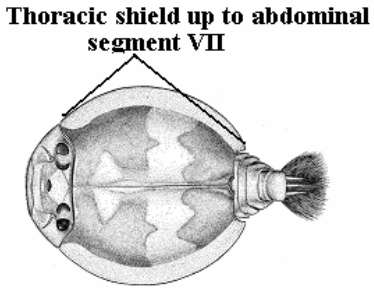
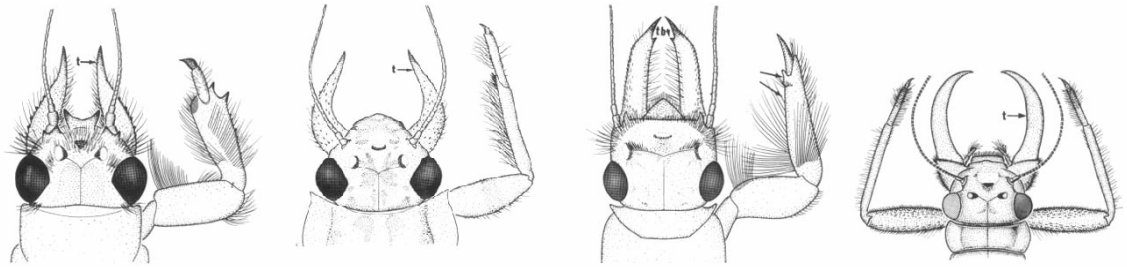
Key to families, genera and known species of mature nymphs of mayfly (Ephemeroptera) of Western Ghats, India

1. Body smooth and hemispherical (beetle-like); all gills and much of the abdomen covered by a thoracic shield extending to abdominal segment VII …..…....Prosopistomatidae…. Go to I



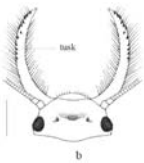
- Body form not as above; abdominal gills partially or completely exposed; mandibles with tusks like projections…….…….....2

2. Mandibles with tusk-like projection; gill II-VII double and uniform in structure with fringed margin, gill I variable……...……3



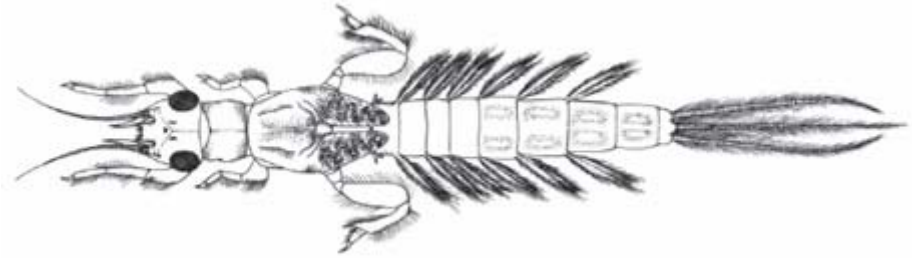
- Mandibular tusks like projection absent; gill form otherwise……...…….……5

3. Mandibular tusk long and sickle- shaped, bearing many long setae; maxillary palp more than twice as long as the galea-lacinia (the apical part of the maxilla) …… ……..Polymitarcyidae …….. go to II

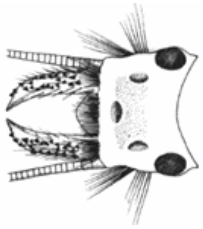


- Mandibular tusks otherwise, bearing short bristles; maxillary palp as long as or slightly longer than the galea-lacinia ……Potamanthidae……Go to III

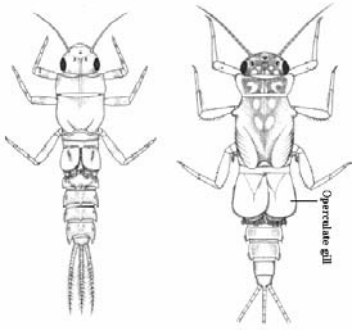
4. Tusks curved outwards, inner edges convex ……..Ephemeridae….go to IV



- Tusks curved inwards, inner edges convex……..…Polymitarcyidae…..go to II

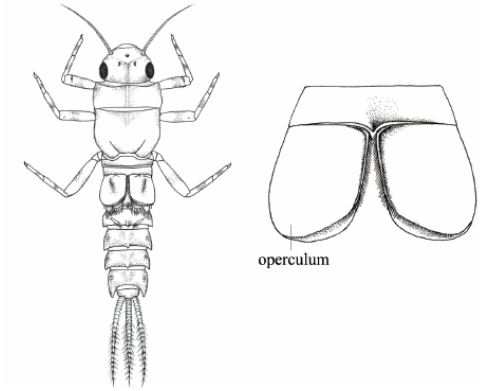


5. Gills on abdominal segment II large and plate like (operculate), touching or overlapping along the dorsal midline and covering all or some of the gills arising posteriorly, gills III – VI with fringed margins.....……. …….....….6

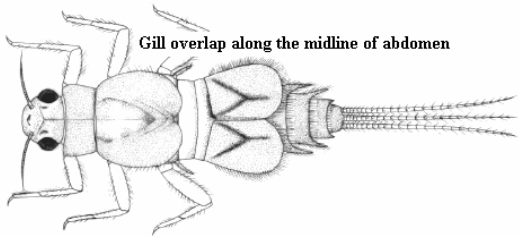


- Gills on abdominal segment II not as above……..7

6. Gills on abdominal segment II meet along the midline; terminal filament densely clothed with setae on both margins, lateral filaments with setae on the inner margins only; mature nymph has small hind wing pads beneath the fore wing pads on the meta thorax.....Neoephemeridae…….Go to V



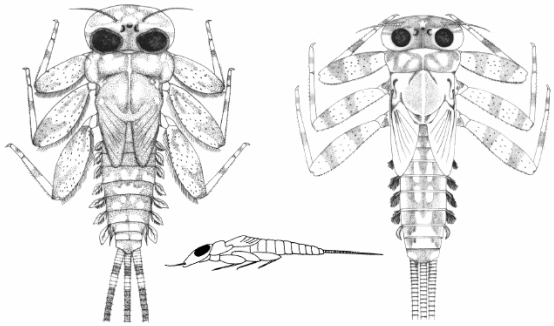
- Gills on abdominal segment II overlap along the midline and covering all of the succeeding (3 -6) gills; lateral and terminal filament bearing rather short and sparse setae on the inner and outer margins, hind wing pads not present.....Caenidae……Go to VI



