The Mayfly Nymphs (Order: Ephemeroptera) of Rawalpindi District

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1. INTRODUCTION

According to L. R. Usinger (1956), "Insects as Mayfly nymphs and midge larvae serve as primary consumers of plant material into animal protoplasm." Both the adult and nymphal stages of mayflies constitute an important item in the diet of many species of fish. Taxonomic study of mayflies (Order: Ephemeroptera) was attempted before in Pakistan. Little work is done on the taxonomy of these insects in India. Eaton (1895-1896) in a monograph on this order, recorded Oreo aegyptiacum from Egypt to North-western India and Ephemerus Eaton from Kure in Punjab (India). Earth (1930) reported the nymphs of Baetis spp. from the torrential streams and the nymphs of Ecdyonurus from the hill streams of India. Trevor (1930) in her paper on the Himalayan Mayflies described five new species, namely, Caenis ringensis from Sinigar, Cleen Kashmirensis from Kashmir, Battellella ladak., Arcturia pristina and Caenis ladakeis from Ladakh. D. E. Kimmins (1948) described Cleen khasii, Cleen beyer, Cleen himalayana, Cleen viridis, Cleen picus and Cleen picus as new species from Calcutta. M. T. Gillies (1939 and 1953) described the following new species from different parts of India: Battilea shahina, Battilea bohara, Battilea shahina, Battilea shahina, Battilea shahina, Battilea bohara, Battilea bohara, Battilea bohara, Battilea bohara, Battilea bohara, Battilea bohara. The above-mentioned works have also described Caenis and Eo as new genera. Kapur and Kirpalani (1961) described Baetis simplex, Baetis chandra, Baetis himalayana, Baetis aegyptiacus, Baetis farreri and Ecdyonurus ladakeiens as new species from Kure and Lahaul Spiti valley, Punjab (India).

The author in this paper described the nymphs of the following new species:—Ephemerina varia, Ecdyonurus islamabadicus Baetis makanis, Baetis melanesii, Cleen gilliesi, Cleen beyerianus, and Cleen khasii. As far as the author is aware these genera Ephemerina and Choroteges are not recorded from India, and Nepal.

2. PHYSICAL FACTORS

Rawalpindi district is located in the lowlands of southern Himalayan slope. Its elevation rising 1000 feet at Gajjar Khan, 1600 feet at Rawalpindi to 7000 feet in the hill station of Murree. There are two rivers and a number of streams around Rawalpindi. The Swan River arises from the Muree Hills, runs towards southwest and drops into the Indus River. The Hazro River arises from the hills of Bannu, runs westwards and discharges into the Indus River. The main streams are Kora, Gujar, Kahi, Ling, Haro, and Leh. These are two artificial lakes that is Rawal and Iltot, and a few ponds in Azab National Park. The bottom of the river and streams consists of small stones, boulders and rocks. The average minimum temperature is 36°F in January and maximum temperature rises up to 112°F in the summer. The relative humidity is low most of the year. This may rise up to 70% during the months of July and August. There are two periods of rainfall that is winter and summer, the average rainfall is about 35 inches per annum.
3. PLACES OF COLLECTION

The bulk of the collection of mayfly nymphs has been done from the following places:
(a) The Korang Stream at Salgran, Chautara, and Solpur on Murree Road.
(b) The Korang and Guwarah Streams meeting the Lethar Road.
(c) The Leh stream near Holy Family Hospital.
(d) Rawal Lake.
(e) The streams of Nupur and Saidpur.
(f) The Soan River crossing the Grand Trunk Road.
(g) Ponds of Sultanpura, Gordon College New Campus and Ayub National Park.

Location Map of Rawalpindi is attached.

4. METHODS

Sunder, Ekman samplers and dip nets were used for the collection of mayfly nymphs. Surber sampler was used in shallow running water of streams, Ekman in pool areas, and dip net along the banks of ponds and streams. Nymphs were preserved in distilled formalin.

