The life cycle of great Mormon butterfly (Papilio memnon memnon) in captivity

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Abstract. Papilio memnon memnon is one of the butterflies groups of the Papilio clan in West Java, Indonesia. This study aims were to determine the morphology, behavior, and life cycle of the P. m memnon butterfly. The research method used is descriptive with survey techniques and literature studies. This study aims to determine the morphology, behavior, and life cycle of the P. m memnon butterfly. The research method used was descriptive with survey techniques and literature studies. Data about morphology, duration of life, and behavior at each development phase during the P. m memnon butterfly life cycle were analyzed descriptively based on direct observation. The results showed the egg phase of P. m memnon takes about 7-8 days to the phase instar1 of the larvae. The average total time needed in the larval phase is around 23 - 45 days to the pupa phase. The Pre-pupa phase lasts 1-2 days, while the pupa phase lasts 2-3 weeks. P. m. memnon performs the larval phase as many as 5 stages of instar. Food eaten by first phase instar1 of larvae is the eggshell, which is useful for insect growth and helps eliminate evidence of eggs from parasitic attacks. At each phase of development, the larvae eat the outer skin to obtain additional energy to support growth.

1. Introduction
Butterflies are a group of insects belonging to the order Lepidoptera which are easily recognized and spread very widely from lowlands to highlands [1]. The Lepidoptera consists of 45 tribes and one of them is the Papilionoidea tribe consisting of the Papilionidae, Pieridae, Riodinidae, Lycaenidae, and Nymphalidae tribes [2]. In Indonesia, the clan of butterflies belonging to the Papilionidae tribe include: Trogonoptera, Troides, Ornithoptera, Graphium, Losaria, Pachliopta, Lamproptera, and Papilio [3]. Papilio memnon is a type in the Papilio genus [4]. Papilio memnon memnon is also called the Great Mormon Butterfly / Butterfly Pastor [5]. The butterfly life cycle generally consists of four different stages: egg, caterpillar, pupa, and adult. The length of the life cycle, from eggs to adults, varies greatly between species [6]. The aim of this research to find out the life cycle of the butterfly Papilio memnon memnon) as a basis for conservation efforts.

2. Research methods
The research was conducted at Butterfly Breeding laboratory in the Curug 7 Cilember, Jalan Raya Puncak Cisarua Km. 10, Puncak, Cisarua, West Java. The research method was descriptive with survey techniques and direct observation, as well as literature study. The data obtained included morphology,
age of development, and behavior in each phase of development during the life cycle of the *P. m memnon* butterfly. Data were analyzed descriptively.

The sample were used 20 larvae with 5 larva’s phase (100 experimental units). The first Instar of larvae were obtained from *Paplio m memnon* eggs which were successful in hatching. Larva 1 is then prepared for larvae 2, and so on. Observations were started on *Paplio m Memnon* butterfly egg samples, placed on the microhabitat near the food or in the host plant. Observations included morphology, age, and behavior in each development phase consisting of 5 phases during the *Paplio m memnon* butterfly life cycle. Then the data were analyzed descriptively.

3. Results and discussion

3.1. Age of eggs

The age of *Paplio m memnon* eggs until hatching takes around 7-8 days. The newly hatched egg will eat the eggshell as the first meal (Figure 1).

![Figure 1. Eggs of *Paplio m memnon* and hatching eggs into larvae.](image)

3.2. Larvae

*P. memnon* larvae consist of 5 instars stage. The first instar will continue to be the second instar, and so on. The age of each larval instar is different each other (table 2).

| Instar 1 | Instar 2 | Instar 3 | Instar 4 | Instar 5 |
|----------|----------|----------|----------|----------|
| 4-7      | 3-9      | 3-8      | 5-8      | 8-13     |

Each instar (1-5) has the following morphological characteristic.

- The instar 1 larva is slightly pointed, the body color of the larvae is grayish white and dark brown in the lateral part. Initial body length of about 4 mm.
- The instar larvae of 2 body segments are clearer.
- Larvae 3 colors of larvae become dark brown to slightly yellowish green
- Instar 4 larvae look like bird droppings, dark green mixed with white lines and many spots on the head of the larva.
- Instar 5 larvae change dramatically, there are 2 eye spots in the third thoracic segment, white bands transverse in the abdomen and smooth green body. The performance of each larval instar can be seen in Figure 2.
Figure 2. Development of 1st instar larvae until instar 5 of *Papilio m memnon*.

3.3. Pupa (cocoon)
Pupa or cocoon is a period of rest or period of inactivity in all holometabola insects. Ahead of the final instar larvae, the larval skin begins to dry out, looks like it wants to peel off and the skin color becomes more different. The transformation of the final 5 (pre-pupa) instar larvae to the pupa phase (Figure 3).

Figure 3. The process of transitioning the final 5 instar larvae (pre-pupa) into pupae (left to right).