7. Gills on abdominal segments I – VII, a tuft of filamentous gills present upon the coxa of fore-leg and the base of maxilla respectively; frontal edge of fore-leg fringed with long hairs; infero-distal end of tibia of fore-leg fringed with long hairs; infero-distal end of tibia of fore-leg with a long and pointed spine…….……...Isonychidae

- Inner margins of femora and tibiae of forelegs without rows of long setae ……..…..8

8. Head is flat and plate-like with dorsal eyes; body dorso-ventrally compressed (flattened); gills plate-like and never doubled but may have a dorsal tuft of tracheae (= gill tufts) at the base of the lamellae…….....……..….Heptageniidae…..…Go to VII



- Head not plate-like; gill form various shapes but if plate-like then never with a dorsal tracheal tuft at the base of he lamellae….....9

9. Labium fused into a single semicircular structure, palps with long setae; gills on abdominal segments II-V or II-VII, gill II may overlay and partially conceal the rest of the series; a terminal filament is present; …….....….Tricorythidae…..….Go to VIII

- Mouthparts and gills not as above; terminal filament reduced or lacking….……...…….10

10. Gills on abdominal segment II absent and gills borne dorsally… Ephemerellidae….Go to IX

- Gills on abdominal segment II present and gills borne laterally …….…….……11

11. Terminal filament absent but two lateral filament present; lamellate gills on abdominal segment II-V; femora greatly expanded; posterior margin of abdominal terga I – X each with mid dorsal tubercle…….....Teloganodidae…….Go to X

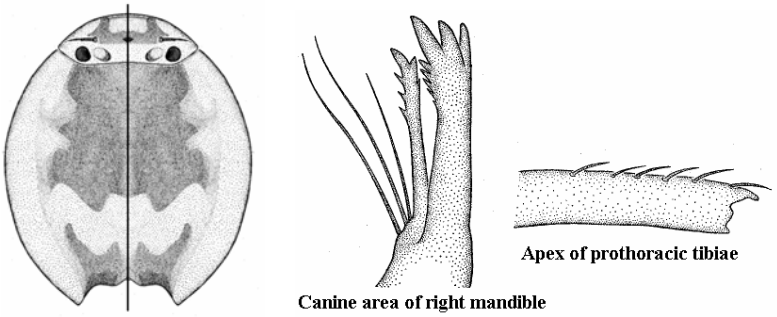
- Larva with a well developed terminal filament……..12

12. Head rectangular; gills similar, long, slender and bifurcate (forked) in form or the first pair is rudimentary (thread-like) and others plate-like (usually with apical prolongations or fringes) and doubled; terminal filament is well-developed and similar to cerci (= lateral filaments)…….……Leptophlebiidae……Go to XI

- Head round, antennae long and twice the width of the head; median terminal filament often much reduced and always shorter than the cerci (lateral filaments); hind corners of the last few abdominal segments are not drawn out into spines……....Baetidae…..Go to XII

I. Key to genera and species of Prosopistomatidae

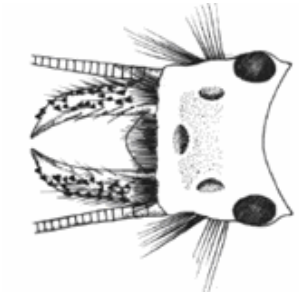
1. Two pairs of lateral indentations in anterior color pattern of mesonotum; apex of inner margin of prothoracic tibiae with six unserrated spines ……..……..***P. indicum***.



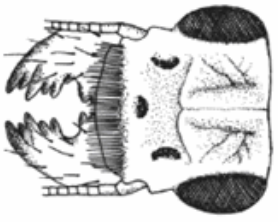
II. Key to genera and species of Polymitarcyidae

1. Long filtering setae on the mandibular tusk and without tubercles; caudal filaments with inconspicuous fine setae……***Euthyplosia***

- Medium sized filtering setae and small tubercles; a single gill on abdominal segment I, and others are forked ……..***Ephoron***
  Larval description unknown……..***Ephoron indicus***

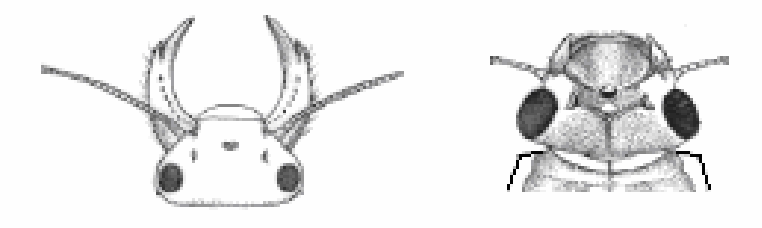


2. Broad and flat tusks which are strongly toothed close to the apex .....***Povilla***



III. Key to genera and species of Potamanthidae

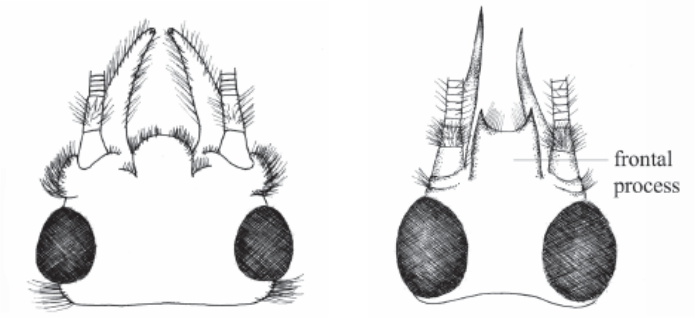
1. Mandibular tusks roughly equal to or longer than the length of the head, fore tibiae relatively two to three fold long, with dense hair like setae on dorsal and lateral surface ....***Rhoenanthus***
   larval species description unknown…….……***R.distafurcatus***



- Mandibular tusks shorter than one half of the length of the head..... ***Potamanthus***
  larval species description unknown……..……..…..…***P. subcostalis***