Temporary glycerine mounts of nymphs were used for the study. For permanent mounts, specimens were treated with 10 per cent KOH (cold) for varying length of time depending upon the size, and after usual process of dehydration and clearing, mounted in Canada balsam. Mouthparts, legs and gills were dissected in clove oil. Final sketches were made with the help of camera lucida.

5. SYSTEMATIC ACCOUNT

The nymphs of five families, six genera and seven species were collected.

The key which follows, is for the families of the mayfly nymphs of Rawalpindi district:

1. Mandibles with external tusk projecting forwards, visible from above; gills two-branched, margins heavily fringed...
   Ephemeridae.

Mandibles with no such tusk; gill never heavily fringed...

2. Eyes placed laterally, body not strongly flattened dorsoventrally...
   Ephemeridae.

3. Cerüli (outer tails) hairy on inner side only, postero-lateral angles of apical abdominal segments not produced into flattened spines...
   Butidae.

Cerüli hairy on both sides are set with short setae...

4. Seven pairs of abdominal gills...
   Leptophlebiidae.

Five or six pairs of gills on segments, 4–6, first pair rudimentary, second large and quadrangular covering the remaining pairs...
   Cinyidae.

Family: Ephemeridae

Genus: Ephemerina

The frontal process of the head has a conspicuous sharply projecting angle at each lateral margin. The mandibular tusks are long, slender and smooth with a few small tooth-like ranks, on outer side near the base. The apex of the labial palp is broad and truncate.

Ephemera 1000–2000 x. nov. (Plates 3, 11.)

It is found in the sandy bottom of streams and rivers. Length of the body is 14 mm, median caudal filament is 9.5 mm, and anal cerci are slightly shorter than the filament.

Body is elongate, perfectly cylindrical tapering at either end. It is dark brown dorsally and pale on the ventral side. The head is prothorax with mandibular tusks projecting sharply in front. The anterior part of the body is produced into a truncate rostrum. Eyes are lateral and ocelli are also present. Antennae are short, and broad with numerous hairs.

Labrum is wide in front, slightly narrow behind; a shallow notch in the centre of the apical margin; a row of long and stout bristles along the sides, a row of smaller bristles in the centre (Fig. 1). Mandibles have long and curved tusk on which hairs are present. Genital areas

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are much bigger than glabrous and para-
gloues and form an arcade structure in
from; they are 
segment is truncate and has bristles towards
the distal end; bristles are also present on
gloues and paragloues (Fig. 4). Lateral
lobes of the hypopharynx are not elongated.
Legs vary in size and shape. The last
leg is the biggest. Femurs are short and
broad; tibiae of the first pair of legs differ
from the others in being broad and boat
shaped; tibiae of the last pair are longest;
the distal ends of the tibiae of the second
and third legs have inward projections.
Long hairs are present on coxa, trochanter,
femur, tibia and tarsus; numerous short
bristles are present on tibia and a few
small bristles on tarsus; claws are elongated
and consist of a row of flat ventral denticles
(Figs. 6, 7).

The gills of the first abdominal segment
are rudimentary and each has two minute
lanes. According to Morgan (1913),
the first pair of gills are single lance-like.
The gills on segments 2–7 are well developed, bilamellate; each lamella is further divided into numerous fine filaments. Tracheation is prominent. These gills are turned upwards over the abdomen. Median caudal filament and cerci are short, and divided into joints. Dense hairs are present on both sides of the caudal filament and cerci (Fig. 5).

**Family:** Eudamniidae

**Genus:** Eudamnius Eaton

Body is flattened dorsoventrally, especially the head, the side margins of which in the mature nymphs are rounded, eyes dorsal. Hind angles of the pronotum are strongly produced backwards. Seven pairs of abdominal gills covering tufts of branchiae. Three caudal filaments, setae arising from joints. General colour of nymphs is brownish or greenish with pair or yellowish markings. Tarsi usually darker at apex, tarsal claws with teeth.

_Eudamnius tasmaniae_ sp. nov. (Plates III and IV)

It is found crawling on the under-surface of submerged stones.

