

Unlocking a hidden relationship: *Plumeria rubra* (L.) as a vital food source for *Euploea core* (Cramer, 1780) (Nymphalidae: lepidoptera) larvae

Mohite Karishma¹, Umesh Pawar¹, Amol Mamlayya²

¹ Department of Botany, SPK College, Sawantwadi, Maharashtra, India

² Department of Zoology, Karmaveer Bhaurao Patil Mahavidyalaya, Pandharpur, Maharashtra, India

Abstract

The selection of food plants by adult females is crucial for insect development, particularly in butterflies. This study reveals *Plumeria rubra* (L.) as a previously unknown larval food plant for *Euploea core* (Cramer, 1780)^[3], a species of Significant ecological importance in the Nymphalidae family (Lepidoptera). The mean durations of the instar stages ranged from 2.0 days (Egg) to 3.3 days (3rd instar), with a total life cycle duration of 21-32 days. Specifically, the instar stages showed the following durations: Egg (2 days, SD: 0.471, SEM: 0.149), 1st instar (2.7 days, SD: 0.483, SEM: 0.152), 2nd instar (3.2 days, SD: 0.421, SEM: 0.133), 3rd instar (3.3 days, SD: 0.483, SEM: 0.152), 4th instar (3.2 days, SD: 0.918, SEM: 0.29), 5th instar (3.2 days, SD: 0.421, SEM: 0.133), 6th instar (2.6 days, SD: 0.516, SEM: 0.163), and Pupa (6.4 days, SD: 0.843, SEM: 0.266). Our findings demonstrate that *Plumeria rubra* serves as a vital food source for *Euploea core* eggs and newly hatched larvae, highlighting the importance of understanding insect-plant interactions. Our research provides valuable insights into the life cycle of the Common Crow under various conditions, elucidating its developmental biology. These discoveries have significant implications for ecological research, conservation efforts, and the management of this species in diverse environments.

Keywords: Vital food, food plants, *Plumeria rubra* (L.)

Introduction

Butterflies, with their striking colors and graceful flight, play a vital role in maintaining the delicate balance of ecosystems. As a popular model insect, they have been extensively studied in various fields, including evolutionary biology (Settele & Kühn, 2009)^[19, 20], behavioral ecology (Rayalu *et al.*, 2013)^[15, 16], and insect-plant interactions (Wilkund, 1984; Kelly & Debinski, 1998)^[9, 25]. The selection of larval food plants and egg-laying patterns are critical aspects of butterfly behavior, with a wealth of research conducted across different geographic regions (Settele *et al.*, 2009; Curtis *et al.*, 2015; Nitin *et al.*, 2018; Robinson *et al.*, 2001; Rayalu *et al.*, 2013; Hill *et al.*, 2018)^[4, 6, 13, 15, 16, 17, 19, 20].

Euploea core (Cramer, 1780)^[3], a widely distributed butterfly species, has been the focus of numerous studies on its life cycle, distribution, and larval food plant preferences (Rayalu *et al.*, 2013)^[15, 16]. While previous research has identified several plant species as food sources for *E. core*, including *Tylophora indica*, *Cryptolepis dubia*, and *Hemidesmus indicus* (Apocynaceae) (Wynter-Blyth, 1957; Kunte, 2000; Robinson *et al.*, 2010)^[10, 18, 27], this study reveals a previously unknown larval food plant, *Plumeria rubra* (L.) (Apocynaceae), and provides new insights into its life cycle. Our findings contribute to a deeper understanding of the intricate relationships between butterflies and their food plants, with important implications for ecological research and conservation efforts.

Materials and methods

Study site

The present study was conducted in Vengurla, Maharashtra, India (15.8514°N, 73.6389°E), situated on the west coast of India, during the calendar year 2022. Vengurla offers a

unique ecosystem with diverse flora and fauna, making it an ideal location for studying butterflies.

Field observations

Systematic field observations were carried out to record the occurrence of butterflies and their developmental stages. The observations focused on the habitat preferences, behavior, and life cycle stages of the butterflies.

Laboratory studies

To complement the field observations, the life cycle of the butterfly was also studied under controlled laboratory conditions. The rearing method and observations followed the protocol established by Rayalu *et al.* (2013)^[15, 16].

Butterfly Identification:

The identification of the butterfly species was confirmed using available literature, specifically (Kehimkar, 2008)^[8].

Additional details

- The field observations were conducted over a period of six months, from June to November 2022.
- The laboratory studies were conducted in a controlled environment with a temperature range of 25-30°C and humidity of 60-70%.
- The butterflies were reared on their natural food plants, and their developmental stages were monitored and recorded regularly.

Results

Our study on *Euploea core* (Cramer, 1780)^[3] reveals fascinating insights into the selection of host plants by adult females and the development of immature forms. The duration required for the completion of the life cycle is presented in Table 1 and Plate 1.

Egg laying

The female butterflies laid eggs on the underside of young and fresh leaves or tender shoots of *Plumeria rubra* (L.) (Family Apocynaceae), commonly known as Frangipani. The eggs were single, creamy, dome-shaped with longitudinal ridges, and shining, measuring 0.85-1.00 mm in height. This observation is consistent with earlier studies on the oviposition behavior of *E. core* (Wynter-Blyth, 1957; Kunte, 2000) [10, 27].

Larval and pupal development

The neonate larva measured 2.00 mm in length and grew through six instars, with each instar showing a significant increase in length and width. The last instar larva measured 30.00-40.00 mm in length and 5.00-6.00 mm in width. The

larval stage lasted for approximately 14-16 days, which is comparable to earlier reports (Robinson *et al.*, 2010) [18]. The pupal stage lasted for about 7-10 days, and the adult butterflies emerged with a wing span of approximately 7-8 cm. The males were distinguishable from females by a narrow pale sex-brand mid-space on the UPF and a white streak at the same place on UNF.