IV. Key to genera and species of Ephemeridae

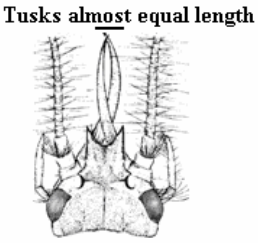
1. Frontal process on the head reduced; rather inconspicuous and not bifid; mandibular tusks are triangular in cross-section; tarsal claws on forelegs reduced relative to those of the mid- and hind legs.....Hexageniinae.....***Eatonigenia***……..5



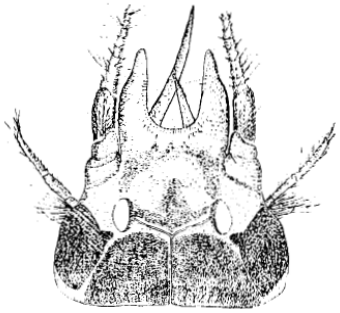
- Frontal process on the head well-developed and bifid; mandibular tusks are circular in cross-section; tarsal claws on forelegs not reduce ……...…Ephemerinae..... 2

2. Mandibular tusks well-developed; abdominal gill I with two lobes of roughly equal size.....***Ephemera***…3

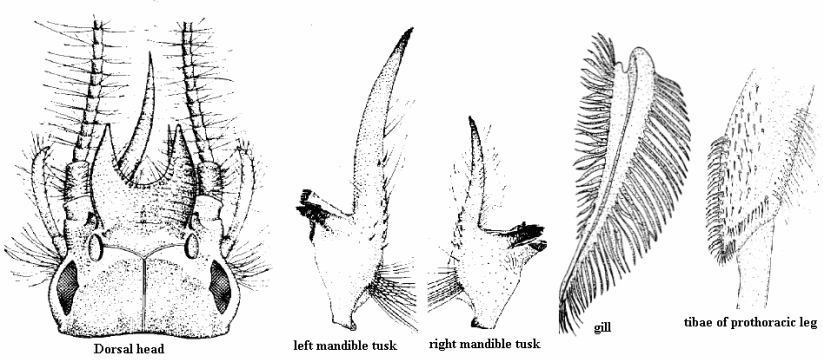
3. Mandibular tusks of approximately the same length……..subgenus …..***Ephemera*** larval description unknown…….. *Ephemera (Ephemera) distincta, Ephemera nathani, Ephemera (Ephemera) diffusa, Ephemera (Ephemera) annandalei, Ephemera (Ephemera) immaculate, Ephemera (Ephemera) exspectans, Ephemera (Ephemera) supposita, Ephemera (Ephemera) fulvata*



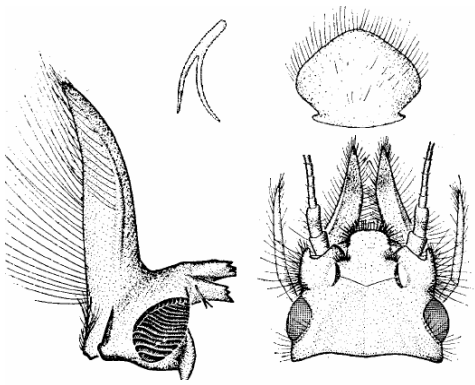
- Mandibular tusks markedly asymmetrical (the right is shorter)…… ……subgenus ……....***Aethephemera***....4



4. Frontal process of head golden brown, deeply concave anteriorly, lateral margins distinctly rounded, margin of concavity fringed dorsally with long golden setae; dorsal surface of tibiae of prothoracic legs entirely spuriferous; tibial processes of meta thoracic legs with dense covering of golden brown setae. ……..…..***Ephmera (Aethephemera) nadinae***



5. Distal margin of labrum with row of long setae, anterior surface with only sparse setae; mandibular tusks with row of setae bordering flattened dorso-median surface for nearly entire length; lateral margin of para-glossae of labium with thick brush of short setae; gill 1 very narrow ……..***Eatonigenia trirama***

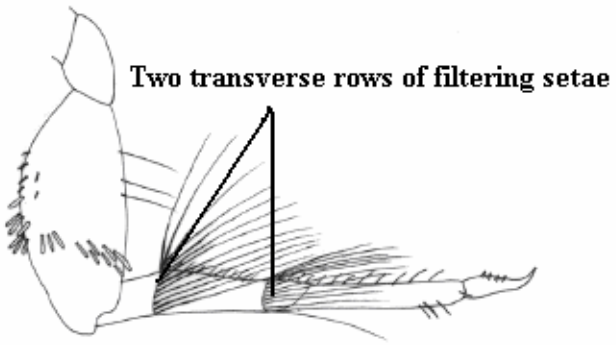


V. Key to genera and species of Neoephemeridae

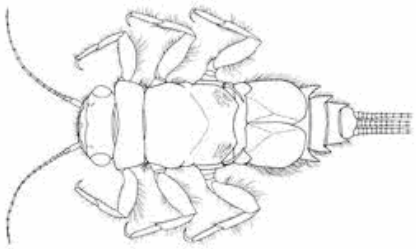
1. Operculate gills with diagonal ridge, abdominal terga 6–8 with distinct postero-median tubercle and without a row of setae on the dorsal fore femora …***Potamanthellus ganges***

VI. Key to genera and species of Caenidae

1. Head lacks ocular tubercles(although ocelli are present), fore tibiae with two transverse rows of filtering setae, long setae protruding from the front of the head between and below the antennae; gill covers with a simple ridge; maxillary palps two segments.....***Clypeocaenis***..2

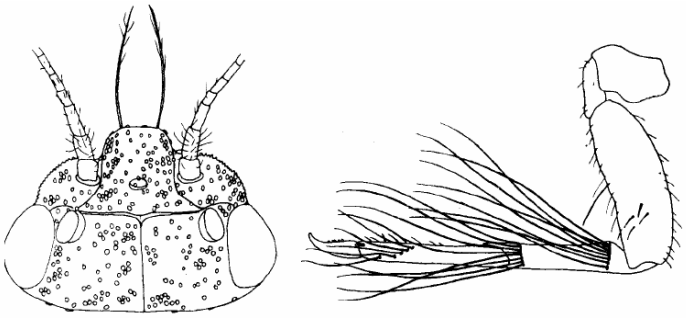


- Fore tibiae without two transverse rows of filtering setae; gill covers may have a triangular or Y-shaped ridge; maxillary palps three segments, gill cover lacks stout spines (but not setae) on the upper surface, but a row of submarginal spines is present ..... ……*Caenis*



