its zenith during the wet season (June–October), aligning with peak host plant availability, whereas successful development rates from egg to adult emergence varied between 78% and 95%. These findings underscore the ecological adaptability of *C. amata* and its ability to flourish under diverse seasonal settings. The butterfly's reliance on *M. apetala* highlights the necessity of preserving this host plant to maintain populations. Due to the susceptibility of voltinism and survival to climatic variations, long-term monitoring of *C. amata* populations in many habitats is key to understanding the potential effects of climate change, habitat modification, and resource dynamics. This research provides essential baseline data to support the conservation management of Pierid butterflies in peninsular India.

References

1. Bonebrake TC, Ponisio LC, Boggs CL, Ehrlich PR. More than just indicators: a review of tropical butterfly ecology and conservation. Biol Conserv. 2010;143(8):1831-41.
2. Devkota K, Lamichhane S, Thapa K. Seasonal variation of forest butterfly diversity in tropical lowland Nepal. Insects. 2024;15(2):192.
3. Dutta S, Chakravorty J, Raha A. Diversity, seasonal dynamics and host plants of butterflies in Forest Research Centre, Siddipet, Telangana, India. Indian J Entomol. 2019;81(4):791-7.
4. Kunte K. Butterflies of peninsular India. In: Gadgil M, editor. Hyderabad: University Press, 2000, 254 p.
5. Roy DB, Oliver TH, Botham MS, Beckmann B, Brereton T, Dennis RLH, *et al*. Climatic warming, voltinism and butterfly abundance. Proc Biol Sci. 2009;276(1673):2283-91.
6. Sreedevi K, Kumar V, Eswaran R. Seasonal patterns in butterfly diversity and abundance in relation to weather parameters at Kambalkonda Eco-tourism Park, Visakhapatnam. J Entomol Zool Stud. 2021;9(6):138-44.
7. Strebel N, Stalder T, Dolezal P, Blomberg O, Menz MHM, Roy DB. Long-term changes in voltinism and abundance of European butterflies under climate change. Proc Biol Sci. 2024;291:20241652.
8. Tsai CC, Childers RA, Shi NN, Ren C, Pelaez JN, Bernard GD, *et al*. Physical and behavioral adaptations to prevent overheating of the living wings of butterflies. Nat Commun. 2020;11:551.
9. Varshney RK, Smetacek P. A synoptic catalogue of the butterflies of India. Bhimtal: Butterfly Research Centre & Indinov Publishing, 2015, 535p.
10. Yadav S, Dey S, Roy A. Impact of climate change on Helicoverpa armigera voltinism in different agro-climatic zones of India. Environ Exp Biol. 2022;20(2):95-104.