



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Study On Biology Of Butterflies (Order: Lepidoptera); Family: Papilionidae At Sanjay Gandhi Postgraduate Institute Of Medical Science, Lucknow, U.P.

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Abstract

Butterflies are one of the most admired insects because they present brilliant pattern of coloration, metamorphosis birth and striking reproduction, nutrition behaviour and death. The wide distribution of butterflies in the study site is an important element in the dynamic of this urban ecosystem. The butterflies are recognized by the scientific community as bio indicator as well as good pollinator. Regular survey was conducted from February 2023 till July 2023 during day time (7.00AM- 11.00AM). Total of 3 species of Papilionidae have been captured and seen and identified on the basis of available literature. The site Sanjay Gandhi Postgraduate Institute of Medical Science was selected on the basis of their position in vegetation and accessibility.

Keywords: Butterflies, Morphology, Diversity, species.

Introduction

Butterflies make up a large group of insects known as the order Lepidoptera in phylum Arthropod. The name from the Greek Lepido "scale" and Ptera "wings" which refers to a prominent feature of adult butterflies (the tiny scales that cover the wings). Butterflies are wonderfully diverse in shape, size and colour. They are found everywhere around the world except near the Poles. There are about 200,000 known species of Lepidoptera, of which about 10% are butterflies. Based on Wikipedia their anatomy, they are classified into six families: the Pieridae, commonly known as whites and sulphurs; the Papilionidae, or swallowtails; the Nymphalidae, including the Morphos, the owl butterfly and the long wings; the Hesperidae, or skippers; the Lybytheidae, or snout butterflies; and the small

Lycaenidae. Butterflies are good indicators of climatic conditions, seasonal and ecological changes, they can also serve in formulating strategies for conservation. However, they have largely been ignored by conservation biologists and policy makers as well. Hence butterflies play a vital role in ecosystem and co-evolutionary relationship between them and plants as well as their lives are interlinked (Ghazanfar et al., 2016).

Kunte et al. 2012, indicated that India harboured total 1504 of butterfly species which accounted 8.74% of the world's butterfly and 285 species found in southern India. The peninsular India and Western Ghats have 351 and 334 species respectively. The order represents a mega diverse radiation of almost exclusively phytophagous insects probably correlated with the great diversification of flowering plants since the Cretaceous (Menken et al., 2012). Butterflies they provide many vital economically important services within terrestrial ecosystems such as nutrients recycling, Soil formation, food resources and pollination). Pahari et al. (2018) revealed on the study of butterfly diversity in Haldia industrial zone that shows few numbers of butterfly species, less diversity and evenness indices when compared with the adjacent rural belt. And also recommend that industrialized areas are harmful places to butterflies. (Leon-Cortes et al. (2019) reported that the most diverse species of butterfly in the study area were belonging to Nymphalidae family with (31) species followed by Hesperidae (12), Pieridae (19) and Lycaenidae (16) respectively. One of the groups of animals with diverse species richness is insects which represent over 50% of terrestrial biodiversity. Butterflies unlike most of other groups of insect are popular, well documented, and easy to recognize.

Butterflies they are well adapted to the landscape and React quickly to an alteration in their habitat as a result of human-induced activities such as farmland intensification and intensive logging (Mora et al., 2011). Climatic change affects the diversity of species and is expected to exacerbate the ecosystems (Scott and Lemieux, 2005). The changes in parameters of temperature, rainfall patterns, and extreme weather conditions such as heat waves, prolonged around of excessive rainfall, have to be taken into consideration. Depletion of nectar and desiccation of host plants cause direct mortality and induce migratory behaviour. Butterflies, being exothermal, are highly sensitive to climatic variation and a short generation time which makes them an appropriate model organism to study. Vu (2009) described that forest edges have greater diversity of butterflies and more exposure to the open forest. Butterflies occupy a vital position in ecosystems and their occurrence and diversity are considered as good indicators of the health of any given terrestrial biotope (Aluri and Rao, 2002; Kunte, 2000). Butterflies and moths (order Lepidoptera) offer good opportunities for studies on population and community ecology (Pollard, 1991). Many of butterfly species are strictly seasonal and prefer only a particular set of habitats (Kunte, 1997) and they are good indicators in terms of anthropogenic disturbance and habitat quality (Kocher and Williams, 2000).