- Larval description unknown……Caenis nigrostriata

2. Two long setae with hairs on the posterior margin of clypeal protrusion; setae shorter than the width of femora on the margins of middle and hind portion of femora, a group of setae (four) on femora of foreleg; pointed spines present in the posterior margin of terga I and II, but without scales and spines on terga III –VII……...*Clypeocaenis bisetosa*



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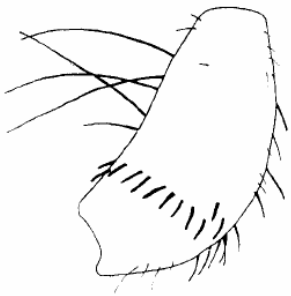
- Numerous (10-15) long setae with hairs on the anterior margin of the clypeal protrusion, setae longer than the width of femora on the margins of middle and hind portion of femora, transversal row of stout spines on fore femora, no spines on medial projection of tergum II, blunt teeth on the posterior margins of terga VIII and IX……..*Clypeocaenis multisetosa*

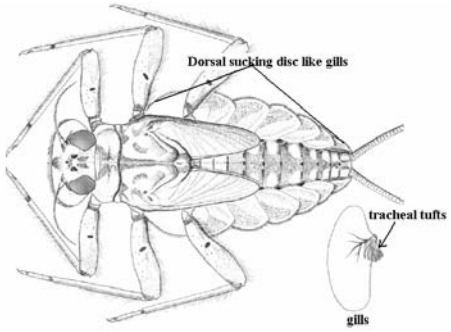


VII. Key to genera and species of Heptagenidae

1. Two filaments at the end of the abdomen (i.e. the terminal filaments are absent)…...……. 2

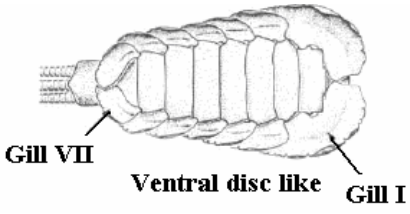
- Three filaments at the end of the abdomen (i.e. two lateral and a terminal filament are present) ....……..3

2. Gills I-VII modified to form ‘sucking disc’; tracheal tufts of gills weakly developed;: the first pair of gill strongly broadened anteriorly and the opposite members of the pair contact each other under the body; gill VII curves inward and often has longitudinal fold; usually paired spines or a row of hairs along the median dorsal line of the abdomen. ..... ***Iron***



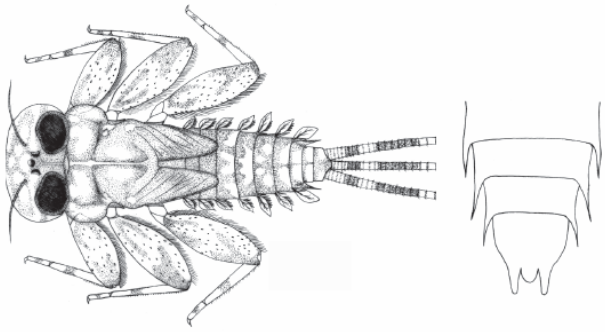
- Gills I-VII not modified to form ‘sucking disc, although they may be well developed .....***Epeorus***

3. Gills on abdominal segments I and VII enlarged and meet or almost meet beneath abdomen to form ventral disc……..... ***Rhithrogena***



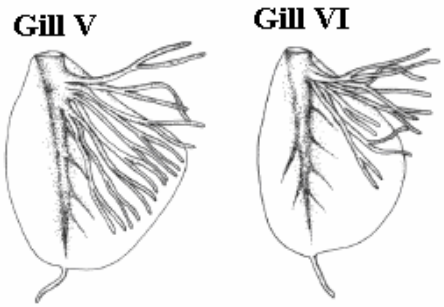
- Gills not as above.....4

4. Spiniform lateral process on segment II – VIII well develop; those of segment VII may extend slightly beyond the posterior boundary of segment VIII.....***Thalerosphyrus***……8



- Lateral abdominal processes less well developed or lacking…….5

5. Lamellae of gill V and VI with acutely pointed apical prolongation; cerci with rings of short, black bristles, and alternating bands of light and dark pigment on the segments…….....…***Cinygmina***



- Gill lamellae without apical prolongations; cerci not as above……..……6

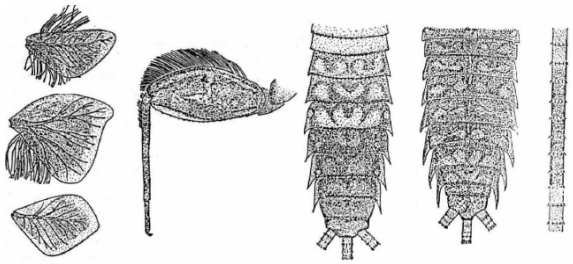
6. Lateral borders of the pronotum are dilated and extend posteriorly onto the sides of the mesonotum……..***Ecdyonurus***……..7

- Lateral borders of the pronotum not elongates posteriorly; cerci without fine setae but may have spines; cerci long (up to twice the length of the body); lamella of gill I lanceolate or rather blunt…….. ***Afronurus*** …9

- Tibia lack spines; maxillary palp with two segments; gill VII with rounded tip and no more than twice as long as broad; cerci bear spines as well as lateral bristles and segments of the cerci with stout spines alternate with those lacking such spines……..***Rhithrogeniella***

7. Femora with a wide zigzag band and bristles slim-tapered, slightly pointed. Claws with 4 subapical denticles; gills VI acutely pointed apical prolongation…….E. keralensis

