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# Biology And Morphology of Nymphs of Indialis Badia (Ephemeroptera : Leptophelebiidae)

KEYWORDS: Indialis badia, biology, nymph morphology

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**ABSTRACT** *Indialis badia (Order: Ephemeroptera) is incomplete metamorphic insect which resembles with their adults and is good source of food for fishes and plays an important role in food web. Hence biology and morphology of nymph has been studied. I. badia completed its life cycle from egg to adult within 8 to 12 months. Egg stage lasted for 14 days. Eggs hatched during the months of August and September. Nymphs found during the months of September to April and adults were seen in May. Only one generation was completed during the year by this species in Kolhapur region.*

*Nymphal morphology - Body 3.46 mm long, dark brown in colour, sutures and sterna paler.*

*Antennal Formula =S-0.03, P- 0.05, F-0.79, 1.37/3 = A=.458*

*Gills- Gills leaf like, 7 pairs, located on first 7 abdominal segments; last 3 segments have no appendages from lateral side. Last segment shows terminal filament and a pair of banded cerci.*

## INTRODUCTION

Mayflies (Order: Ephemeroptera) are incomplete metamorphic insects usually resembles with their adults. Wings develop externally as wing buds in the immature stages. The life cycle is divided in to three definate stages viz egg, larva (nymph) and adult. Mayflies are also called as one day flies due to their brief life of the adult. Mayflies are unique among winged insects in having two adult stages. The first is subimago and second is imago. Ephemeroptera is small order containing about 2000 species from the world with more than 200 genera and 19 families (Brittain, 1982).

Review of literature indicates that Lestage (1921), Chopra (1927), Hugen (1858, 1959), Kapur & Kriplani (1963), Eaton (1971, 1992), Hubbard & peters (1978), Clifford et al., (1979), etc. worked on identification and classification of mayflies. While, life cycle and biology of mayflies have been studied by several workers noteworthy amongst them are Degrange (1960), Pleskot (1961), Hirvenoja (1964), Sowa (1965), Landa (1968), Illies (1968), Bohle (1969), Lavandier and Dumas (1971), Brittain (1974, 1980, 1982), Sowa (1975), Mackey (1978), Larsen (1978),), Lingdell and Muller (1979), Humpesch (1979, 1980, 1981), Cianciara (1980), Wise (1980), Nagell (1980), Whelan (1980), Clifford (1982), Elliot and Humpesch (1983), Schmidt (1984), Tokeshi (1985), Rosillon (1986), Savage (1986).

## MATERIALS AND METHODS

Life cycle of *I. badia* was studied from Kolhapur region, India by spot observations of various life stages. Kolhapur is located between 15°-17° North Latitude and 73°-74° Each Longitude with rainfall range 500 mm-6000 mm and characterized by various kinds of water bodies. Eggs, nymphs, sub imago and imago of mayflies have been taken in to account for life cycle record, especially duration of their availability in natural condition throughout the year. Observations were taken at one-week interval from Kolhapur region. For morphological studies samples of nymphs were frequently (one week interval) collected from Kolhapur region. Measurements were taken in millimeter and descriptions were made on various body parts like head, thorax and abdomen and their appendages.

## RESULTS

*I. badia* completed its life cycle from egg to adult within 8 to 12 months. Egg stage lasted for 14 days. There were two broad groups of nymphs namely swimmers and crawlers. *I. badia* is bivoltine species found in the environment from April to August. Eggs and nymphs were found in Panchganga River during the above period. Eggs hatched during the months of August and September. Nymphs found during the months of September to April and adults were seen in May. Only one generation was completed during the year by this species in Kolhapur region. In the month of October nymph population was found increased. It mostly breeds in running water in the rivers and work as sprawler and climber and feeding behavior was as collector and gatherer. The nymphs found on soft, small particle substrate of lakes and slow moving streams.

Mating- Aerial copulation was noted during the day time for about a minute.

Oviposition- Mature female oviposited shortly after copulation on water surface by bending its abdomen and releasing eggs in to the water. Oviposition occurred during the day light.

### *I. badia* nymph morphology (Fig - 1)

3.46 mm in body length, dark brown in colour, sutures and sterna paler.

**Head**- 0.45 mm in length, 0.33mm in width, blackish in colour, 3 ocelli present (1 medial ocelli and 2 lateral ocelli).