Methodology

Lucknow is capital of Uttar Pradesh and geographical position is 26.84'N latitude and 80.92'E longitude .located on elevation of 126 meters above sea level and in the plain of northern India. Lucknow has diverse weather patterns and climate change. The study site Sanjay Gandhi Postgraduate Institute of Medical Science (26.74642°N 80.93606°E) was chosen in the present study depending upon the plant diversity. The institute is situated in a 550 acres (2.2 square kilometers) campus at Raebareli Road, 15 km from the main city. The butterfly fauna was surveyed from February 2023 to July 2023. All surveys and sampling were limited to day time from 7.00 am to 11.00 am. when butterflies were more active. The butterflies were identified using the available literature. (Wynter-Blyth 1957 Kunte 2000; 2001, Makris 2003 , Varshney 2010).

Observation and Result

GRAPHIUM DOSON- THE COMMON JAY

Scientific classification

Domain **Eukaryota**

Kingdom **Animalia**

Phylum **Arthropoda**

Class **Insecta**

Order **Lepidoptera**

Family **Papilionidae**

Genus ***Graphium***

Species ***doson***

Morphology

The butterfly is characterized with wing Expanse of 70-80 mm; under surface ground colour black: both wings with a pale green semi-transparent discal band from near apex of forewing to dorsum of hindwing; this band passes through cell hindwing and broken up into spots on forewing. Both wings with a marginal series of small pale greenish spots Under surface hindwing with short red-centered costal bar near base: extreme end cell brown, not joined to dark basal bar; tailless. (Plate 1(1))

Life Cycle

Eggs: Eggs are laid singly on both the upper and under surface of young leaves.

sometimes also seen on mature leaves. Eggs are creamy white, spherical and smooth measuring about 1.0 mm in size. Colour turns yellowish on maturity and hatching takes place on the 3rd or 4th day.

First Instar Larva: The newly hatched larva feeds on the egg shell. Colour is initially yellowish and then turns dark brown as it starts feeding. Thorax with three pairs of large, equal sized dorso-lateral spines. Dorsal surface of body flat with dorso-lateral tubercles beset with long setae. Body outline squarish and more or less uniform in Width. Anal segment with a pair of white spines.

The instar feeds by scratching the surface of leaves. Within 3 days attains a length of about 5.5 mm before moulting into second instar. Table.1

Second Instar Larva: Length about 6.5 mm at moulting. Body shape distinct from first instar, with enlarged and swollen thorax. Dark brown and somewhat cylindrical. Abdominal setae are wanting but all the three pairs of thoracic spines of relatively shorter length are present. Anal spines shorter and shining Silver with blackish tinge. Feeds on margins of young leaves. After two days length is 10 mm and ventro-lateral sides of body with white streaks. On fourth day body length increased upto 12 mm and moulting takes place. Table.1

Third Instar Larva: Body length 13 mm. skin rubbery soft and colour similar to second instar. Thoracic spines or freshly moulted third instar are translucent shining yellowish and become deep black when full grown. Anal spines connected by a white bar at base. Spiracles initially without visible rings but black ringed in full grown third instar. Full grown third Instar is somewhat greenish brown with metathoracic spines ringed black at base. Osmeterium exit visible as a white streak on second day. Feeds voraciously on leaves. On disturbance reluctantly protrudes yellowish-green camphor smelling osmeterium from prothoracic pocket. On third day body length is about 26 mm and it moults into fourth Instar. Table.1

Fourth Instar Larva: Moulting takes 25 minutes. Body is yellowish brown to soft greenish including the anal segment and spines. Anal spines outwardly black streaked. Metathoracic spines with shining purple sheen and encircled at base with black rings having green inner region. Prothoracic spines interconnected by a black streak. Osmeterium horn like yellowish green fluid filled sac about 5 mm with well-marked transverse slit like opening at base of prothoracic spines. Spiracles shining white and prominently black ringed. Abdominal legs pale green. It lasts for 3-4 days attaining a length of 33 mm before moulting. Table.1

Fifth instar larva: Resembles with fourth instar. Body is darker green or yellowish brown. Metathoracic spines encircled at base with black rings having bicoloured yellowish orange inner region. This stage lasts for 4-5 days and the instar is about 34 mm in length. Towards the end of this stage, the body becomes pale green, shortens in length, black lines on anal setae disappear, spiracles change to mere white streaks, larva stops feeding, searches for a pupation site and ultimately stops hanging downwards. Table.1.

Pupa: Pupation occurs after a day or so. Mouth of the fifth instar is discarded by a longitudinal split developed in the head and thorax region. Cremaster is positioned after second abdominal segment. Pupa is pale green and about

28 mm. There are two dorsal carinae on abdomen. a mesothoracic horn and two small cephalic horns. In summer months, pupal stage generally lasts for 10-15 days but may last for 15 days for pupation occurred during third week of October. Before emergence of the adult, the wing pattern becomes visible through the pupal skin.