Length of the body is 14 mm, caudal filaments are longer than the body. General colour is brown. Head is flattened more than twice as its length, widest at the level of the anterior portion of eyes. Epicranial and coronal sutures are pale. Eyes dorsal, ocelli are also present. Antennae are short.

Labrum (Fig. 20) is short and wide, its width is four times the length, it is fringed with long hairs and short bristles towards the apical margin. Mandibles are broad in grinding areas and slender in the basal halves. Anterior canines are teeth on both sides, posterior canine has three elongated teeth towards the tip and three minute teeth along the outer margin, long hairs arise between these teeth. Prostheca is represented by 10 or 11 spines. Molar surface is well developed with irregularly scattered bristles. Long hairs arise from the outer and inner margins of mandibles (Figs. 11, 12 and 13). Maxillae are well developed, maxillary palps are three segmented, the second segment is fringed with two series of long hairs on the outer margin. Along anterior margin of gulae-lacinia there is a series of hook-like teeth. A number of spines are present on the rest of the surface, hairs arise from the inner surface of gulae-lacinia (Fig. 15). Labium (Fig. 16) is large in size, labial palps are broad and two segmented, the distal segment is thickly beset with bristles on outer margin. Glosae are rounded and widely separated paragnathae are laterally elongated, both glosae and paragnathae are thickly beset with long hairs. Lateral lobes of hypopharynx are somewhat rounded and beset with bristles (Fig. 14).

Pronotum is short, slightly wider than head, with divided rounded lateral margins which are prolonged behind and fixed to the sides of mesonotum, with dark colour on either side of the median line.

Legs are equal in size, femora are broad and flattened, long spines are present on the
Caudal filaments are equal in length, longer than the body. They are stout and straight and have rows of minute spines along the joints.

Family: Batiidae
Genus: Batis Leach

Nymphs are streamlined and live in shallow running water. They are most commonly found under stones and among debris or emergent vegetation along the banks of brooks or creeks. The labrum with a deep notch towards the anterior end. Just inside the front margin there are finely- and closely-frayed. In most species there is a transverse row of stout and longer bristles. On the under surface of the labrum, epiphorous is present consisting of long fine-curved hairs. Mandibles are robust, pyramidal structures, consisting of outer molar and outer canine areas. In most species there are seven rows on canine area with a minute extra row between 4th and 5th counting from outside. Below the canine area the mandibular palp or process is present. The process of the left mandible bears on its outer margin an area of teeth of which upper are short and lower are long; the process of the right is smaller and consists of bristles. The maxillary palp may be two or three-segmented; the palp may extend the tip of gula-lacinia. Teeth and bristles are present on gula-iacinia. Claws and paragnaths are distinct. The labial palp has 3 segments, the inner distal corner of middle is produced into a process which varies in size and shape. The terminal segment towards the tip bears numerous fine hairs and robust spikes.

Along the Genus there is row of long spines usually a single row except at the base and origin. Claws with rows of ventral desicles.

Gills are simple lamellae posterior 1-7 segments. The gills except in the basal third is finally dochtulate and these is a minute hair between each end.

Batis maculis sp. nov. (Plates V & VI)

Length of the body is 5 to 8 mm, cereal area 3 mm and median caudal filaments is 2
suture is prominent, clypeus has a blackish, siderovated, area; antennae are long and arise from the anterior end, minute hairs arising from the antennal joints. Eyes are lateral.

Labrum is quadrangular wider than long, a deep-rooted in the crenate of apical margin, from the inner side of the anterior margin a row of plumose bristles arise, posterior to this there is another row of longer bristles which are few in number, on the dorsal surface bristles are scattered, on the ventral surface in the middle there are two rows of long bristles (Fig. 21). Mandibles are well developed, canine teeth are nearly pointed, 8 teeth are present on the left and right mandibles. The first tooth is set back; in addition to these there are 4 minute teeth along the inner margin of canines of the left mandible and 5.

Pl. V. Dorsal view of Rhith maenas.

mm in length. There are two dark brown patches on the posterior side of the head between the eyes; thoracic and abdominal tergites have dark brown markings.