Antenna- Antenna brownish yellow with spines, longer than head, 0.87 mm in length, scape 0.03 mm in length, pedicel 0.05 mm in length, flagellum 0.79 mm in length.

Antennal Formula =S-0.03, P- 0.05, F-0.79, 1.37/3 = A=.458

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Compound eyes – 0.12 mm in length, 0.12 mm in width, black in colour, eyes large, distance between 2 eyes more than single eye, eyes located posteriorly on head.

**Thorax**- 0.94 mm long, 0.45 mm wide, brown in colour, with 3 thoracic segments.

Prothorax- 0.28 mm long, 0.59 mm wide.
Mesothorax - 0.32 mm long 0.61 mm wide
Metathorax –0.34 mm long 0.64 mm wide

**Legs** – Hind leg 0.78 mm in length with spiny hair pale yellow, with 2 dark spots on hind leg and mid leg and dark U patch on fore leg.

Coxa- 0.015 mm in length, trochanter – 0.02 mm in length, femur – 0.27 mm in length, tibia- 0.32 mm in length, claw – 0.08 mm in length, curved.

Other legs more or less similar.

**Abdomen** – 2.07 mm in length, 0.70 mm in width, with 10 abdominal segments, abdominal segments with brown dark patches in center.

**Tail (Terminal filament)**

0.98 mm in length, blackish brownish, banded with small hairs and 11 segmented.

**Cerci –** Cerci slightly longer than terminal filaments, blackish brownish banded, 0.99 mm long.

**Gills**- Gills leaf like, 7 pairs, located on first 7 abdominal segments; last 3 segments have no appendages from lateral side. Last segment shows terminal filament and a pair of cerci.

**DISCUSSION**

Information on adult emergence, flight period, flight behavior, mating fecundity, oviposition behavior and egg development was summarized by Elliot & Humpesch (1983). According to them most species hatch within the range 3-21°C, but *Baetis rhodani* has a higher upper limit of 25°C whilst the lower limit was between 4.5°C (no hatching) and 5.9°C (4-11% hatching) in *Rhithrogena semicolorata*. Egg hatching period were very considerably within the same species e.g. *E. disper* from lakes and river (Humpesch, 1980). These differences may begenuine but not in both *Ecdyonurus* spp. and one *Irhithrogena spp,* the hatching time and rate of development were similar for constant and fluctuating temperatures (Humpesch, 1980).

Parthenogenesis was recorded in May flies by Degrange (1960). It was noted that out of twenty-six European species, fourteen were found in Britain, namely: *Caenis luctusa, Ephemerella ignita, Ecdyonurus insignis, E. dispar, Heptasgenia lateralis, H. sulphurea, Leptophlebia vespertina, Siphlonurusla custris, Centroptilum luteolum, C. pennulatum, Cloeon simile, Baetis niger, B. muticusm, B. scambus.* Ovoviviparity was rare in the Ephemeroptera and restricted to the Baetidaes (Hirvenoja,1964).

Ephemeroptera have a large number of postembryonic moults. The number of larval instars was known for several species (Humpesch, 1979), including the British species *Baetis vernus* (Schmidt, 1984). It was vary from ten to fifty but the majority of species showed the range of twenty to thirty instars.

Growth patterns of larval Ephemeroptera have reflected the interaction between the size increment per moult and the moulting frequency. Both variables were affected by many factors, including temperature, food, water chemistry and larval activity. In *Ecdyonurus dispar*, the average body length increment per moult was fairly constant at about 15% and therefore, Dyar's rule is applicable (Humpesch, 1981). Smaller mature larvae showed fewer instars than larger mature larvae and the number of instars between egg hatching and adult emergence was not constant. Temperature was the chief variable affecting the interval between molts. According to some authors the moulting interval has relation with larval age. Ephemeroptera has been found to have a larval diapause (Bohle, 1972).

The growth rates of may flies were higher in summer than winter, and temperature was the most obvious factor responsible for the differences. Some of the variations in growth rates were also due to food quality and quantity as noted in *Cloeon dipterum* that the larval period was 147 days on a diet of detritus and 211 days on a diet of the alga *Siprogyra spp.* (Cianciara, 1980).

Clifford (1982) collected the data on 718 life cycles for 297 species, from Europe and North America. He found that about 60% of all life cycles were univoltine about 30% were multivoltine and 4% were semivoltine and the remaining were variable.

