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Life Cycle Assessment in two Lepidopterans, *Ariadne merione* (Common Castor Butterfly) and *Achaea janata* (Castor Semilooper Moth)

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Abstract: At various phases of their lives, *Ariadne merione* (the common castor butterfly) and *Achaea janata* (Castor semilooper moth) were studied (Egg, Larva, Pupa, Adult). The study was performed in the year 2019. Both kinds of lepidopterans were recovered at egg and larval stages from *Ricinus communis* (the castor plant). The eggs were laid in a cluster beneath the host plant's leaves. During the investigation, the captured larva was fed fresh castor leaves, and the various stages of its life cycle (egg, larva, pupa, and adult) were seen, recognized, and reported. The goal of the study was to monitor the dramatic changes in the common castor butterfly and castor Semilooper moth's life cycles, as well as to investigate the entire description of the adults, eggs, larvae, and pupae. *Ariadne merione* blooms from March to May, whereas *Achaea janata* blooms from August to September. The castor Semilooper moth takes 48 to 50 days to complete its life cycle from egg to adult, while the common castor butterfly took 22-32 days.

Index terms: Castor plant, Lepidoptera, Life cycle, *Ariadne merione, Achaea janata.*

1. INTRODUCTION

Insects belong to the class Hexapoda or Insecta, which is the largest division of the Phylum Arthropoda. Insects have a segmented body, jointed legs, and an exoskeleton on the outside. All of the systemic functional organs are located in the head, segmented thorax, and abdomen, which make up the three major parts of insect biology (Brown, 1983). The eyes, antennae, and mouthparts are on the head, while the segmented thorax has three pairs of legs and two pairs of wings. Ametabolous, hemimetabolous, and holometabolous metamorphosis are the three types of metamorphosis seen in insects (Headstrom, 1982). The life cycle of insects differs from one species to the next. Gradual and complete metamorphosis are the two most common lifecycle patterns. The life cycle is significant in insect management because, depending on the type of life cycle, the habitat, habits, and appearance of an insect can change dramatically over time (Lund, 1977).

Insects that go through a gradual metamorphosis go through three phases of development: egg, nymph, and adult. The nymph stage is quite similar to the adult stage, and both phases of insects live in comparable habitats, have similar habits, and eat similar foods. In general, targeting juvenile and adult stages of insects with slow metamorphosis does not necessitate separate methods. Insects that go through a complete metamorphosis go through four phases of development: egg, larva, pupa, and adult (Papp, 1968). Adults and larvae have radically distinct appearances, live in various environments, and have different habits and eat different foods. The pupal stage does not normally crawl or feed, and depending on the species, it may be resistant to various management techniques. Targeting juvenile and adult stages of insects with complete metamorphosis may necessitate distinct strategies (Singh, 1977). All insects begin their lives as eggs. Some eggs require sperm fertilization and mating to mature. Through a process known as parthenogenesis, females and other insects such as ants, bees, and wasps can generate female progeny without the need for fertilization. Insects must shed their exoskeleton, or outer skin, at some point throughout their life cycle, which is designated as moulting (Singh and Moore, 1985). Insects is declared as part of the kingdom Animalia in accordance with the hierarchy of scientific categorization system (Silverly, 1962) in the name of Arthropods meaning jointed legs. Among the several phyla under the Arthropods, Insecta is an exclusive class with an expansive range of insects under them. Phylum Arthropoda is further divided into distinct classes, with the class comprising of insects being designated Hexapoda, so named because every species in it has six legs. Coleoptera (beetles and weevils), Blattodea (cockroaches and termites), Diptera (flies, gnats, midges, and mosquitoes), Ephermeroptera (May flies), Hymenoptera (ants, bees, and wasps), Lepidoptera (butterflies and moths), Mantodea (mantises), Odonata (damselflies and dragonflies), orthroptera (fleas). Each order is broken down further into families, genera, and species. (Stokes, 1983).

1.1. Study on Life cycle of butterflies and moths

Place the females in paper bags for oviposition after the males and females have mated. Some species attach their eggs to the interior of the bag, while others drop them to the bottom of the sack (Stone and Mid-winter, 1975). Remove the eggs from the sack once they've been laid and place them in groups of 20 in separate hatching containers. Cut the sack around the eggs if they are stuck to it, then insert the paper discs in the hatching containers (Anonymous, 1982). Place some leaves of the suitable food plant in the container once the eggs have hatched. Make sure the leaves you're using haven't been pesticide-treated! A screen or cheesecloth cover should be placed over your container to prevent escape while yet allowing ample ventilation (Telulksky, 1985). Moisture will build up if you employ an airtight cover, and the leaves and larvae may mould. Maintain a steady supply of fresh leaves once the larvae begin to feed. Frequently remove any uneaten or dry leaves (Dickerson, 1979), It may be necessary to shift the larvae to a larger container or cages if they get large or if you have many larvae. To keep food plants fresher for longer, store them in bottles of water. If you want your raising efforts to succeed, make sure the food is fresh, the container is clean and uncrowded, and there is plenty of ventilation (Mayer, 1979). Once the larvae have begun to spin cocoons or form chrysalises, do not disturb them. At this time, you must establish whether the species you're raising hibernates (overwinters) while in the pupal stages (Willard, 1975). This will determine whether the adults emerge in a week or two, or if the pupae (cocoons) must be subjected to low temperatures first. Pupae (cocoons) can be kept in any secure location that is exposed to cold temperatures. A brief "artificial" winter will have an impact on many species (Zweifel, 1961) Place the cocoons in a jar with a single green leaf and keep it in the refrigerator for 8 to 12 weeks. Remove the cocoons from the refrigerator and, if possible, allow them to warm up gradually. Then place them in a cheesecloth or screening-lined rearing cage. Do not disturb the emerging adults until their wings have fully expanded and hardened, which takes around 24 to 48 hours (Wilcox, 1972). Sphinx moths, for example, pupate underground. The larvae should be relocated to a container with several inches of peat moss in the bottom after their last moult. The mature larvae will burrow into the moss and can be left there until they are ready to emerge on their own (Wood, 1979).

1.2. Types of Metamorphosis

Metamorphosis is the term describing the transformation that insects go through as they grow. Simple (or progressive) metamorphosis, intermediate metamorphosis, and complete metamorphosis are the three stages of metamorphosis.

1.2.1. Simple (or Gradual) metamorphosis

The young insects, commonly referred to as nymphs, resemble adults but lack wings. On nymphs, wings are reduced wing buds, and only the adult has full-sized wings. Nymphs and adults tend to share the same environment and eat the same types of plants. Grasshoppers and crickets, mantids, true bugs, leafhoppers, and aphids are examples of insect groups that undergo this transformation.

1.2.2. Intermediate metamorphosis

Some insects go through a stage of metamorphosis that is halfway between gradual and complete. Whiteflies, scales, and thrips are examples of insect groups that undergo this type of metamorphosis.