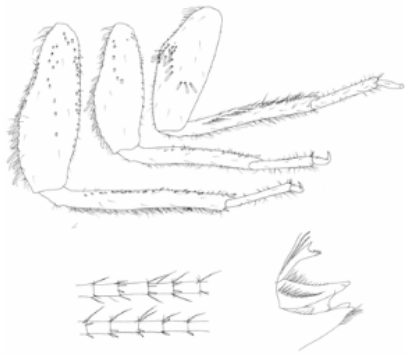
8. Gill I is asymmetrical, ovoid and 1.5 times as long as wide, femora of all legs are yellowish-brown with a median, zig-zag pale yellow bands; terminal filament is hyaline, lateral cerci are yellowish brown, three filaments are interspersed with blackish brown segments……..…***Thalerosphyrus flowersi***



9. Gill leaflets on abdominal segment 5 without acutely pointed apical elongation; femora of legs with scattered pale maculae and median, transverse, zig-zag pale yellow band…….. ***Afronurus Kumbakkariensis***

VIII. Key to genera and species of Trocorythiridae

1. Right prostheca notched, with several pointed teeth, bearing several setae on the inner side; legs are very slim, transversal row of setae on the fore femora bow-shaped, with a group of chaotically inserted setae near fore femoral posterior margin, Individual segments of caudal filaments rounded at its posterior margin with setae approximately as long as 1/3 of the length of segments…….***Sparsorythus gracillis***



IX. Key to genera and species of Ephemerellidae

1. Larvae with spines or tubercles on the head; fore-femora usually expanded bearing spines along the anterior margin; body robust……..……..Drunella

- Larvae without spines or tubercles on the head; fore-femora not expanded and without spines along the anterior margin……...……2
2. Gill III is enlarged and semi-operculate, covering most of the rest of the gill series…….…….Torleya
- Gills III is not enlarged or semi-operculate…….....3

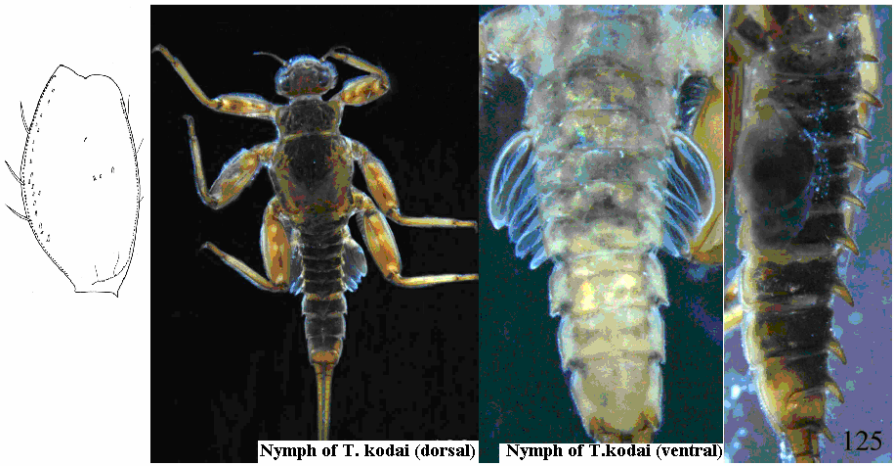
3. Cerci with whorls of setae at the end of each segment, and with lateral intersegmental setae; maxillary palps present……...Ephemerella

X. Key to genera and species of Teloganodidae

1. Abdominal gills present on segments II–VI; outer margin of fore-femora without a row of transverse setae on dorsal face……2

- Abdominal gills present on segments II–VI; outer margin of fore-femora with a dense row of thin setae and some scattered thick and pointed setae …….……3

2. Teeth of inner incisor of left mandible similar in size; outer margin of fore femora with a dense row of thin setae only .....***Teloganodes kodai***



3. Labrum 3 times wider than long; outer margin of mandibles with one stout seta; outer margin of fore-femora with 12–15 thick and pointed setae .....Teloganodes insignis

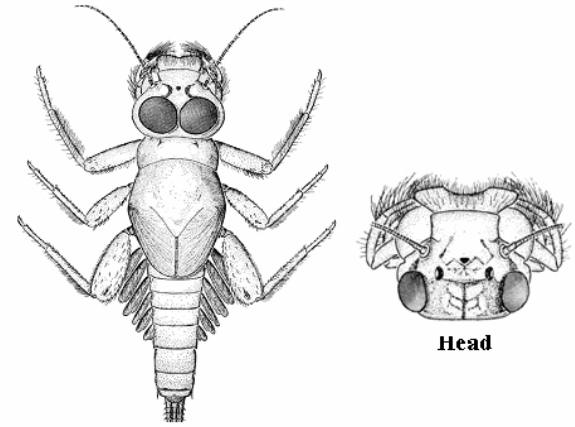
- Larval description unknown…….……..……..Teloganodes dentatus

XI. Key to genera and species of Leptophelebiidae

1. Abdominal terga extending around to the ventral surface of the abdomen on segments III-VII, so that the slender gills arise ventrally…….....***Isca***
   larval description unknown …..……..***Isca purpurea***

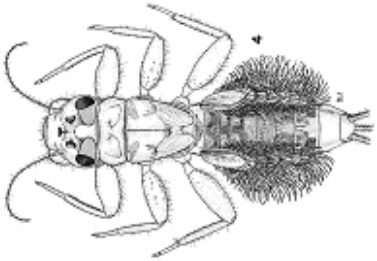
- Abdominal terga extending to lateral sides of abdomen, all abdominal gills lateral or dorsal.....2

2. Maxillary and labial palpi greatly elongated and highly setaceous; extending beyond side of head ……..……3



Nathenella sp.