Life cycles of most species vary slightly with respect to environmental conditions but, in some species, like *Baetis rhodani,* remarkable changes have been noted. It was univoltine in northern Europe above latitude of 65°N and in mountain areas, bivoltine with both a winter generation and a summer generation throughout most of Europe, and bivoltine with one winter and two summer generations in warmer streams of southern Europe (Clifford, 1982).

According to Brittain (1980) *Siphlonurusla custris* was univoltine (Siphlonuridae) with overwintering egg and larvae. Adults were usually found in June, July and early August, but have been recorded between May and September (Elliot & Humpesch, 1983). In central Europe, this species overwinted only in the egg stage (Landa, 1968). Similarly, *Ameletusino pinatu* was also univoltine and adults noted from May to early August (Larsen, 1978).

According to (Pleskot, 1961), *Baetis fuscatus* (Baetidae) was univoltine, and also bivoltine with overwintering eggs. Due to very rapid larval growth, more than two generations have been noted per year and the multivoltinism may be an artifact due to the successive hatching of egg batches laid in the previous summer. *Baetis scambus* was bivoltine with overwintering eggs (Rosillon, 1986). *Baetis vernus* overwintered in the egg stage and showed univoltine, bivoltine or multivoltine patterns of life cycle (Schmidt, 1984). This species diapaused in egg stage (Bohle, 1969), and the length of the diapause was controlled by temperature (Schmidt, 1984). According to (Wise, 1980) *Baetis muticus* was bivoltine with an overwintering generation and a fast growing summer generation of one or two cohorts wherein adults were seen from April to October.

*Centroptilum pluteolum* was bivoltine with a slow growing over wintering generation and a fast growing summer generation and adults were found from April to November (Wise, 1980). In *Centroptilum pennulatum* adults have been recorded from May to October (Elliot & Humpesch, 1983), and that in central Europe this species overwintered in the egg stage

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and has more than one generations per year (Landa, 1968).

*Cloeon dipterum* exhibited a wide range of life cycles but always had slow growing winter generation that was often followed by one or more rapidly growing summer generations and adults were found from May to October (Nagell, 1980). Being an ovoviviparous it overwintered in the egg stage and was capable to produce extra generations in warmer summers. The adults of *Procloeon bifidum* were recorded from April to October (Elliot & Humpesch, 1983) and that in central Europe this species has overwintered in egg and more than one generation were noted per year (Sowa, 1975).

*Leptophlebia marginata* (Leptophlebiidae) was univoltine with overwintering larvae (Lingdell & Muller, 1979). *Leptophelebia vespertina* was usually univoltine with overwintering larvae (Savage, 1986). In the mountains of Sweden, *L. vespertina* is was semivoltine (Kjellberg, 1973). *Paraleptophlebia submarginta* was univoltine with overwintering larvae (Wise, 1980). Adults have been noted from April to July in the British Isles (Elliott & Humpesch, 1983), but a longer flight period from March to November has been recorded in Southern France (Lavandier & Dumas, 1971). In *P. cincta* and *P. werneri* adults have been found from May to August and May to June respectively in the British Isles (Elliott & Humpesch, 1983). According to Landa (1968), both species overwinter in the egg stage and have fast growing some generations, but Sowa (1975) found that *P. cinta* overwintered in the larval stage. While, *Habrophlebia fusca* adults have been found from May to September in the British Isles (Elliot & Humpesch, 1983), and that it was univoltine with overwintering larvae in central Europe (Landa, 1968).

*Ephemera danica* (Ephemeridae) was usually semivoltine but some populations were reported as univoltine, or mixed univoltine/semivoltine, or having a life cycle lasting three years (Whelan, 1980; Tokeshi, 1985). The adults of *Ephemera lineate* were found in July in the British Isles (Elliot & Humpesch, 1983). This species was semivoltine in central Europe (Sowa, 1975). The small amount of information on the life cycle of *Caenis macrura* suggests that this species was probably bivoltine with overwintering larvae (Mackey, 1978). Adults have been found from May to August in the British Isles (Elliot & Humpesch, 1983).

According to Brittain (1974) *Caenis luctuosa* may be univoltine or bivoltine (Landa, 1986), but always overwintered in the larval stage. Adults have been found from June to September in the British Isles (Elliot & Humpesch, 1983). In general, may flies are good source of food for fishes and have astonishing patterns of life cycle, the present information will be helpful for baseline data for Kolhapur region of India.

**Fig – 1;** *I. badia* **nymph**

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