Adult: After pupa adult occurs after a day or so. Adult is characterized with wing Expanse of 70-80 mm; under surface ground colour black: both wings with a pale green semi-transparent discal band from near apex of forewing to dorsum of hindwing; this band passes through cell hindwing and broken up into spots on forewing. Both wings with a marginal series of small pale greenish spots Under surface hindwing with short red-centered costal bar near base: extreme end cell brown, not joined to dark basal bar; tailless.

PAPILIO DEMOLEUS -Lime Butterfly

SCIENTIFIC CLASSIFICATION

Domain:

Eukaryota

Kingdom:

Animalia

Phylum:

Arthropoda

Class:

Insecta

Order:

Lepidoptera

Family:

Papilionidae

Genus:

Papilio

Species:

demoleus

Morphology

Adult butterflies were large and beautiful with wide wing spread. Its head and thorax were black with creamy yellow streaks on each side. Antennae were dark reddish brown, touched with ochraceous on the inner side towards the club.

The legs and abdomen were dusky black, with creamy yellow colouration on the underside of the abdomen and the body was covered with black and yellow hairs. (plate 7) The wings were dull black, ornamented with yellow markings. Upperside of wings had the ground colour black.

The fore wings were black. At the outer edge there was a chain of yellow spots. Next to the body there were four chains of little yellow spots. There were some other yellow spots at the rest of the wing. Post-discal mark were absent on the upperside of forewing. The underside of *P. demoleus* was very similar to the upperside. Next to the body there were four yellow lines.

The hind wings of *P. demoleus* were black. The edge was wavy. Next to the body the wing was spotted by yellow scales. The wing was dominated by a broad, yellow band. At the outer edge there were five yellow spots. The underside was similar to the upperside. But all yellow marks were bigger than the marks on the upper side. Next to the body there was an yellow area with black lines. Hind wings had a black costal eyespot near apex that gradually

spreads over the blue scales and shaved as crescent. normal spot on over hind were orange with little blue scale in male and partial orange with more blue scale in female.(plate 1- 2)

Life Cycle

Egg: Fertilised adult female laid eggs singly, mostly on the under surface of tender leaves and also on tender twigs by curling its abdomen. Freshly laid eggs were creamy yellow, flattened at the base. smooth and spherical in outline..Before hatching the eggs turned to greyish colour with brown streaks all over the chorion. The eggs on an average measured 0.99 mm in diameter on host plant. Incubation period varied from 2.77-2.98 days with an average of 2.87 days on acid lime.

Larval stage

First instar larva: The newly hatched caterpillars were less spiny cylindrical in shape light brown to brownish black with dirty white marking on the dorsal side of the abdomen and resembled the bird droppings in appearance. Its thoracic region is broader than the rest of the body. The mean body length and width of newly hatched caterpillars were 2.30 and 0.40 mm respectively on acid lime. Mean body length, width and width of head capsule of first instar larvae were 0.64 and 1.5 mm respectively on acid lime. The duration of first instar larvae lasted from 2-3 days on acid lime. Table.2.

Second instar larva: The second instar larvae were less spiny and dark brown in colour with a dirty white line present obliquely along lateral sides of the abdomen with a break on the dorsal side. The mean body length, width and head capsule width of second instar larvae were 0.85 and 2.6 mm respectively on acid lime. The duration of second instar larvae ranged from 3-4 days on acid lime. Table.2.

Third instar larva: The third Instar larvae resembled the second instar larvae in general appearance and colouration except in size. Mean body length. with and head capsule width of third instar larvae were 1.4-3.7 mm respectively on acid lime. The duration of third instar larva varied from 3.98-4.02 days with an average of 4.00 days on acid lime. Table.2.

Fourth instar larva: The fourth instar larvae were almost black in colour with a little greenish tinge. Whitish bands were seen on meso and meta thoracic segments laterally anterior part of the abdomen and on the last anal segments. It had two red coloured sacs or osmeteria opening in the first thoracic segment dorsally at the anterior position. When disturbed. the osmeteria were pushed out from the anterior part of the prothorax that was bifid or forked in structure. It

emits foul smelling material which is defensive in function. The mean body length, width and head capsule width of fourth instar larvae were 25 00 5 6 and 2 50 mm respectively on acid lime. he duration or fourth instar larvae were 3 17-3 33 days with an average of 3.25 days on acid lime. Table.2.