Larval food plants

Our observations on egg laying and larval feeding revealed that *Plumeria rubra* (L.) (Family Apocynaceae) serves as a larval food plant for *E. core* (Cramer, 1780) [3]. This finding is significant, as it represents a new larval food plant for *E. core*, adding to the existing knowledge of its host plants (Wynter-Blyth, 1957; Kunte, 2000; Robinson *et al.*, 2010) [10, 18, 27].

Table 1: Duration of different stages required completion of life cycle

	Egg	1instar	2 instar	3 instar	4 instar	5 instar	6 instar	Pupa
Min.	1	2	3	3	2	3	3	5
Max.	3	3	4	4	4	4	3	7
Mean	2	2.7	3.2	3.3	3.2	3.2	2.6	6.4
SD	0.471	0.483	0.421	0.483	0.918	0.421	0.516	0.843
SEM	0.149	0.152	0.133	0.152	0.29	0.133	0.163	0.266

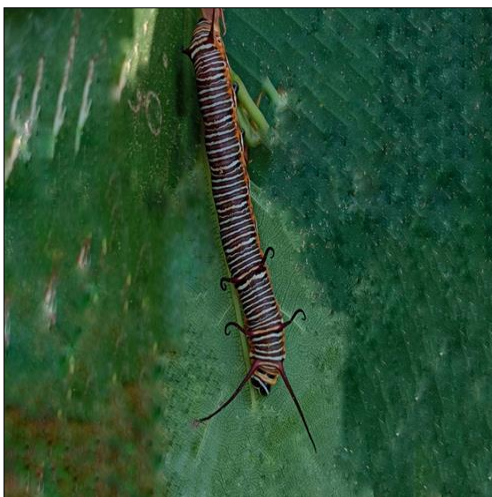


Fig 1: Lar



Fig 2: Pupa

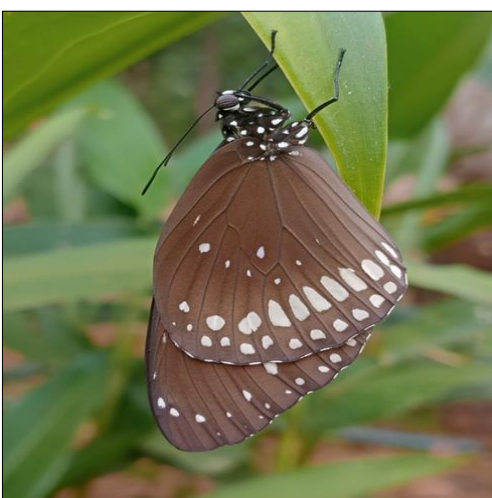


Fig 3: Adult



Fig 4: Flowers of *Plumeria rubra* L.

Plate 1 : Developing Stages and Larval food plant of *Euploea core* (Cramer, 1780)

Discussion

Our research sheds new light on the life cycle and host plant preferences of *Euploea core*, highlighting the importance of continued exploration into the intricate relationships between butterflies and their host plants (Thomas, 2005; Hanski, 2011) ^[5, 22]. Numerous studies across the Indian subcontinent have investigated the life cycle and host plant preferences of *E. core*, yielding valuable insights into its ecological adaptations and niche specialization (Kunte, 2000; Wijesekera, 1997; Robinson, 2010) ^[10, 18, 24]. For instance, research in India and Sri Lanka has revealed that *E. core* larvae exhibit a specific feeding preference for *Tylophora indica* and *Cryptolepis dubia* leaves, respectively (Kunte, 2000; Wijesekera, 1997) ^[10, 24]. More recently, Robinson (2010) ^[18] identified three host plants for *E. core* in India, including *Tylophora indica*, *Cryptolepis dubia*, and *Hemidesmus indicus*, showcasing the species' adaptability and plasticity.

Isaac Kehimkar's work (2008) ^[8] further documented *E. core* larvae feeding on *Tylophora indica* and *Cryptolepis dubia*, while Müller and Tennent (2011) ^[12] classified *E. core* as a species of least concern in the IUCN Red List. Varshney and Smetacek (2015) ^[23] included it in their comprehensive catalogue of Indian butterflies, and Kunte (2000) ^[10] documented its presence in Peninsular India. Novák (2007) ^[14] profiled *E. core* as the Common Indian Crow, and Howse *et al.* (2013) ^[7] discussed the use of insect pheromones, including those of *E. core*, in pest management strategies.

Our work contributes to a deeper understanding of the complex relationships between butterflies and their food plants, with significant implications for ecological research, conservation efforts, and habitat preservation (Thomas, 2005; Hanski, 2011) ^[11, 22]. The unique characteristics of the adult Common Crow, such as its slow and careless flight, make it a model for other species of edible butterflies to mimic, exemplifying Batesian mimicry (Bates, 1862; Wyatt, 1997) ^[1, 26]. Several species of butterflies, including the Common Mime, Malabar Raven, Common Raven, and Great Eggfly, mimic the Common Crow (*E. core*) (Moore, 1890; Wynter-Blyth, 1957) ^[11, 27].

In conclusion, our study provides new insights into the ecological adaptations of *E. core*, highlighting the need for continued research into the complex relationships between butterflies and their host plants. Further studies on the life cycle and host plant preferences of *E. core* may provide valuable insights into the ecological adaptations of this species and inform conservation strategies for threatened butterfly populations (Chaturvedi & Kumar, 2020; Smith *et al.*, 2019) ^[2, 21]. Additionally, our findings underscore the importance of preserving habitat diversity and maintaining ecological balance to support the survival and thriving of *E. core* and other butterfly species.

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