- Maxillary and labial palps not extending any distance beyond the sides of head……..…….4



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3. Gills present on abdominal segments I-VI; the apical denticle on the tarsal claws is greatly enlarged; India only……..***Notophlebia***……12

4. Middle abdominal gills III – V flat and rather plate like and fringed with filamentous processes…….……..……5

- Middle abdominal gills without a fringed margin, may be plate-or leaf-like, or bifurcate and long and slender……..…..…7

5. Middle abdominal gills plate like and broadly oval and fringed with thin filamentous processes; postero-lateral spines on abdominal segments VII – IX or VIII – IX……...…6

- Middle abdominal gills plate like but irregular in shape, unevenly fringed with rather broad filamentous processes; postero-lateral spines on abdominal segments III – IX or VIII – IX, which are especially long and well developed on the last two segments …….***Petersula***….13

6. Ventral lamella of abdominal gills II- VII subequal to or slightly larger than dorsal lamella; posterior margin of labrum not strongly convex; entire margins of abdominal gills II – VII fimbriate ……...……...***Thraulus***…….14

7. Gill I similar to the others in the series, middle abdominal gills plate like and broad……..…….……8

- Gill I differing from the others……...…..…….….9

8. Margins of the head capsule are broadly expanded(giving it a rather rounded appearance), apex of gills I – VII with three filamentous processes, the median process is longer than the laterals…….……..……...***Nathenella***……15

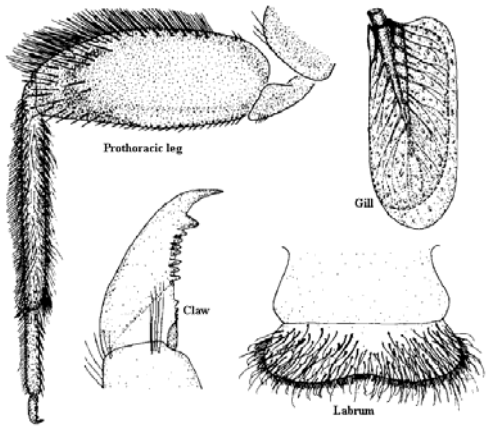
9. Gills not forked, trachea branched in each gill portion; a moveable denticle absent at the base of the tarsal claw; Head prognathous ……..…….10

10. Third segment of the labial palp has a row of short stout spines on the inner dorsal margin; outer margin of the mandibles with a median tuft of around 10 long setae; postero-lateral spines on abdominal segments IV- IX……***Edmundsula***……16

- Third segment of the labial palp without a row of spines on the inner dorsal margin; outer margin; rather sparse or scattered setae on the outer margin of the mandibles; posterolateral spines on abdominal segments V- IX……..….11

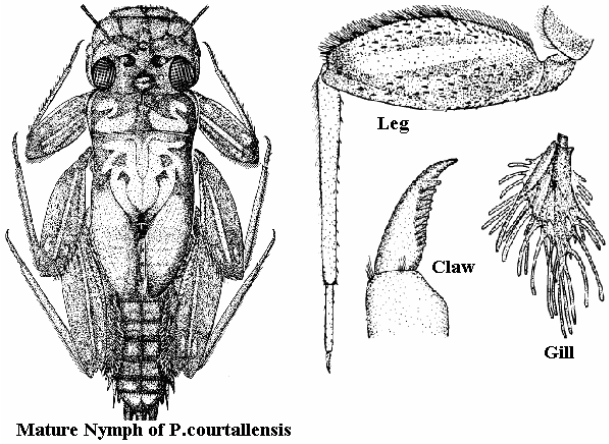
11. Denticles on tarsal claws increase in size apically; tip of tarsal claw strongly hooked; trachea of gills branched; larvae known from India only……..…….***Indialis***……17

12. Abdominal gills rectangular shape; lateral margins of labrum angular; tibiae of prothoracic legs are interspersed with plumose spines and hair laterally; tibiae of remaining legs are profusely hairy; and basal 4 denticles on claws are distinctly set apart from remaining denticles ……..…….....…….***Notophlebia jobi***



- Larval description unknown…….……..***Notophlebia hyallina***

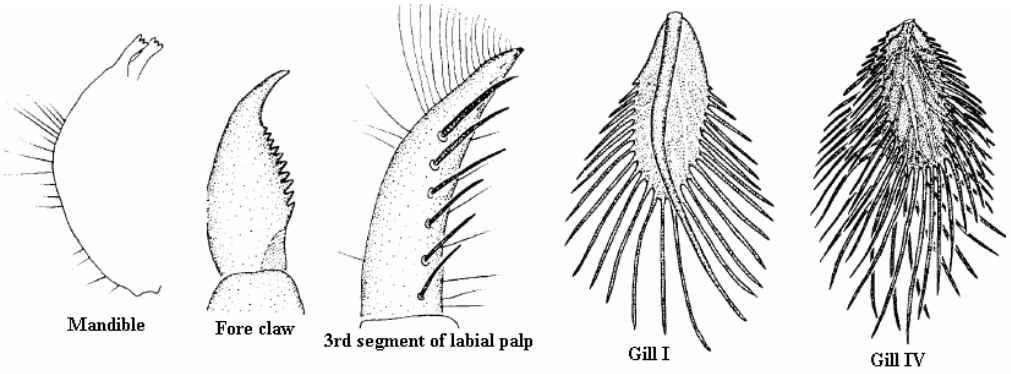
13. Dorsum of thorax yellowish brown, washed with dark brown at margins; Venter pale; marks of nota as in figure given in the below, posterior margin of terga 1-10 with a narrow, brownish-black, transverse band; sterna pale, posterior margin of all abdominal terga with a row of fine spines; postero-lateral spines on abdominal segments 3-9, spines progressively larger posteriorly, terminal filament a little longer than cerci……***Petersula courtallensis***



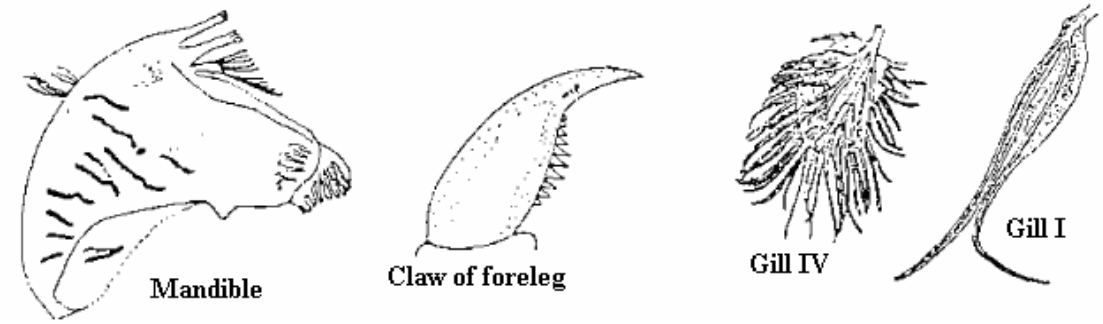
Mature Nymph of P.courtallensis

- Larval description unknown…….***Petersula nathani***

14. Mandible lateral setae sparse, thin clump near middle of lateral margin, thinning posteriorly; labial palpi segment 3 with row of long thin lateral setae and 6-7 large dorsal setae; claws with 10-13 denticles decrease in size apically; gills on abdominal segment 1 with a long lanceolate dorsal lamella and an oval ventral lamella ……....***Thraulus gopalani***