1.2.3. Complete metamorphosis

Immature and adult versions have radically distinct appearances, and they frequently reside in various habitats and eat different food plants. Larvae are the early larval stages that look like worms. Chewing mouthparts are common in larvae. The insect turns into the pupal stage after the last larval stage. Pupae are frequently protected by a cocoon or other protective construction, such as a clay chamber. At the end of the pupal stage, the final moult occurs. Adulthood is the final stage of life. Lacewings, beetles, flies, butterflies and moths, ants, wasps, and bees are examples of insect groups that undergo complete metamorphosis. Moths and butterflies have larval stages that are known as caterpillars. Beetle larvae are commonly referred to as grubs, and fly larvae are commonly referred to as maggots.

1.3. Castor-oil plant (*Ricinus communis)*

Castor-oil plant (*Ricinus communis),* often known as castor bean, is a big plant in the spurge family (Euphorbiaceae) that grows in disturbed places such as river bottoms and road sides, as well as fallow fields on the outskirts of cultivated lands. Farmers in southern and western India grow a lot of this non-edible oil seed crop. Castor butterfly is one of the yield limiting factors in West Bengal (Gosh, 1914; Srivastava *et al.*, 1972; and Kausale *et al.*, 1979), and it has recently become a significant pest in India (Gosh, 1914; Srivastava *et al.*, 1972; and Kausale *et al.*, 1979). (Singhal, 1980). It reproduces using a mixed pollination system that favours geitonogamy but can also be an out-crosser via anemophily (wind pollination) or entomophily (insect pollination) (insect pollination). The principal host plant is Castor. Castor butterflies are known for soaring gently through the air as though gliding through the air among castor plants in dense foliage (Anubala *et al.*, 2014). Eri silkmoth and the Castor Semi-Looper moth both use it as a host plant. The larvae of the common castor butterfly feed on stinging nettles, *Tragia involucrate* and *T. plukenetti* (Euphorbiaceae), as well as the castor seed plant, *Ricinus communis* (Nayar *et al.*, 1976 & Kunte 2000) The common castor butterfly, *Ariadne merione*, is an orange butterfly with brown lines whose larvae eat castor almost entirely. Castor, pomegranate, rose, xixyphus, euphorbia, Tridax citrus, and mango are all susceptible to this pest. The castor seed plant, *Ricinus communis*, is a particular pest of the common castor butterfly (Nayar *et al.*, 1976) by feeding gregariously and voraciously on the mid rib and vein of the leaves, the larvae defoliates very fast. The size of the species has a direct relationship with the host's harm. Young plants are unable to withstand injury and will eventually die. Adults are fruit-eating moths who like to drink the juice from their hosts. The pest is found throughout the Indian subcontinent, as well as Thailand, Malaysia, the Philippines, and Indonesia. The castor semiloopers or croton caterpillar, *Achaea janata*, is an erebid moth whose larvae are known as semiloopers due to their style of mobility. Castor, rose, pomegranate, tea, citrus, mango, and *Cadiospermum helicacabum* are all susceptible to this pest.

Both the caterpillar and the adult moth are responsible for the harm. Newly born larvae feed indiscriminately, scraping the chlorophyll, and spread quickly. Except for petioles and branches, intense feeding causes damage to the entire plant. Caterpillars munch on the leaves and destroy the crop completely. The effectiveness of reproduction is influenced by one's lifestyle and feeding habits (Boggs, 1981; Slansky & Scriber, 1985; and Muthukrishnan & Pandian, 1987). The castor semilooper, *Achaea janata*, is a major defoliator and a devastating pest in most of the country's castor-growing areas (M. Prabhakar and Y.G Prasad, 2005). In August, September, and October, the infestation is at its peak. Rainfall appears to be the most essential element in *A. merione* Cramer's greater reproduction rates. In India, Pakistan, Sri Lanka, Thailand, Laos, Malaysia, and the Philippines, *A. janata* is found. It takes place from July through September.

2. MATERIALS AND METHODS

2.1. Materials

Castor semilooper moth (egg and larvae), common castor butterfly (egg and larvae), collecting jar, castor leaves, sterilized forceps, feeding tray, Leaves of Castor plant (Host plant for *A. merione* and *A. janata*).

2.2. Site of sampling

The species were collected in Ethiraj salai, Egmore, Chennai, Tamil Nadu, India, at *13.0651141* (Latitude) and *80.2578566* (Altitude) (Janaki Bai Atluri *et al.*, 2010). The two pest species were obtained from the castor plant, and because they are a significant pest of the castor plant, their availability is quite likely (figure 1).

Figure 1. sampling site

2.3. Methodology

Using sterilized forceps, the egg and larval stages of the common castor butterfly and castor semi looper (moth) were gathered and placed to a decontaminated container (K Roy and AK Mukhopadhyay, 2002). Fresh eggs were gathered to study both species of lepidopterans (castor semilooper moth and common castor butterfly) throughout their whole life cycle (Janaki Bai Atluri *et al.*, 2010).

Figure 2: feeding tray

The larval sample is then transferred to a feeding plate (Fig 2), which is kept at room temperature and adequately aerated (Rode *et al.*, 2015). Castor leaves taken from the research area are overflowing the feeding trays. The larvae are allowed to eat as much as they like, and the subsequent instars are photographed and examined. Fully grown larvae were permitted to pupate inside the rearing cages after they reached maturity. Incubation, larval, and pupal phase observations were analyzed and recorded at regular intervals.

2.4. Life Cycle Stages in *Ariadne merione*

A

B

C

D

A - Larval stage (Instar I) of *Ariadne merione*
B - Larval stage (Instae IV) of *Ariadne merione*
C - Pupal Stage of *Ariadne merione*
D* - Adult stage of *Ariadne merione

2.5. Life Cycle Stages in *Achaea janata*


E **F**


G H

E - Larval stage of *Achaea janata*
F **- Feeding behaviour of *Achaea janata***
G - Pupal stage of *Achaea janata*
H - Adult stage of *Achaea janata*

3. RESULTS

3.1. *Ariadne merione* (Common Castor Butterfly)

Taxonomic classification

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Nymphalidae

Genus: *Ariadne*

Species: *A. merione*

3.1.1. Life Cycle of *Ariadne merione*

The common castor butterfly, *Ariadne merione is* a reddish orange butterfly with black wavy lines on its wings. This butterfly species goes through a complete metamorphosis, therefore there are four stages in its life cycle: egg, larva, pupa, and adult. From egg to adult, the life cycle can take 22-32 days. Figure 3 depicts the life cycle and its stages.

3.1.1.1. Egg

Eggs were spherical, with a diameter of 1-1.5mm and a height of 1.0 to 2.0 mm. The colour of the egg changes from white to brown (during oviposition) (during hatching). The texture of the egg shifts from soft to hairy. The maximum incubation period of an egg is 3-4 days during the pre-monsoon season (May to June), while the shortest incubation period is 2-3 days during the post-monsoon season (July to August) (Oct to Nov). My research was conducted in September; thus, the egg stage can take up to 2-3 days.