The head is hypognathous, slightly narrower towards anterior end, epicranial

Pl. VI. Figs. 20-30 Rhith maenas: 21. labrum; 22. left mandible; 23. right mandible; 24. clypeus and proboscis of left mandible; 25. clypeus and proboscis of right mandible; 26. right maxilla; 27. left maxilla; 28. hypopharynx; 29. leg; 30. gill.

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of the right mandible; this character was not mentioned in any genera before.

Pottery to the caudal area there is an enormous process known as protostoma, it consists of 9 short-teeth towards the outer side and 4 long teeth towards the inner side of the left mandible; the prostration of the right mandible has a number of bristles. Molar teeth of the left mandible has 3 processes towards the inner side. (Figs. 22, 23, 82 and 35). Maxillary palp is segmented and extended to anterior and of gala-lacta, the last segment is the smallest and consists of minute spines; 4 well-developed teeth and a number of bristles are present at the anterior end of gala-lacta, and a few hairs are present along the inner margin (Fig. 29). Labial palp are 3 segmented; second segment has a distinct projection towards the inner side; last segment is the smallest and dome-shaped; it has numerous fine bristles; paraglossa are slightly longer than palps, numerous bristles are present along the anterior and outer sides; glosae are broader towards the base, spines are present along inner and outer margin (Fig. 31). Middle and lateral lobes of hypopharynx are near, equal and spines arise from their margins (Fig. 42).

Legs are similar, femora are not broad; a row of long spines are present along the outer margin of the femur, numerous short and broad spines on the rest of the surface; on the inner side towards the proximal end of femur there are minute hairs. A row of spines are present along the inner margin of tibiae and tarsi, on the rest of the surface there are short and broad spines; minute hairs are present between the spines on femora, tibiae and tarsi. Claws are pointed and consist of well-developed ventral denticles.

Gills have single lamellae, they are somewhat oval in shape; the margin is demarcated; and 2 minute hairs arise from each denticle; tracheole is prominent and tracheae are branched. First and the last gills are smaller in size (Fig. 30).

Cecci (outer filaments) are longer, long and dense, and present on both sides of median filament and on the inner side of cecci, along the outer side of cecci, there are minute setae.

*Basti meridoni* sp. nov. (Plates VII and VIII).

Length of the body is 5 mm and cecci are 3 mm long, median caudal filament is very short. Lack brown markings on the head, thorax, and abdomen.

Body is broader than *B. meridoni*, antennae are short, eyes are lateral, ocelli well developed.

Labrum resembles that of *B. meridoni*, but is shorter in length. (Fig. 34) Canine areas of each mandible have eight teeth, 3 minute teeth along the inner margin of the caudal of the left mandible and 4 minute on right mandible. The prostration of left mandible has 3 short and 5 long teeth and that of right mandible has several pointed teeth (Figs. 39, 43, 34 and 35). Maxillae resemble those of *B. meridoni*, but their palps are very short.
three segments; each tarsal claw is relatively short, broad at the base, slender at the tip, and bear a single row of minute ventral denticiles; the abdominal gills are sheet like, undulated and double with tracheation branching palmately; the three caudal filaments well developed.

**Cleon gillicus** sp. nov. (Plates IX and X)

Length of the body is 6 to 5.5 mm, cerel and caudal filaments are 4 mm long. Colour of the body is brown, head is hypognathous; eyes are lateral, and antennae are long.

Labrum with a deep notch in the centre of apical margin; there is a marginal row of plumose bristles; a row of longer bristles towards the inner side, and a

(Fig. 33) Labial palp are 3-segmented. second segment has a blunt projection towards distal end, the last segment is flattened (Fig. 36). Thorax is broader as compared to S. mariae. Femora are broad, there is a row of long bristles along the outer margin of femora, tabiae and tarsal, while there are minute spines on the inner side; claws consist of 11 or 12 teeth (Fig. 38 and 39). Gills are 7 pairs, they are broad, first and seventh gills are smaller than the rest.

