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Morphology of *Einfeldia* (Diptera: Chironomidae) found in Udaipur region

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Abstract
Larval *Einfeldia* were collected from Udaisagar Lake, Udaipur. They were cultured in the laboratory to assess their life cycle. Photographs and morphological descriptions of different life stages of *Einfeldia* were given. Larvae are red in color with well developed, non-retractile head capsule with prognathous mouthparts. The larval head capsule is dark colored sclerotized structure composed of frontoclypeal apotome. Pupal stage is short lived stage in which metamorphosis occurs. Silk secreted by larval salivary glands wrap the larva and make cocoon. Pupa hangs beneath water surface. Pupa is comma shaped with swollen cephalothorax and dorsoventrally flattened abdomen. Adults look similar to mosquitoes. Adult head is rounded with shortened non biting mouthparts. The antenna is with well-developed flagellomeres. The antenna is sexually dimorphic: male have a plumose antenna.

Keywords: Chironomidae, Udaipur, *Einfeldia*, Udaisagar

1. Introduction
Chironomids are one of the most dominant, widespread and diverse aquatic invertebrate taxa in freshwater systems (Armitage *et al.* 1995) [1]. Chironomids are distributed from the Arctic to the Antarctic and from the seas to permanent snowfields. Chironomids live in the glaciated areas of the highest mountains, including an elevation up to 5600 meters in the Himalaya (Kohshima 1984; Saether & Willasse 1987) [5, 7] and are active at a temperature of -16°C. Larvae of *Sergentia* live at over 1000 meters depth in the abyss of Lake Baikal. Their life cycle includes three aquatic developmental stages (egg, larva and pupa) and a terrestrial reproductive stage (winged adult). Chironomids are closely related to mosquitoes (Culicidae) and biting midges (Ceratopogonidae). Unlike Culicidae and Ceratopogonidae, female Chironomids do not bite due to the absence of elongated mouthpart and they lack wing scales too. The larvae of most Chironomids hatch out from the eggs and usually lead bottom dwelling life forming tubes with the help of silk secreted from the salivary glands taking and taking of clay particles and organic matters from the substratum. Some forms are found to live inside muddy substratum. Chironomids are an important food source for large predatory invertebrates, fishes, and birds (Hudson *et al.* 1990) [4]. *Einfeldia* Kieffer (1924) was originally designated as a distinct genus after its type, *Einfeldia pectoralis* Kieffer (1924). It had been placed as a subgenus of the genus *Chironomus*. Ashe (1983) [2] confirmed the generic rank of *Einfeldia* putting *Benthalia* Lipina as a synonym of the genus. Only three species known from Belgium, Canada and Thailand have now been identified in India. The genus is now recorded in 3 species from India and those too in adults only.

2. Materials and methods
Larval Chironomids were collected from Udaisagar Lake, Udaipur. Then larvae were examined under a microscope for identification up to genera using keys (Epler, 2001) [3]. For morphological analysis, larval *Einfeldia* were cultured in the laboratory at water temperature 20°C and proper aeration was maintained with mini air pump (VENUSAQUA AP 208). For culture, glass truft was filled up to 1 cm sand and up to 3 cm of distilled water (including sand). Samples were put in the culture chamber (Figure 1) and waited till emergence of adults. For morphological slide, preparation specimens were preserved in 70% alcohol. After which specimens were kept in 10% KOH for clearing. Then passed in distilled water (5 min.), then glacial acetic acid (10 min.) and finally permanently mounted in DPX (Distyrene Plasticizer Xylene). Photographs of larvae, pupae and adults were taken using *Sony Cybershot DSC* camera mounted on compound microscope. The measurement was done in µm and mm. Morphological nomenclature follows Saether (1980) [6].

Fig 1: Culture chamber used for rearing Chironomids

3. Results and Discussions
3.1 The larva (Figure 2)
Larvae are red in color with well developed, non retractile head capsule with prognathous mouthparts. The larval head capsule is dark colored sclerotized structure composed of frontoclypeal apotome (fusion of frontal apotome and clypeus). During ecdysis, frontoclypeal apotome opens as dorsal flap. 5 pairs of cephalic setae are seen: S1 and S2 on the labrum (labral setae), S3 on the clypeal region (clypeal setae), S4 and S5 on the frontal apotome region (frontal setae). Cephalic setae are important in taxonomy. Genae form the ventral and lateral walls. The most dominant feature of larval head is toothed plate called mentum