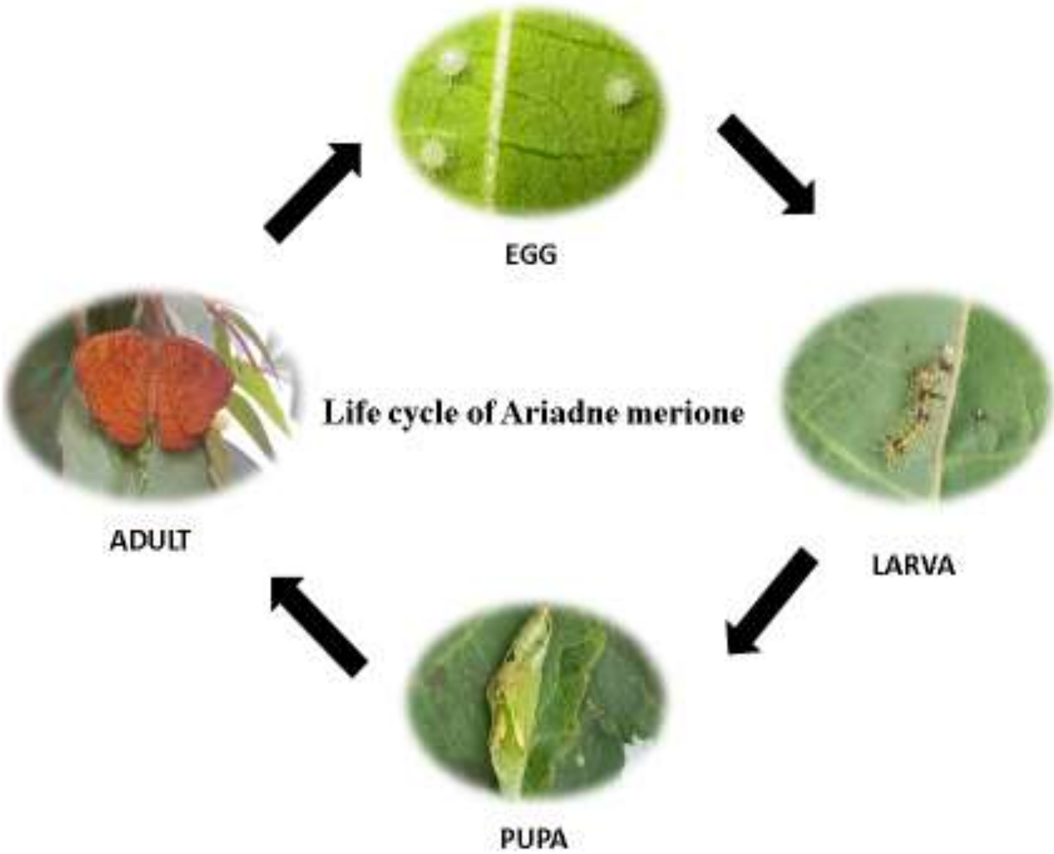


Figure 3: life cycle of Ariadne merione

3.1.1.2. Larva

Castor leaves were vigorously fed to the larvae, and five instars of the larval stage were discovered, with a time span of 13 to 18 days.

Instar I: The larvae feed on empty egg shells and the epidermis of leaflets immediately after emerging. Larvae are cream-colored when they first hatch, then turn brownish green with three brown-colored horizontal bands on the dorsal side. This stage lasts 3-4 days for the larvae.

Instar II: It has whitish green spines with branching tips. Brown horns protruded from the top of the head. The average length of the larvae was 6-8 mm, and the instar phase lasted 3-4 days.

Instar III: The heads grow larger, the legs become apparent, the body colour changes dramatically to brownish green, and the larvae grow to be about 8-16mm long. This period lasts around 3-4 days.

Instar IV: The body turns green, and the body is segmented. This stage lasts around 2-3 days and the larvae are roughly 17-26mm in length.

Instar V: The larvae have matured to the point that their bodies are clearly segmented. It's roughly 27-40mm long and lasts for about 3-5 days.

3.1.1.3. Pupa

Before approaching the pupal stage, the fifth instar larvae stop feeding and become lethargic. This stage is known as the pre pupal stage, and it lasts for 8-10 hours before the pupa is created. The larvae's body contracted, and it clung to the substratum with its posterior ends dangling downwards. The pupa weighs around 202.3 mg at this stage. The pupal stage lasts approximately 5-7 days.

3.1.1.4. Adult

The adult emerges from the pupal case after this stage by tearing the pupal case open. Both sexes (male and female) were nearly identical, with the exception of their reddish brown wings with black wavy lines. Mating occurs in the middle of the day, usually between 1100 and 1500 hour, and lasts for more than an hour. The stages of development and the incubation time are listed below (Table 1).

Table 1: Stages of life cycle in *Ariadne merione*

Developmental stages		Incubation period			
		Pre-monsoon (may to june)	Mean Days (d)	Post-monsoon (Oct-Nov)	Mean Days (d)
Egg stage		3-4 days	3.5 d	2-3 days	2.5 d
Larval stage	Instar I	2-3 days	2.5 d	3-4 days	3.5 d
	Instar II	2-3 days	2.5 d	3-4 days	3.5 d
	Instar III	3-4 days	3.5 d	2-4 days	3.0 d
	Instar IV	2-4 days	3.0 d	2-3 days	2.5 d
	Instar V	2-3 days	2.5 d	3-5 days	4.0 d
	Total larval period	11-17 days	14.0 d	13-20 days	16.5 d
Pupal stage		6-7 days	6.5 d	7-11 days	9.0 d
Total life cycle period		20-28 days	24.0 d	22-32 days	27.0 d