Fifth instar larva: Fifth instar larvae were entirely different from the previous four instars in all aspects. they were yellowish green or green in colour. The fifth instar larva had characteristic brownish stripes on each of the eighth and ninth sternites with two semi-circular yellowish bands on the elevated portion of the body. Head is pale green in colour Two eye like spots were present on the second thoracic segment. A horn like structure was found on the

dorsal side of the last body segment. The mean body length, width and head capsule width of fifth instar larvae were 40.76, 6.75, and 3.55 mm on acid lime. The duration of fifth instar larvae were 3.96-4.09 days with an average of 4.025 days. The prolegs will grasp onto the leaf and chew from the edge onwards with the help of its pairs of thoracic legs. Table.2.

Pre pupal stage: The mean length and width of pre pupa were 27 and 7.625 mm and duration of pre pupa varied from 1.02 to 1.06 days with an average of 1.04 days on acid lime.

Pupa: When the caterpillar is ready to pupate, it would orient itself to the wall with its head facing upwards and expelling its waste from the system. A network of silk pad span onto the surface and attached its body to the silk girdle for extra support. Then the body of the caterpillar became shorten in length gradually forming a hunch. After a day. The body gets hardened into a chrysalis. forming a hard pupa with a pair of anterior horns and bent away from the support.

The pupa was variable in colour from green, straw to brown There were numerous small black markings on the body. The pupa was initially green in colour and at the time of adult emergence it turns to brown colour. At the end, the pupal stage case was clearly seen. After the pupal stage. The butterfly underwent eclosion or emerged from its pupa. A slit was opened at the anterior portion of the chrysalis. The butterfly wiggled from the chrysalis and pushed itself away from the wall to free its 2 front legs. After achieving that, it climbed out into the silk pad or branch to dry its wings. It slowly expands and to dry its wings before fluttering off to feed. The mean length and width of pupa were 29.7 and 9.5 mm and duration of pupa varied from 8.82 to 9.20 days with an average of 9.01 days on acid lime.

Adult: The fully developed butterfly inside the pupal case emerged out by splitting the case dorsally. Newly emerged adult butterflies were round to possess weak wings hence, were unable to fly in 1-3 h. Later they started to fly. Adult butterflies were large and beautiful with wide wing spread. Its head and thorax were black with creamy yellow streaks on each side. Antennae were dark reddish brown, touched with ochraceous on the inner side towards the club. The legs and abdomen were dusky black, with creamy yellow colouration on the underside of the abdomen and the body was covered with black and yellow hairs. The wings were dull black, ornamented with yellow markings. Upperside of wings had the ground colour black. The forewings were black. At the outer edge there was a chain of yellow spots. Next to the body there were four chains of little yellow spots. There were some other yellow spots at the rest of the wing. Post-discal mark were absent on the upperside of forewing. The underside of *P. demoleus* was very similar to the under side. Next to the body there were four yellow lines.

PAPILIO POLYTES : THE COMMON MORMON

Scientific Classification

Domain	Eukaryota
Kingdom	Anamalia
Phylum	Arthropoda
Class	Insecta
Order	Lepidoptera
Family	Papilionidae
Genus	<i>Papilio</i>
Species	<i>polytes</i>

Morphology

The male and female are morphologically distinct. Both are in black and tailed. The head was with white marking. The upper forewing was with terminal series of white spots decreasing in size towards the apex. In the male, a complete discal band of elongate white spots is present. Female exhibits polymorphism and there are three forms on record in India: these include *Papilio polytes* form *stichius*, *P. polytes* form *cyrus* and *P. polytes* form *Romulus* (Winter Bylth, 1957). Only the former was distributed in this part of the globe. It was larger than male and it mimics *Pachlioptaaristolochia*. The upper forewing marking is with Red Crescent and termen with red spots. The adults are in flight throughout the year, with the population peaking in October. They forage on such plants as *Duranta repens* with violet flowers *Eupatorium triplinerve*, *premnalatifolia*, *Clerodendron phlomis* with white flowers, *antigonon leptopus* with pink flowers, *caesalpinia coriaria* with yellow flowers and *Lantana camara* with orange flowers. (Plate- 1(3))

Life Cycle

Egg: Eggs are spherical, smooth, cream-colored and measure 1.8 to 2.1 mm (2.0 mm ± 0.12) wide and 0.9 to 1.2 mm (1 mm ± 0.1). An egg hatches three days after laying. Its colour becomes dull just before hatching.

Larva:

First Instar: This instar completes for 2 - 3 days. On the first day, the larva was 1.8 to 2.1 mm (2.0 mm ± 0.11) long and by the second day it grows up to 4.8 to 5.8 mm (5 mm ± 0.55). Head was round, brown, smooth and measures 0.5 to 0.7 mm (0.5 mm ± 0.07) in diameter. The body was a pale brown. Tufts of setae are located at the thorax and also at an anal region. These setae disappear after the first molt. Table.3.