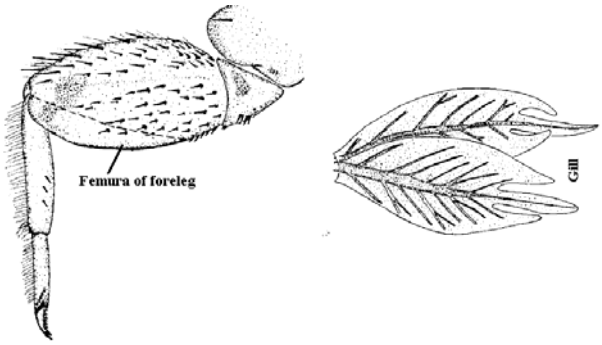


- Mandibles lateral setae less on mid region only; fore leg claw with 10 basal denticles increasing medially and decreasing apically and sub-apical row with 5 minute denticles; gill I dorsal lanceolate and ventral slender, 2-7 gill's dorsal elliptical and ventral oval shaped with entire margin fringed ……..…….….***Thraulus mudumalaiensis***

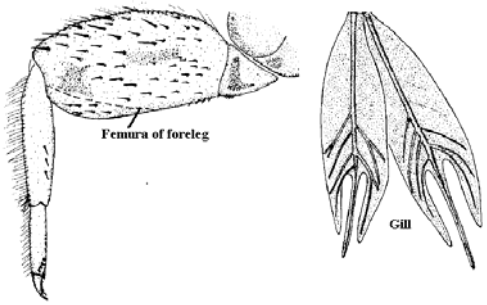


- Larval description unknown ……***Thraulus semicastaneus***

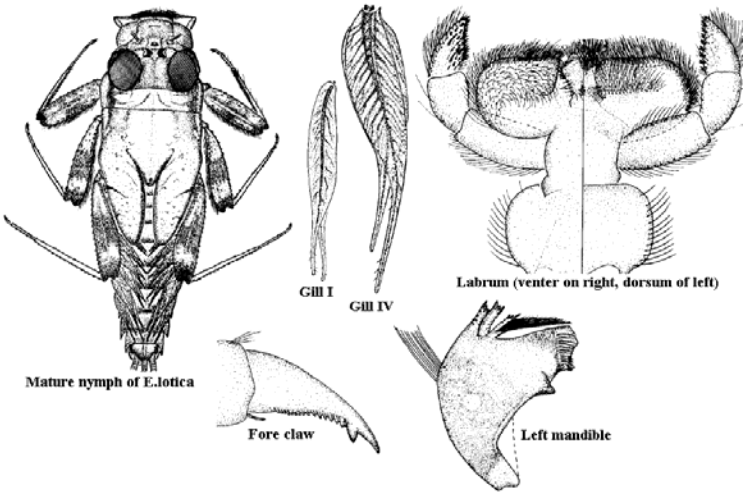
15. Median projection of abdominal gills broad and approximately twice length of laterals; tracheation in gills uniformly distributed; distal, irregular light brown maculae on femora of legs…….....***Nathanella indica***



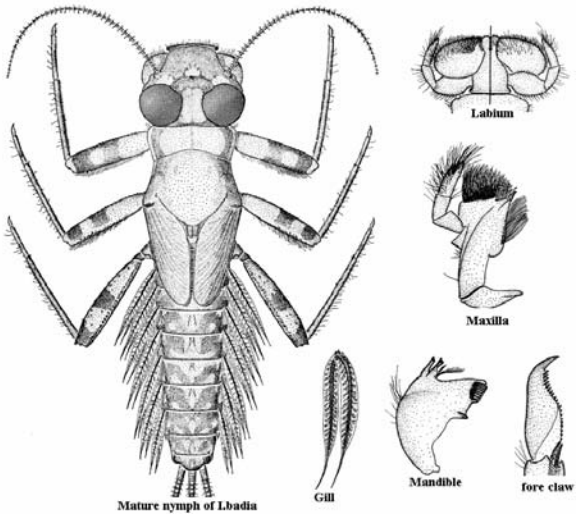
- Median projection of abdominal gills narrow and approximately 1-112 times length of laterals; main trunk of tracheae of gills forked near distal half of lamellae; medial and distal, irregular black maculae on femora of legs…….. .....***Nathanella saraswathiae***



16. Gills with abdominal segments I - VII; dorsal and ventral portions of gill I are slender and lanceolate with few tracheae; dorsal and ventral portions of lamellae of gills II - VII are lanceolate, long, and smoothly tapered near apex; segment 3 of labial palpi has a row of heavy spines on inner dorsal margin; denticles on claws are progressively larger apically, apical denticle is much larger; outer margin of mandibles is smoothly curved with 8 to 10 long hairs on median area of outer margin….....……***Edmundsula lotica***



17. Body dark brown, sutures and sterna paler, markings on abdomen as in figure. Legs and caudal filaments pale, markings on legs as in figure. Gills hyaline, tracheae black…….....***Indialis badia***