Graph 1: Life cycle of *Ariadne merione*

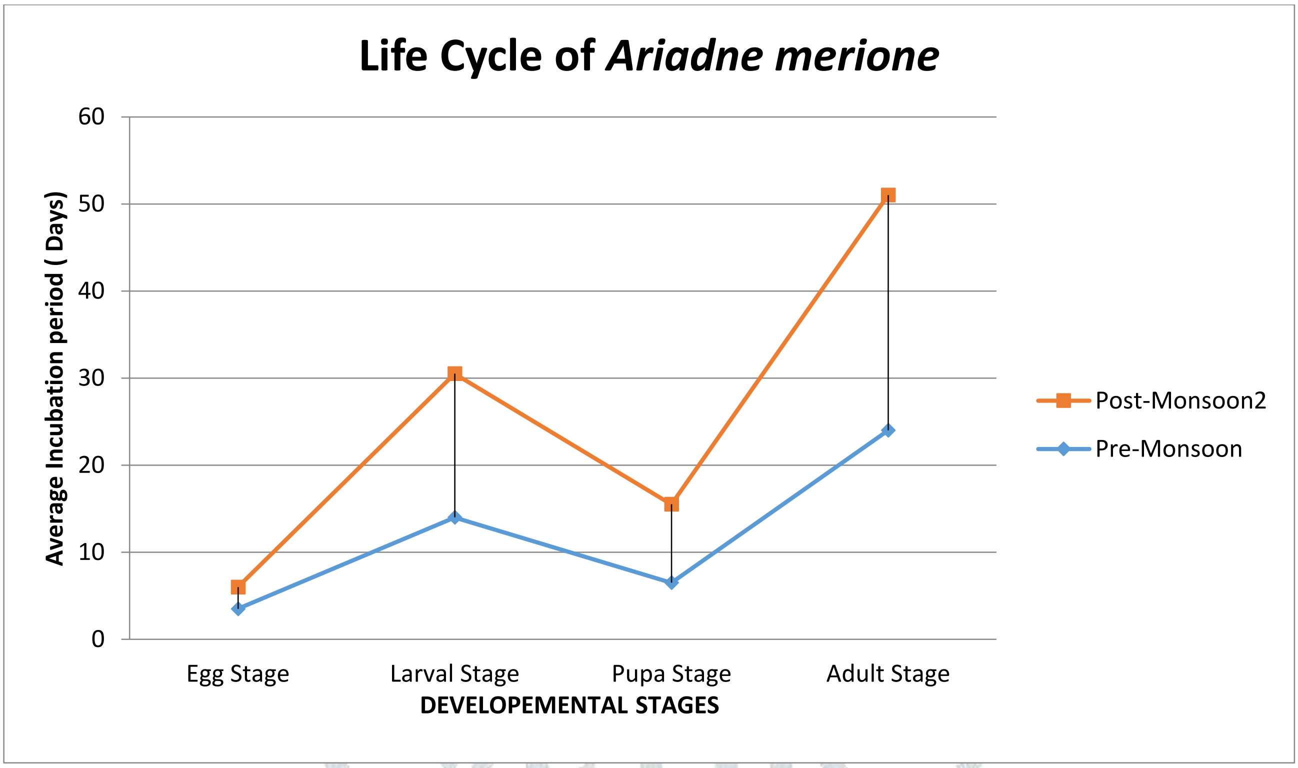
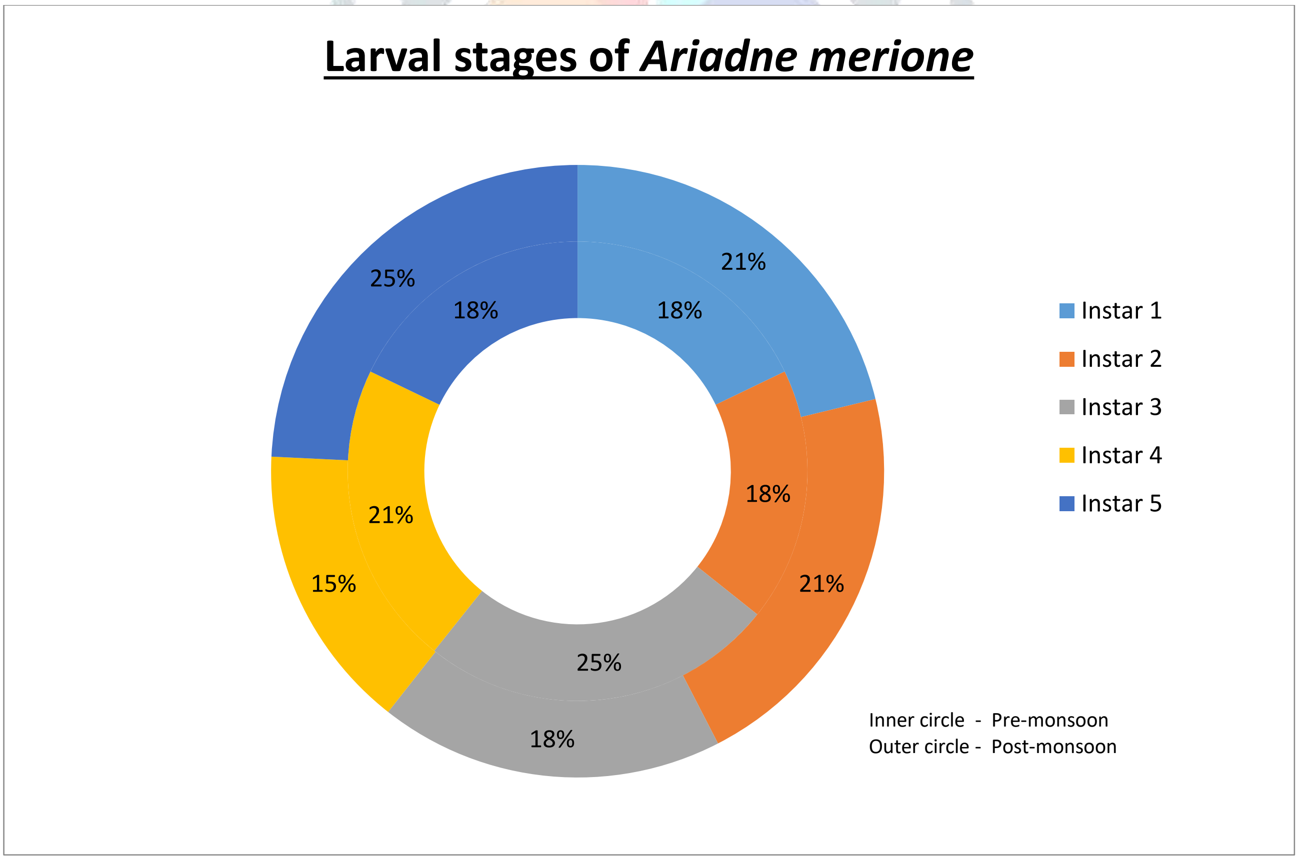


Chart 1: Larval Stages of *Ariadne merione*



3.2. *Achaea janata* (Castor Semilooper)

Taxonomic position

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Erebidae

Genus: Achaea

Species: *A. janata*

3.2.1. Life Cycle of *Achaea janata*

A. janata, also known as the castor semilooper or croton caterpillar, is an erebid greyish brown moth that goes through a complete metamorphosis and has four life stages: egg, larva, pupa, and adult. Its life cycle takes 40-48 days to finish. Figure 4 depicts the life cycle and its stages.

3.2.1.1. Egg

During the night, the moth (female) lays roughly 450 greenish blue spherical eggs on the castor plant's leaves. 4-6 eggs were found in each leaf. The eggs are spherical and blue green in colour, and they are normally placed on the underside of the leaves. The egg has a diameter of 0.9mm. This stage lasts between 2 and 5 days (July to September) There are several ridges and furrows in the chorion. The egg is concave on the bottom and concave on the top.

Figure 4. Life cycle of Achaea janata

3.2.1.2. Larva

The newly hatched larva measures 3.5mm long and are yellowish green in colour with a light brown head and thorax. The fully grown larvae are dull greyish brown in colour with a black head, reddish patches on the back, and a reddish anal tubercle, measuring 60 to 70 mm in length. The missing legs in the median segment cause the looping action. The young larvae hatch and go through five instars. The larval period takes about 14 to 16 days in the months of July, august and September.

Instar I: The newly emerging larvae's head capsule is slightly brownish in colour, and the larva measures 4mm. This stage lasts two days.