(older term labium) on ventral side. Mentum is double walled plate of dual origin. On lateral adjacent side of mentum, a pair of ventromental plate (older term paralabial plates) present. Ventromental plates are striated and fan shaped. Term gula is used for the area that is posterior to the mentum. The labrum is present anterior to frontoclypeal apotome. On ventral side of labrum, a pair of premandibles present. The most prominent mouthparts are paired toothed mandibles arranged obliquely to horizontal plane. Each mandible is with 1 apical and 2 inner tooth. Maxilla lies dorsolateral to mentum and is importing in feeding and extension of silk. Larvae have well developed, non retractile, segmented antennae mounted on pedestal. Antenna can be demarcated into basal segment (1st segment) and remaining flagellum (2nd to 5th segment). A sensory structure called ring organ is present on the basal segment and another sensory structure called Lauterborn organ is present on 2nd segment. Larvae have simple, ovoid, pigmented double eye spots. Larval body is demarcated into three broader thoracic segments and nine relatively narrower abdominal segments. Late fourth instar larva was recognized by its swollen thoracic segments. Thorax has fleshy unsegmented appendages called anterior parapods (also called false legs) that bear claws and situated on first thoracic segment. Another similar posterior parapods found on ventral side of the terminal abdominal segment. Along with it a pair of anal procerci (tubercles) bearing an apical tuft of setae is present on dorsal side. On ventral side, two pairs of anal tubules (anal gills) are present on 8th abdominal segment (12th body segment). These function in ionic regulation and respiration. This larva also has a pair of abdominal tubules (ventral gills) present on 7th abdominal segment (11th body segment). These tubules are hemolymph filled and associated with respiration.

Fig 2: mentum and mandibles, head, antenna, posterior part of larva, ventral tubules and setae on prolegs.

3.2 The pupa (Figure 3)

Pupal stage is short lived stage in which metamorphosis occurs. Silk secreted by larval salivary glands wrap the larva and make cocoon. Pupa hangs beneath water surface. Pupa is comma shaped with swollen cephalothorax and dorsoventrally flattened abdomen. The cast skin of pupa is known as exuviae. The paired thoracic respiratory organs of pupa are called thoracic horn lies on anterior thorax. Leg sheaths and wing sheaths are prominent. Pupal abdomen is eight segmented, demarcated into dorsal tergite and ventral sternite. Shagreen presents on 3rd to 5th tergite. Frontal plate is with elevated cephalic tubercle. Pupal locomotion derives from abdominal flexion. The posterior segments are modified as an anal lobe covered with filamentous setae. Caudolateral spur present.

Fig 3: pupa (w. m.), wing sheath, posterior part of pupa and pupal exuvia.

3.3 Imagines/Adults (Figure 4 and 5)

Adults look similar to mosquitoes. Adult head is rounded with shortened non biting mouthparts. The antenna is with well developed flagellomeres. The antenna is sexually dimorphic: male have a plumose antenna. The eyes are round, dichoptic. The ommatidia have microtrichia between them. Clypeus is well developed and larger than labrum. Mouthparts are reduced. Mandibles, hypopharynx, labium and labella together form a food canal. Head bear many setae. Thorax is with well developed two functional wings. Thorax is dorsally convex, which give space for attachment of flight muscles. Thorax is demarcated into anterior pronotum (prothorax), medial mesonotum (mesothorax) and posterior postnotum (metathorax). Mesonotum is the largest part. Wings are setose with venation. The six primary veins are present on wing *viz*: Humeral crossvein, costal vein, radial vein, medial vein, cubital vein and anal vein. There is a sexual dimorphism in wing shape. Female wings are relatively broader than male wings. Three pairs of legs (forelegs, midlegs and hindlegs) present. Each leg is divided into one femur, one tibia and five tarsomeres. The abdomen is dorsoventrally flattened. Abdomen also shows sexual dimorphism: the female abdomen is shorter and broader

than that of male. Terminal abdominal segments bear genitalia. The male genitalia comprise of a paired claspers that further composed of basal gonocoxite and apical gonostylus. They surround the Y shaped anal point. The gonocoxite bear several appendages called volsellae. Male genitalia pass spermatophore (sperm package) to the female spermathecae. The female genitalia mainly comprises of gonapophysis and gonocoxite.

Fig 4: adult female, antennae, posterior part of adult female and seminal capsule.

Fig 5: adult male, antenna, hypopygium, and wing.

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