The color and shape of the cocoon is always vaguely adjusting its environment. Gradually towards the pupa, the prospective pupa (pre-pupa) writhes and moves around to change the skin on the legs, head and whole body until the actual cocoon is formed. Age of pupae varies between 2 – weeks (Figure 4).

Figure 4. Pupa of *Papilio m memnon* and the rest of the pupa (right).

3.4. Imago (adult)
After the end of the pupa, then it becomes an adult butterfly (Imago). In subsequent growth and development, adult butterflies will carry out fertilization by copulating between male and female, after which conception will begin after the life cycle. *P. memnon* in capturing, the fertilization of the butterfly imago lasts more than 24 hours. In this copulation process, the male is initially chasing the female, circling the female, and attracting the female's attention to immediately establish copulation.

Movement (flight) during copulation is requested by females, and males are only attached to females. During copulation, the female actively pumps the abdomen to allow the male to excrete sperm into the female genital organs. Females ready for copulation remain perched on various substrates. The reception signal for copulation from females to males is fluttering wings and lower abdomen raised, then the male will approach him.
The eggs hatch into caterpillars for several days. Larvae come out of eggshells through holes in the side of the egg, or microfils [7]. The newly hatched caterpillar will eat the eggshell as the first food, then it will eat the feed plants [8]. Butterflies will select certain host plants as oviposition sites. The preference of the oviposition site is carried out by female butterflies to maximize the chance of egg hatching (survival) and their best offspring [9]. Imago $P.\text{memnon}$ places mature and fertilized eggs. Embryonic development occurs outside the parent's body and obtain food from egg yolk [10].

The laying of eggs by $P.\text{m. memnon}$ the parent is by way of the parent arching his abdomen, then laying the eggs. The new egg is placed by the parent of a bright yellow butterfly, a slippery surface, also coated with white liquid that is useful as an egg adhesive on the substrate (leaf of the host plant). In $P.m.\text{memnon}$ species, eggs are placed one by one (not all at once) on the host plant to protect the eggs from the weather directly [8]. $P.\text{m. memnon}$ eggs are rounded in shape [3]. Creamy with a rough surface [11].

Many larvae will not develop properly, unless the larvae eat eggshells. This eggshell develops well for insect growth because it contains important nutrients [6]. In addition to the first nutrition, According to Figure 1. These egg shells are eaten by larvae to help eliminate evidence of eggs that can otherwise steal the parasitoid's attention [1].

After the eggs hatch, the next is the development of larvae. Premature insects that just come out of the egg are called instars 1. After instar 1 changes the skin, the form is called instar 2, and so on [10]. Insects managed to adjust to almost all types of environments, which were achieved with a number of modifications to the body parts. One such modification is related to the mouthpiece. The type of mouth determines the type of food and the type of damage it causes. In $P.\text{memnon}$ butterfly larvae, the type of mouth is biting-chewing (mandibulata type), where the mouthpiece is used to cut or bite and chew solid food ingredients. This mouthpiece is characterized by a strong mandible [10]. $P.\text{m memnon}$ larvae passes through its entire life cycle more openly, usually well or disguised to predators [6]. Insects have the tools or the ability to defend themselves and protect themselves from enemy attacks [10]. Some Papilio genus larvae have osmeteria which is released by larvae when threatened to prevent predators [12]. Osmeteria is a tubular sac located on prothorax in some swallowtail butterfly larvae [3]. This osmeteria organ is orange and will be removed along with a sharp smell [13].

When the final instar larva prepares for the pupa phase, the body size of the final instar larvae will shrink. According to Kunte, at the right time, the skin of the third segment of the larvae will split [1]. Then the larvae stretch and pull back the skin, until finally the old skin is released. The post-molting appearance of larvae is completely different. There are no capsules on the head, no jaws, and no legs. The new appearance of the initial pupa is still wet. Pupa then moves to reduce length and increase width, so that it looks short and looks compact. A few hours after molting, the cocoon skin hardens, and the pupa gets its final shape.

The color and shape of the cocoon is always vaguely adjusting its environment [12]. In the Papilionidae, silk corsets cover the entire third thoracic segment and tie the pupa to the substrate. The color and shape of the cocoon is always vaguely adjusting its environment [12]. Some research results show that the time of copulation in butterflies is different. Generally Imago butterfly marriage lasts for 6-8 hours (or lasts only 2-4 hours) [13,14].

4. Conclusion
The duration of the $Papilio\text{ m memnon}$ egg phase takes about 7-8 days until it reaches the 1st instar phase of the larva, with the average phase of the larva is around 23 - 45 days to the pupa phase. The pupae lasts 1-2 days, and the pupa phase lasts 2-3 weeks. In the life cycle, the larval phase eats up to the pupa phase. In the pupa phase fasting and metamorphosing into an adult butterfly, and when the adult butterfly has come out of the pupa, the butterfly can carry out a marriage to continue its generation. $Papilio\text{ m. memnon}$ holds the larval phase as many as 5 stages of instar. The first food instar phase 1 of the larva is its eggshell, to support growth and help eliminate evidence of eggs turning the attention of the parasitoid.
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