Instar II: Head capsule is black with a few white patches in instar 2. This stage's semiloopers have a wider range of colour variation. It is roughly 7mm in length. This phase lasts two days.

Instar III: Colours range from brown to black in Instar 3. The larvae are around 48mm long, with a bright red yip on the anal tubercles. This phase lasts two days.

Instar IV: The larvae are around 63.5mm long. This is a 2-3-day period.

Instar V: This stage lasts for two days. The caterpillar has reached the pupal stage.

Instar VI: Now the larva is ready to step in to pupal stages. This stage lasts around 4 days.

3.2.1.3. Pupa

The pre-pupal stage lasts for about 2-3 days. After covering its body with leaves and other materials, the larva develops a silken cocoon. After 18-36 hours, the pupa develops an ashy coating. Pupation takes place in the soil or on the plant's folden leaves. The pupal phase lasts 11-27 days.

3.2.1.4. Adult

Adult moths have a drab brown coloration with a white or slightly reddish band in the centre of the forewings. The hind wings are black with white stripes in the centre and three white spots on the outer border. The moth is about 60-65mm long. Throughout the research, many stages were photographed.

Table 2: Stages of Life cycle in *Achaea janata*

Developmental stages		Incubation period			
		Pre-monsoon (may-june)	**Mean Days (d)**	**Post-monsoon (Oct-nov)**	**Mean Days (d)**
Egg stage		3-4 days	3.5 d	3-5 days	3.5 d
Larval stage	**Instar I**	2 days	2 d	3days	3 d
	Instar II	2 days	2 d	2 days	2 d
	Instar III	2 days	2 d	3 days	3 d
	Instar IV	2 days	2 d	2 days	2 d
	Instar V	2 days	2 d	2 days	2 d
	Instar VI	4 days	4 d	4 days	4 d
	Total larval period	12-14 days	13.0 d	14-16 days	15 d
Pupal stage		10-12 days	11 d	11-27 days	19 d
Total life cycle period		38-40 days	39 d	45-50 days	47.5 d

Graph 1: Life cycle of *Achaea janata*

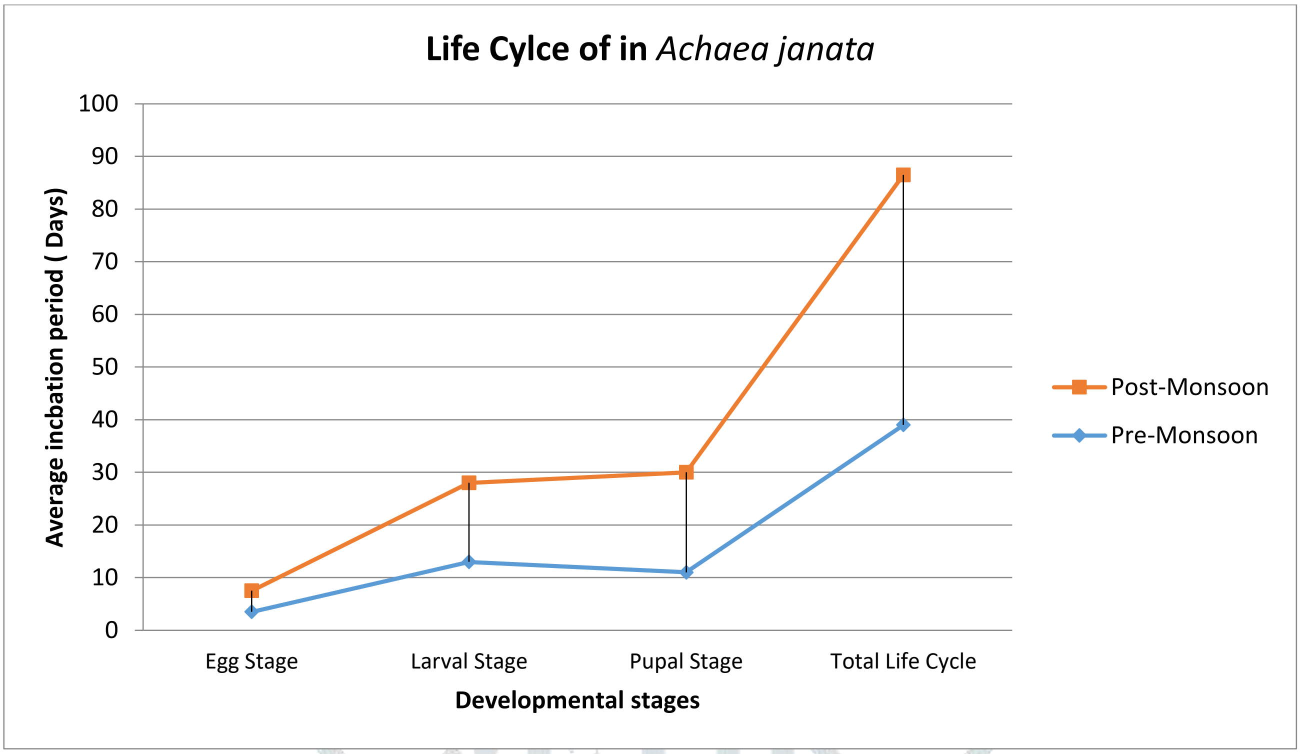
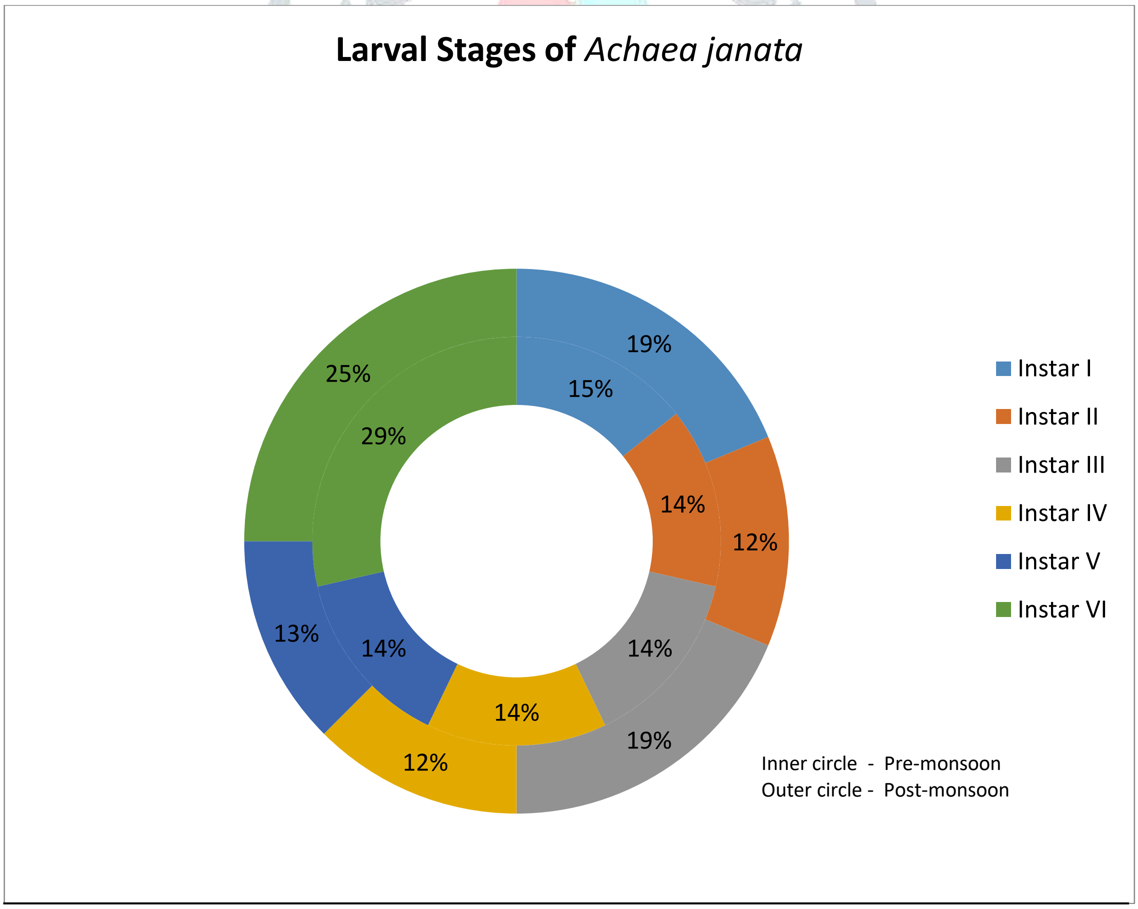