Second Instar: This lasted for 3 to 4 days, grows up to 10 to 12 mm (10 mm ± 1.0) in length; head measures 1.5 to 1.7 mm (1.5 mm ± 0.1) in diameter. The body was rough, snuff-coloured with white marking at the abdomen

and anal regions on a dorsal profile. The thorax becomes stout. On the lateral sides of both head and anal regions, 2 spines develop. Table.3.

Third instar: This instar lasts for 3 to 4 days, grows up to 20 to 22 mm ($20 \text{ mm} \pm 1.0$) in length and 3 to 5 mm ($4 \text{ mm} \pm 1.0$) in width, with head 1.9 to 2.2 mm ($2.0 \text{ mm} + 0.1$) in diameter. The body was rough, snuff-coloured with white marking on the dorsal profile of the abdomen and anal region. Table.3.

Fourth instar: this stage also lasts for 3 to 4 days and grows up to 27 to 29 mm ($27 \text{ mm} \pm 1.1$) in length and 5.5 to 6.5 mm ($6 \text{ mm} + 0.4$) width, with head 2.6 to 3.6 mm ($3 \text{ mm} + 0.3$) wide and 2.5 to 3.5 mm ($3 \text{ mm} + 0.2$) long. The ventral profile of the body was brown and the dorsal profile was green with 2 brown and the dorsal profile was green with 2 brown horizontal bands on the thorax and 2 lateral brown bands and 2 brown spots below them on the abdomen, and a horizontal brown band at the anal region. Segmentation of the body was clear with 13 segments with 3 pairs of legs colored brown, 4 pairs of prolegs (abdomen) and 1 pair of claspers. Table.3.

Fifth instar: Fully grown larva measures 40 to 42 mm ($40 \text{ mm} \pm 1.2$) in length and 7 to 9 mm ($8 \text{ mm} + 1.1$) in width; it lasts for 3 to 4 days. Head was 3 to 4 mm ($3.5 \text{ mm} + 0.3$) wide and 3.5 to 4.5 mm ($4 \text{ mm} + 0.5$) long. The body of the dorsal profile becomes dark green and much smooth. Bands and other characters are similar to 4th instar. Table.3.

Pre- pupa: The body of the larva shortens by contraction and measures 31 to 33 mm ($32 \text{ mm} + 1.0$) in length, then it attaches to the substratum.

Pupa: This stage lasts for 10 to 11 days. The pupa was 29 to 31 mm ($30 \text{ mm} \pm 1.2$) long, 12 to 14 mm ($13 \text{ mm} \pm 1.4$) wide at the pupa was V-Shaped. The posterior end was pointed, attached to the substratum. The dorsal side of the pupa was dome-shaped and the ventral surface was indented. The pupae may be dimorphic, the color being either snuff or green; the green color was rare. The time taken for the development from the egg stage to the adult was 28 to 34 days.

The first diet of the first instar was egg shell from which it becomes out. From the second day of its life. It feeds on the leaves on which it develops. It stops feeding at the end of fifth instars.

Plate 1

1 *Graphium Doson*

(Family:Papilionidae)



2 *Papilio Demoleus*

(Family:Papilionidae)



3 *Papilio Polytes*

(Family:Papilionidae)



Table- 1. Morphometry of Instars in *Graphium doson*

Instar	Duration(Days)	Length (mm)	Head diam.	Body colour
1	2-3	4.8-5.8	0.5 - 0.7	yellowish
2	3-4	6.5-12	1.5-1.7	dark brown
3	3-4	13-26	1.9-2.2	dark brown
4	3-4	27-29	2.6 - 3.6	yellowish brown to soft greenish
5	3-4	33-35	4-5	Dark green

Table 2. Morphometry of Instars in *Papilio demoleus*

Instar	Duration(Days)	Length (mm)	Head diam.	Body colour
1	2-3	4.8	0.5 - 0.7	yellowish black
2	3-4	7	1.5-1.7	dark brown
3	3-4	10.5	1.9-2.2	dark brown
4	3-4	25	2.6 - 3.6	black
5	3-4	33-39	4-5	green

Table- 3.Morphometry of Instars in *Papilio Polytes*

Instar	Duration(Days)	Length (mm)	Head diam.	Body colour
1	2-3	4.8-5.8	0.5 - 0.7	Pale brown
2	3-4	10-12	1.5-1.7	Snuff
3	3-4	20-22	1.9-2.2	Snuff
4	3-4	27-29	2.6 - 3.6	Ventral brown Dorsal green
5	3-4	40-42	4-5	Dark green

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