Median caudal filament is very short and consists of 11 or 12 joints, and consists of hairs and setae on both sides; cerel area long and curved outwards, hairs are present on the inner side, and minute setae are present along the articulations.

Genus: Cleon Leach

Both maxillary and labial palps have

Plate IX. Dorsal view of Cleon gillicus.
number of bristles scattered on dorsal surface (Fig. 41). Each mandible consists of 2 canine projections, four teeth are present on each projection, 4 minute teeth along the inner margin of the inner projection. Of the left mandible and 40 on the inner margin of the inner canine projection of the right mandible. This character is not mentioned by previous workers. The prostheca of the left mandible has 5 short and three long teeth, that of the right consists of 5 short teeth. On both mandibles between canines and molar areas there are numerous long bristles. The molar area consists of crenate bristles (Figs. 42a, 42b, 42d, and 43a). Maxillae are slender, in addition to 4 maxillary teeth there is a row of pointed bristles; maxillary palp are three-segmented, spines are present on all segments (Fig. 43). Labial palp are 3-segmented, the third segment is truncate with pointed bristles along the free end; paraglossae and glossae are elongated; longer spines on paraglossae and short spines on glossae (Fig. 40). Masticatory lobe of hypophasyx is small (Fig. 44).

Legs are slender, femora are thin, spines are present on inner side of femora, tibiae and tarsi, hairs are present on the outer side of all joints. Claws with a row of well-developed teeth.

Tergites of abdomen have spines along the sides. Towards the posterior margins of terga and sternum of abdomen there is a row of pointed teeth like spines. Gills 1-7 are similar, bilaminate except the last; dorsal lamellae are smaller, tracheation is palmate. Gills are turned towards the back.

Cerci and caudal filaments are straight. From the inner side of each cercus and the both sides of the median caudal filament number of long hairs arise; setae arise from both sides of joints of cerci and caudal filaments, setae also arise from the articulation of joints.

**Family:** Leptodylididae

**Genus:** Chroserpes Eaton

Head and body dorsoventrally flattened. There are three segments in each of the labial and maxillary palps. The labrum is quadrate and strong. Each tarsal claw is single relatively short, thick at the base and provided with one or two rows of ventral denticles. The first abdominal segment bears a pair of single filamentous gills, 2 to 3 have each a pair of bilobed lamelli form gills, each lamina has a spatulate terminal extension which varies in shape among different species. The median caudal filament is longer than cerci.

**Chroserpes gubinus** sp. nov. (Plates XI and XII).

Length of the body is 6 mm and median caudal filament is 8 mm long, cerci are short.

The colour of the body is brown, there is a blackish patch between the eyes, and an elongated patch on each abdominal tergite. Head is quadrangular; eyes are relatively
Plate II. Dorsal view of *Charaxes gabrius*.

Small and placed laterally. Antennae are long.

Labrum is broad with a shallow notch towards the anterior end, bristles are present along the margin; there are rows of bristles on dorsal side (Fig. 51). Mandibles are rounded towards the anterior side from where long bristles arise; there are 2 projections in the canine area. Outer canine projection of each mandible has 4 teeth. The inner projection of the left mandible has 2 long teeth on the tip and 3 minute teeth along the outer margin, the inner canine projection of the right mandible has 3 teeth at the tip, 3 behind along outer margin. The prostoma of each mandible is bifurcated and each branch consists of bristles; the maxillae also consist of crenate bristles (Figs. 52, 53, 54 and 55). Dense hairs are present on the anterior end of golen-hachis, and a row of long hairs along the inner border; maxillary palps are 3-segmented, the last segment is the smallest and has bristles, hairs are present on all segments; paraglossae are much wider; glossae are small, dense bristles are present on both (Fig. 52). The lateral lobes of hypopharynx are expanded (Fig. 58).

Long spines are present on the outer side of femora only, and short spines on the inner side of femora, tibia and tarsi. Claws consist of well developed teeth (Figs. 61 and 62).