Chart 2: Larval stages of *Achaea janata*



4. DISCUSSION

Despite the fact that the host plant was on the market all year, the chemical element and water content of the leaf could change. *Pachliopta arisolochiae* - August to February (Atluri *et al.*, 2004), *Graphium Agamemnon* - August to December (Atluri *et al.*, 2004), and *Papilio polytes* - August to February (Atluri *et al.*, 2002 &Venkata ramana *et al.*, 2003), *Euploea core* Nov to Gregorian calendar month (Venkata ramana *et al.*, 2003), *Eurema hecabe* Gregorian calendar month to Nov (Venkata ramana *et al.*, 2003 & Venkata ramana *et al.*, 2001). Wynter - Blyth (1957) rated spring as the most favourable season for many Asian countries, followed by post monsoon and South – West monsoon. Kunte (1997) discovered the highest flight activity in the Northern Western Ghats during the late monsoon (August to September) and early winter.

These differences in butterfly phenology suggest that various species respond differently to the prevailing environmental seasonality and have diverse life history patterns. Even wholly different species of the same genus can behave differently, as Jones and Rienks (1987) discovered in the three tropical Eurema species they studied. It has been estimated that the overall development time from birth to adult eclosion is 22-32 days, allowing for a maximum of eight to nine overlapping broods every year. This behaviour is consistent with tropical butterflies having a short life cycle and several broods throughout the year (Owen, 1971). Temperature has an impact on arthropod period and, as a result, overall development time (Mathavan & Pandian, 1975; Palanichamy *et al.*, 1982; Pathak & Pizvi, 2003; Braby, 2003).

Adults ingest proteins and carbon sources from broken and ripe fruit (Levey & Del Rio, 2001), and their egg output rises because of this nutrient intake (Fischer *et al.*, 2004). Within the laboratory, the tormenter's entire life cycle took around 34.629.62 days. According to Bala *et al.* (2014), the entire life cycle from egg to adult took 22-32 days, and there were typically 8-9 generations per year. The temperature, location, and plant species on which it feeds are all important factors in biology and biological process times. The mature castor bristly butterfly's wings were brown with black wavy lines. Janaki *et al.* (2010) discovered that male and female adults were essentially identical, with the exception of their brown wings with black wavy lines. On the lower surface of the leaves, once sex, feminine organised spherical, sculptured, hairy, and glossy white eggs on an individual basis. Janaki *et al.* (2010) found that child females deposit eggs on the underside of castor plant leaves on an individual basis primarily before midday, between 900 and 1200h. The feminine has a lifetime fecundity of forty.43.72 eggs and a lifespan of eight.122.31 days.

Freshly hatched larvae began feeding and skeletonizing the lowest portion of the leaf shortly after emergence. The dorsal part of fully grown larvae (caterpillars) was bristly and inexperienced in colour, with yellow stripes. The last larval stage of castor bristly butterfly larvae with orange horns and black ends was 3.60 0.43 millimetres in length. On each lateral side of the body, light and dark inexperienced crossed lines appeared. The hue of the spines was changed to brown with black tips and yellow to orange coloured dots at the base, which agrees with Janaki et al findings. .'s (2010). Five larval instars were identified in the laboratory, with periods of 2.710.17, 2.810.41, 2.211.02, 3.401.21, and 3.301.04, respectively, from the first to the fifth. The average overall larval quantity was found to be 14.43.385 days. At close distances from the host, a fully grown creature pupates as a brown pupa that was born inexperienced. The immature stage lasted seven days and twenty-eight hours and twenty-eight hours and twenty-eight hours and twenty-eight hours and twenty-eight hours and twenty-eight hours The findings are consistent with Janaki *et al.* (2010) and Bala *et al.* (2014), who state that the immature stage of the castor butterfly lasts for five to seven days.

Exopterygotes skip the prepupal and pupal stages, which are patterned in a variety of ways by different groups, including the omission or brevity of specific sub stages. The instars can be extremely similar or quite different, and one or more modified resting stages may be included. The egg, larva, protonymph, and deutonymph are the consecutive immature stages in typical mites (as in tetranychids). Diverse groups of mites, like insects, have different life-cycle patterns. Some species, have an extra nymphal stage, whereas others lose one or two.

The Egg stage After oviposition, the egg hardens and may change colour. Before hatch, other colour changes, particularly darkening, are noticeable. In numerous species, a resting stage occurs before hatching, resulting in a fully formed pharate larva in the egg (e.g. *Lymantria dispar L*.). The hatching process is normally quick, yet in certain species, the early instars stay in structures linked with the eggs for a long period, such as a gelatinous matrix (For chironomids, Danks, 1971; for *Limnephilid caddisflies*, Wiggins, 1973). This is the larval stage. The larvae's primary function throughout the life cycle is to feed and grow. As a result, their structural and temporal patterns of development are substantially influenced by the need to survive in certain habitats and to acquire and exploit the food resources available to them. First instars differ from later instars in many species, especially if they are used for dispersal (as in the planktonic first instars of Chironomidae: Davies, 1976), host discovery, or resource protection from other individuals. First instars typically moult quickly to the second instar and do not feed in some species [Harvey, 1957 for the tortricid moth *Choristoneura fumiferana*, and Strickman *et al.*, 1997 for the pholcid spider *Crossopriza lyoni* (Blackwall)]. Other instars are adjusted depending on the group or species and its specific life cycle. The hypopus, a modified resting instar, is the pre-adult (second nymphal) instar in many Acaridiae. In apterygotes (e.g., up to 30 in silverfish: Nishizuka *et al.*, 1998) and primitive exopterygotes, the number of instars is often high. Mayflies usually have 15-25 instars, but depending on the species, they might have as few as 10 or as many as 52. (Trost & Berner, 1963; Clifford *et al.*, 1979; Fink, 1980; Brittain, 1982). Stoneflies have 12-24 instars (Vaught & Stewart, 1974; Baumann, 1987), while dragonflies have 10-15. (Westfall, 1987).