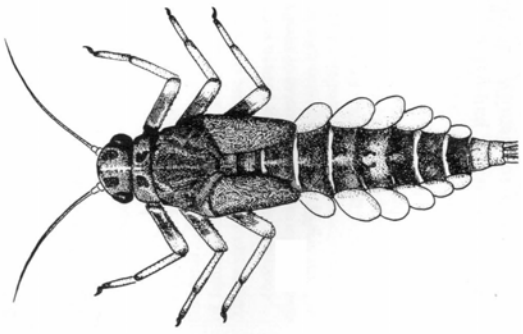


- Larval description unknown…….....***Indialis rossi***

XII. Key to genera and species of Baetidae

1. Abdominal gills on one or more segments bilamellate (double).....2

- All abdominal gills single lamellae….....3

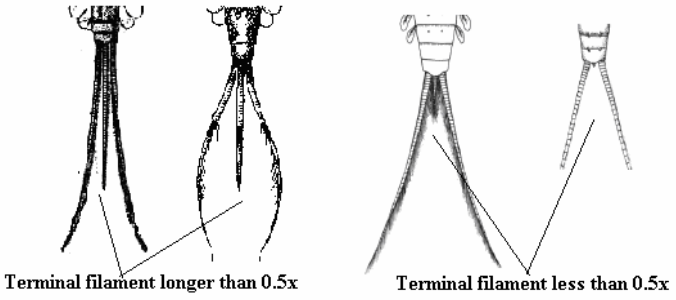


2. Lamellae of gills I-VI doubled, but gill VII is single; gill margins smooth and denticles absent; setal tuft present between the incisors and molars of the mandibles; tarsal claws long

and gently curving (somewhat sickle shaped) .....***Cloeon*** larval description unknown .....***Cloeon bicolor, Cloeon kimminsi, Cloeon marginale, Cloeon taeniatum***

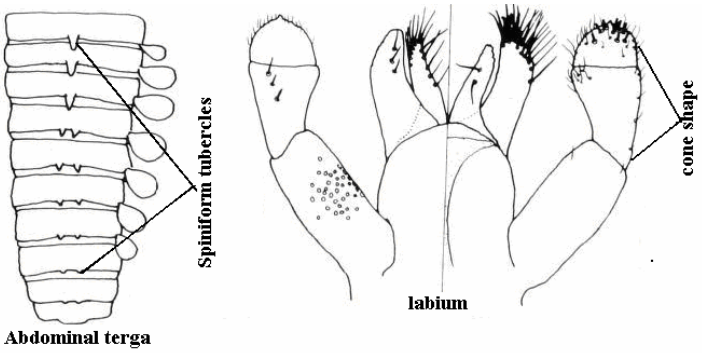
- Lamellae of gills I-V distinctly asymmetrical and bear small dorsal flap, gills VI - VII are single .....***Procloeon*** larval description unknown…… ***Procloeon bimaculatum Procloeon harveyi***

3. Terminal filament absent or reduced, always shorter than 0.5x cerci ……..….4

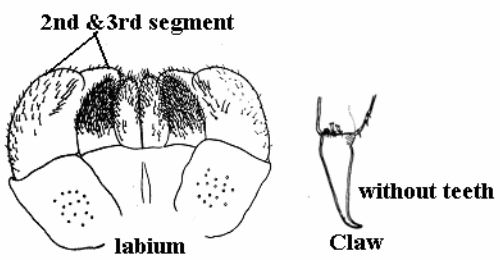


- Terminal filament developed, always longer than 0.5x cerci 5

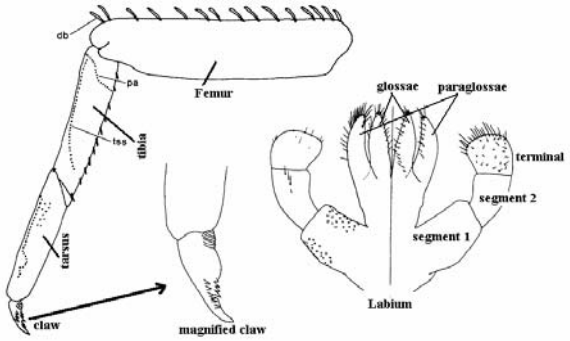
4. Abdominal terga with spiniform tubercles; the tergites bear single median (I-III) or paired submedian dorsal tubercles (IV-IX); apex of labial palp conical..... ***Baetiella***



5. Labium with the 2nd and 3rd palpi segments almost completely fused together to form one large stout segment; tarsal claws without teeth and strongly hooked at apex (nymph lives in bivalves).....***Symbiocloen***…….9



- Labial palpi terminal segment rounded to broadly rounded apically; segment 2 with weakly developed inner apical lobe; glossae subequal to paraglossae; paraglossae with subparallel margins, not convex; tarsal claws with two rows of denticle…….. ……***Chopralla***……..***Chopralla ceylonensis***



- Labium and claws not as above ……6

6. Dorsal surface of all tibiae with long transverse hair like setae..... ***Centroptilum*** Larval description unknown……***Centroptilum campestre***

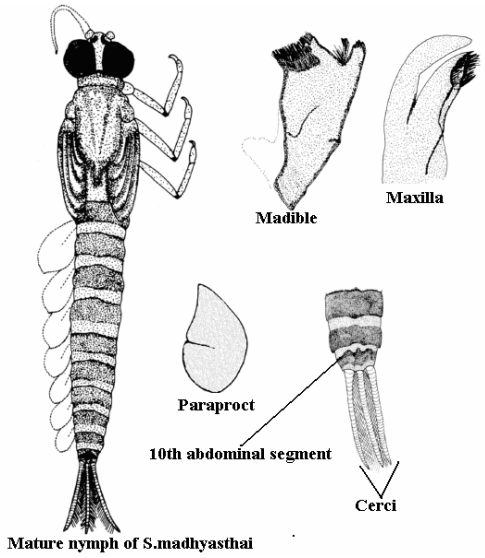
- Dorsal surface of all tibiae without long transverse hair like setae.....…...7

7. Labial palpi enlarged, terminal segment of maxillary palpi excavate…… ***Labiobaetis***

- Labial palpi not enlarged, terminal segment of maxillary palpi not excavate……..…...….. 8

8. Maxillary palps two-segmented; femur, tibia, and tarsus without rows of long fine bristles; claws shorter, with only one row of denticles; hind wing pads either lacking, heavily reduced, or well developed.....***Baetis***

9. Dorsum and margins of legs without spines or setae; thorax of male extends posteriorly as a short blunt process; tergum of 10 abdominal segment has a dark brown “bird in flight” pattern; abdominal segments without marginal spines; caudal filaments and cerci extremely short and equal in length; mandible without setae in the middle part; maxillary palp equal in length to galea-lacinia; paraproct smooth, without bristles or pores ……..…… ……..……..***Symbiocloeon madhyasthai***



Note: All images are taken from the species published respective authors as given in the list of species in Western Ghats and bibliography.