Gills are well developed, present from 1-7 abdominal segments; the gill of the first pair is long and filamentous, the rest of the gills are bifid, each lamina has three filaments which contain trachea (Figs. 59.

Plate XII. Figs. 57—60. *Charaxes gabrius*: 57, labrum; 59, left mandible; 59, maxilla and prostoma of left mandible; 59, right mandible; 59, maxilla and prostoma of right mandible; 59, right maxilla; 59, labium, 59, hypopharynx; 59, first gill; 59, second gill; 60, fig. 60, tarsal claw.
The lateral margin of each abdominal tergite ends into a pointed projection facing posteriorly, minute hairs are present along the lateral margin.

Cerci and median caudal filaments are long, short hairs arise from both the sides of cerci and caudal filament; articulations of points have noticable setae.

**Family:** Canidae

**Genus:** Canis

The body is flat, the width of the prothorax is narrower than metathorax. The head is smooth without tubercles, each antenna is twice as long as the head and pronotum combined. The legs are relatively short and stout; the claws are small and slender, have extremely minute tubercles. The first abdominal segment bears a pair of prominent single filament gills; the gills of second segment are quadrate and operculate. The gills on 3 to 5 segments are single plate like, each gill has margin deeply flared to produce a marginal fringe of long filament, each filament is incompletely divided near the tip to produce two or three smaller filaments. Caudal filaments are straight with a wheel of three to four sense at each articulation.

**Canis simmansi** sp. nov. (Plate XIII)

Length of the body is 3 mm. and caudal filament is 4 mm.

The body is dark brown on the dorsal surface and pale on the ventral side. There are dark markings on head and thorax. A few hairs arise from the anterior margin of car; antennae are more than twice in the length than head and pronotum combined; hairs arise from 3rd joint.

Labrum is broad with a shallow notch towards the anterior end (Fig. 67). Each mandible has two outer projections, there are 4 teeth on outer and elongated teeth on inner comissals; prostheca consists of a minute projection ending into bristles.

Malar spines have plumose bristles (Fig. 63). Maxillae are slender, maxillary palps have 3 segments; last segment is the longest and consists of spines at tip (Fig. 67). Labial palps are 3 segmented, glossae are rounded, bristles are present on palp and paraglossae (Fig. 67). The lateral sides of hypopharynx are expanded laterally (Fig. 68).

Prominent is broader towards the anterior end, minute spines are present on the sides. Yemona are broad and consist of long spines along the outer side and a few hairs on the inner side; there are a few long hairs on the outer side of tubae and trans, and spines along the inner side; the claws are pointed and have ventral denticles (Fig. 69).

Abdominal tegmina have posterolateral spine...
like projections, numerous minute spines are present on lateral margin of tentacles, from the posterior margin of tentacles hand arise.

First pair of gills are small and have single filament with spines (Figs. 70, 71, 72). Second pair of gills are large and opposite with white or striated margin. Post of the gills are single plate like with fleshy margins.

Caudal filament

Cerci and caudal filament are long, pines are present on both sides of cerci and caudal filaments, setae arise from the articulations of joints (Fig. 73).

DISCUSSION

Euphorbia manica was found in pool area of verna and the sotam River; it is bottom-feeder and its legs are modified for digging.

Clava glabella was found in temporary and persistent ponds and Kawan Lake. It was also collected from pools of Kiswa, Dist. Kannur, Kollam, Thrissur, and Trivandrum. It was collected from all running waters; it was collected from Kerala, Harshara, Distt. Kollam, Thiruvananthapuram, and Trivandrum. Clava glabella was found in all running waters.

Number of teeth in calice area of manubria are of great importance in the identification of species. row of minute teeth which the author found in Harim manubria, buds meckes and Clava glabella were not mentioned before by any other workers. prosencephalic mandible, appearance of spines on fomor, antennae and caudal filament were also used for the identification of species.

Along the posterior margin of abdominal tentacles of Eucyrtisflatus blakcfieldii and Clava glabella there is a row of pointed teeth, like structures which were not mentioned by any worker before.

The Simple Nymph of Jessup District

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