In Heteroptera, on the other hand, there are usually only five instars. Many Coleoptera and most Diptera have only 3-4 instars, while advanced endopterygotes have 4-7 instars (most Lepidoptera and Hymenoptera). Although the number of instars in many species, particularly endopterygotes, is set, the number in some species can fluctuate depending on the temperature and food available. Variations in the number of instars have been observed in spiders (Miyashita, 1997), ticks (Dautel & Knülle, 1997), mayflies (Brittain, 1976), stoneflies (Vaught & Stewart, 1974), dragonflies (Rivard & Pilon, 1977), grasshoppers (Kawano & Ando, 1997), beetles (Beck, 1971; Gerard & Ruf 1997), Individuals with varying numbers of instars have different developmental paths, hence data on instar durations must be documented separately for each of these individuals. Each instar can be in one of three states at any given time: active and feeding, inactive and moulting, or inactive and dormant.

Pre-pupae usually have enlarged or more noticeable anterior segments, which correspond to the pupa's thorax and are plainly apparent in Diptera larvae such as Chironomidae. Unlike the larval stage before it, the prepupal stage's duration is regulated in part by the availability of adequate pupation sites as well as temperature. Stage of the pupal. Leg or wing rudiments, eyespots or other coloration, thoracic or abdominal setae, and internal reproductive features can all be used to distinguish substages of pupal development. As eclosion approaches, the colour darkens noticeably. Pupae's distinctive U-shaped respiration curve displays a drop in metabolism after pupation and a bigger increase before eclosion (Schneidermann & Williams, 1953). In most species, the substages of pupal development have not been identified, albeit several diapause stages or indicators have been described, for example, Ohnesorge (1979), Hackett and Gatehouse (1982), and Kusters and Herrebout (1989). Stage of adulthood. For compiling data on the life cycle, a few rather readily identified substages of adult life are important. In both mites and insects, these substages are commonly observable.

During adulthood, only Collembola and other primitive hexapods moult. The cuticle is still fragile when the adult emerges from the last-instar larva or pupa, and the adult is teneral. Adults harden quickly in some species, but in others, such as dragonflies, the process of sclerotization might take several days. Mandibles must harden before a species can chew its way out of a pupal cocoon, hence "emergence" is delayed for a few days following adult eclosion in species that, they are able to chew their way out of a pupal cocoon. The duration of a life cycle is determined by the temporal pattern in which eggs of the next generation are produced. A typical individual's life cycle begins when it is deposited as an egg, but determining the corresponding endpoint is dependent on the temporal pattern in which eggs of the next generation are produced. Most species preoviposition or oviposition times, as well as longevity, are affected by mating. For two reasons, the preoviposition period in many species is longer than the teneral period, the premating period, or both. First, extensive ovarian development may be necessary, which is often preceded or accompanied by adult feeding. The availability of adult food aids in determining the pattern of oviposition in such animals. Second, many species contain a phase of dispersal early in the lives of some or all adults before eggs are formed (for further discussion on this "oogenesis-flight syndrome," (Johnson, 1969; Dingle, 1972). The developmental process of polymorphic species (Zera & Denno, 1997) frequently changes between flying and nonflying individuals. In some species, long-distance flying occurs before and after reproductive diapause (e.g., Oku, 1983), and a similar phenomenon occurs on a smaller scale in many other insects (Wissinger, 1997). It may be difficult to assess oviposition responses in such animals under laboratory circumstances. To summarise oviposition, it must be explained in terms of its temporal pattern, as well as its commencement and end. Normally, more eggs are laid shortly after oviposition begins than at the end. A few species, such as mosquitoes that develop egg batches after successive meals and long-lived adults that survive more than one season, oviposit in two or more independent bouts (Danks, 1992). Other species, particularly those with long-lived adults, can live for a long time before dying without laying any eggs.

Many laboratory investigations have found such post-oviposition adults, and "spent" females have also been recorded in the outdoors (e.g. Matalin, 1998). Because some individuals live after oviposition, and because oviposition is frequently skewed over the oviposition period, the commonly measured intervals of preoviposition duration and lifespan are insufficient to characterise oviposition on their own. Stages that have been omitted or shortened. Some of the typical life-cycle stages have been decreased or removed by other groups or species. Such modifications may be used to eliminate or safeguard susceptible periods, as well as to speed up the life cycle. One of the most prevalent alterations, aside from the reduction in the number of instars, is the reduction of eggs by larviposition or viviparity, as seen in tachinids, some sarcophagids, and aphids. In ovoviviparous pyemotoid mites, eggs, larvae, or both can be retained in the mother, resulting in an adult to adult life cycle (Wrensch & Bruce, 1991). Some parthenogenetic species, such as the aphid *Schizaphis graminum* (Rondani) (Wanjama & Holliday, 1987) and some individuals of the black fly *Prosimulium ursinum* (Edwards), can create progeny even before adult eclosion (Carlsson, 1962 as Simulium). Non-feeding instars are also a common occurrence (e.g. some first instars as already noted; specialised dormant stages). Adult phases are shortened by traits such as parthenogenesis (no need for mating), adult eclosion with fully grown eggs (no need for ovarian development), and quick oviposition in a single batch. The many variances of this kind make comparing the durations of different stages and substages among species more challenging. It's important to avoid comparing or averaging statistics for substages that aren't similar. Stages that are not visible. Because not all moults between stages are easily seen in practise, collecting information on duration is much more challenging. Gall formers, endoparasitoids, and other organisms that live inside their food resources, for example, cannot see egg hatching directly. In species that pupate inside tough silken cocoons or in deep substrates such as dirt, the prepupal to pupal transition is not evident without additional methods. Pupation occurs within the puparium (the rounded off, sclerotized exoskeleton of the third-instar larva) up to a few days after pupariation in cyclorrhaphan Diptera, and can thus only be determined by dissection. A stylized cumulative event curve and event line, exhibiting ways to summarise essential measures over the time span that an event happens in a population. See the text for further information. In species that remain quiescent in a pupal cell or rather resilient cocoon after eclosion and while still teneral, the pupal to adult transition is difficult to detect directly. In chrysomelids, curculionids, and other beetles (e.g. Buckingham & Bennett, 1981; Jackson & Elliott, 1988; Purcell & Balcuinas, 1994), and in various Hymenoptera, "adult escape" or "emergence" takes up to several days after eclosion (e.g. Buckingham & Bennett, 1981; Jackson & Elliott, 1988; Danks, 1970, Purcell & Balcuinas, 1994). If the adults are dormant, as in xylocopine bees of the genus *Ceratina*, there are additional delays (e.g. Maeta *et al.*, 1992). The post-eclosion time can be determined in adults who have been separated from their cocoons since meconium is generally expelled after the pupal cell exits. Differences in sexuality. Many animals have different rates of development for males and females. Males develop more quickly because they are smaller or because protandry may be helpful for mating, whereas females develop more slowly because they are larger or can improve fecundity by prolonged eating, according to conventional knowledge (cf. Danks, 1994). This pattern, however, is far from unique (Honek, 1997).

4.1. Importance of butterflies and moths

Butterflies and moths are significant for a variety of reasons, both as individuals and as markers of quality of life. The key causes for the conservation of these species are as follows:

4.1.1. Intrinsic value

Butterflies and moths have inherent value and should be protected in their own right. Butterflies and moths are an integral element of the vast biodiversity of the Earth's ecosystem. They have been present for at least 50 million years, and they are thought to have evolved around 150 million years ago. Butterflies and moths are a varied category with about 250,000 species, accounting for almost a fifth of all known species. Butterflies are a conservation flagship species.

4.1.2. Scientific value

Butterflies (and, to a lesser extent, moths) are important 'model' insects that have been used to study a wide range of biological topics for millennia, including navigation, pest control, embryology, mimicry, evolution, genetics, population dynamics, and biodiversity conservation. The lengthy history and popularity of butterfly research has resulted in a unique data base on an insect group that is unparalleled anywhere in the world in terms of geographical scale and chronology. This has shown to be critical for climate change scientific studies.

4.1.3. Ecosystem value

Butterflies and moths are good markers of a healthy ecology and habitat. They represent a diverse spectrum of other invertebrates, which account for more than two-thirds of all species. Other invertebrates thrive in areas where butterflies and moths thrive. Pollination and natural pest control are among the many environmental benefits provided by these plants. Birds, bats, and other insectivorous creatures eat moths and butterflies, which are an important part of the food chain (for example, in Britain and Ireland, Blue Tits eat an estimated 50 billion moth caterpillars each year). Other predators and parasites prey on butterflies and moths, many of which are particular to individual species or groups of species. Ecologists have long utilised butterflies as model species to examine the effects of habitat loss and fragmentation, as well as climate change.

Knowing how many generations an insect pest will complete per year and when destructive stages will occur might influence management actions, such as planting after detrimental stages have passed. The length of time it takes for an insect to complete a generation varies greatly between species. In temperate regions, most insects complete their life cycle in a year. Periodical cicadas, for example, have life cycles ranging from 13 to 17 years and are significant deviations to this pattern. Many insects have many generations every year, and the number of generations can be consistent across geographic ranges or can fluctuate depending on temperature. In the southeastern United States, for example, some species may have several generations, whereas in the northern part of their range, the same species may only have one or two generations. Many insects go through a life stage in the winter. An egg, an immature stage (nymph, larva, or pupa), or an adult can all overwinter depending on the species. Rather than overwintering in tropical or desert areas, insects may enter a dormant state known as diapause throughout the dry or wet seasons. (Gillot C., 2005).

5. CONCLUSION

Insects can live in a variety of environments. They dwell on land, in water, and in the air, and can be found in every corner of the globe. Currently, there are 10 quintillion bug species on the planet. Insects are vital to the world's environment because they help with plant fertilisation and the decomposition of plant and animal parts. Insects are a food source for a variety of creatures. The length of an insect's life cycle is influenced by a variety of factors. To study and compare the life cycle stages of different species, a thorough understanding of their biology is required.

The common castor butterfly (*Ariadne merione*), the eri silkmoth (*Samia Artemis ricini*), and therefore the castor semi-looper lepidopterous insect (*Achaea janata*) eat *Ricinus communis* (castor). It is also used as a number plant by the caterpillars of other Lepidoptera species. *R. culicivora* has a relationship with *Evarcha culicivora communi*s. They feed on the nectar and prefer to use these plants as a suiting spot. Lepidopterans are cold-blooded insects that require ambient temperature to survive. In extreme cold, the lepidopteron spreads its wings on a leaf, a pile of dirt, or pebbles to generate enough body heat. The egg cycle and how butterflies deposit their eggs on leaves, the larval cycle and how caterpillars feed on leaves, the juvenile stage and how the caterpillar wraps itself in a pupa, and the adult stage and how the butterfly breaks the pupa barrier. In *Achaea janata*, the time it takes to complete one lifecycle is longer than in *Ariadne merione*.

The life cycles of two lepidopteran species, the common castor butterfly (*Ariadne merione*) and the castor semilooper moth (*Achaea janata*), were researched, and it was discovered that both species undergo four stages which involves egg, larva, pupa, and adult termed as complete metamorphosis. By comparing these two lifecycle stages, it is obvious that throughout the larval stage, both species go through a process known as moulting, which allows them to develop into different instars. The larva moults after each instar to progress to the next stage of development, which is pupa and adult. By examining the similarities between the two insect species, it was determined that both were major pests of the castor oil plant (*Ricinus communis*). Because both species are abundant in the castor plant, which serves as a host plant for both, the study was conducted by collecting the species from the Castor oil plant.

5.1. Ecological significance of Butterfly

Butterflies are home to a variety of predators and parasites. Ecologists have long used them as model organisms to investigate the effects of habitat loss and climate change. Every butterfly has developed its unique combination of chemicals to ward off predators and parasites, find a partner, and overcome the host plant's chemical defences. Each of these substances has potential value and might be economically subjugated. Many agricultural crops rely on butterflies for pollination. In addition, predators such as birds, spiders, lizards, and other animals eat them as part of their ecological purpose. The beauty of a butterfly is similar to that of a flower, which attracts attention wherever it blooms. Some potential predators are put off by the bright colours, which signal bad taste. Surprisingly, pollinators are required for the reproduction of 90% of plants. The population of bees is currently on the decline. As a result, butterflies are proving to be extremely important to the eco system. Disease resistance develops in the plants affected. This increases their chances of surviving. Butterflies are recognised for reacting swiftly and carefully to even the smallest changes in the environments in which they live. “Birds organise their entire breeding season around when caterpillars will be most abundant,” says Stephen Dickie of Butterfly Conservation. There won't be much food for developing chicks if the butterfly and caterpillar populations are depleted.” This could be one of the main reasons why experts are concerned that if the butterflies become extinct, the eco systems we rely on will collapse.

5.2. Ecological significance of Moth

Other insects, spiders, frogs, toads, lizards, shrews, hedgehogs, bats, and birds consume both adult moths and their caterpillars. Adult night-flying moths are an important portion of bat’s diet. Both adult moths and their caterpillars are eaten by many birds, but caterpillars are especially crucial for feeding the young. Moths, like the canary in the coalmine, play an important function in informing us about the state of our environment. Moths are particularly helpful as indicator species since they are so widespread and present in so many diverse environments, as well as being so sensitive to changes. Moths, on the other hand, aid in seed formation by pollinating flowers while eating on their nectar. This supports not only wild plants, but also many of our food crops, which rely on moths and other insects for a healthy harvest.

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