

KEYS TO THE FAMILIES AND GENERA OF EPHEMEROPTERA

Mature Nymphs

- 1 Thoracic notum enlarged to form a shield extended to abdominal segment 6,
gills enclosed beneath shield (Fig. 11.3)..... **BAETISCIDAE-Baetisca**
- 1' Thoracic notum not enlarged as above; at least anterior abdominal gills exposed.....2
- 2(1') Gills on abdominal segments 2-7 forked and elongate-lanceolate, with margins
fringed (Fig. 11.5); most with mandibular tusks projected forward and visible
from above head (Figs. 11.7-11.8); if tusks absent, head and thorax with pads of
long spines (Fig. 11.9).....3
- 2' Gills on abdominal segments 2-7 variable; if gills forked and elongate-lanceolate,
margins not fringed (Fig. 11.6); tusks rarely present on mandibles.....7
- 3(2) Head and prothorax with dorsal pad of long spines on each side (Fig. 11.9);
without mandibular tusks; gills ventral.....**BEHNINGIIDAE-Dolania Americana**
- 3' Head and prothorax without pads of spines; mandibular tusks present
(Figs. 11.7-11.8); gills lateral or dorsal.....4
- 4(3') Foretibiae more or less modified, either broad or with tubercles, adapted
for burrowing (Fig. 11.7); abdominal gills held dorsally.....6
- 4' Foretibiae unmodified, not adapted for burrowing (Fig. 11.8); abdominal gills
held laterally.....5
- 5(4') Mandibular tusks with many long setae (Fig.11.4). **EUTHPLOCIIDAE..Euthyplocia hecuba**
- 5' Mandibular tusks without many long setae (Fig. 11.8).**POTAMANTHIDAE..Anthopotamus**
- 6(4) Tips of mandibular tusks curved upward, when viewed laterally (Fig. 11.10);
ventral apex of hind tibiae developed as a distinct acute point (Fig. 11.12).....106

- 6' Tips of mandibular tusks not curved upward, when viewed laterally (Fig. 11.11);
ventral apex of hind tibiae rounded (Fig. 11.13).....**POLYMITARCYIDAE**....109
- 7(2') A double row of long setae present on inner margins of femora and tibiae of forelegs
(Fig. 11.14).....52
- 7' Long setae absent on forelegs, or not arranged as above.....8
- 8(7') Gills on abdominal segment 2 operculate or semioperculate (i.e., partly covering
succeeding pairs) (Fig. 11.15).....9
- 8' Gills on abdominal segment 2 neither operculate nor semioperculate, either
similar to those on succeeding segments or absent.....11
- 9(8) Gills on abdominal segment 2 triangular, subtriangular, or oval and not meeting
medially (Fig. 11.15); gill lamellae on segments 3-6 simple or bilobed, without
fringed margins.....**LEPTOHYPHIDAE**...96
- 9' Gills on abdominal segment 2 quadrate, meeting or almost meeting medially
(Fig. 11.16a); gill lamellae on segments 3-6 with fringed margins (Fig. 11.16b).....10
- 10(9') Mesonotum with distinct rounded lobe on anterolateral corners (Fig. 11.17);
operculate gills fused medially; developing hind wing pads present; East,
mostly Southeast.....**NEOEPHEMERIDAE**....*Neoephemera*
- 10' Mesonotum without anterolateral lobes (Fig. 11.18); operculate gills not fused
medially; without developing hind wing pads.....**CAENIDAE**.....100
- 11(8') Gills absent on abdominal segment 2, rudimentary or absent on segment 1, and present or
absent on segment 3 (Figs. 11.19, 11.44); gills on segments 3-7 or 4-7 consist of anterior
(dorsal) oval lamella and posterior (ventral) lamella with numerous lobes (Fig. 11.20);
paired tubercles often present on abdominal terga.....**EPHEMERELLIDAE**.....82

11' Gills present on abdominal segments 1-5, 1-7, or 2-7; paired tubercles rarely present on abdominal terga.....12

12(11') Body distinctly flattened; head flattened; eyes and antennae dorsal; mandibles not visible in dorsal view (Fig. 11.21).....54

12' Body not flattened (Figs. 11.22, 11.24) or, if flattened, mandibles visible and forming part of the flattened dorsal surface of head (Fig. 11.25).....13

13(12') Claws of forelegs differ in structure from those on middle and hind legs (Figs. 11.26-11.27), claws of middle and hind legs long and slender, about as long as tibiae (Figs. 11.26-11.27).....14

13' Claws of all legs similar in structure, usually sharply pointed, rarely spatulate; claws variable in length, if claws of middle and hind legs are long and slender, then usually claws are shorter than tibiae (longer than tibiae in three rare genera).....15

14(13) Claws on forelegs simple, with long slender denticles; spinous pad present on forecoxae (Fig. 11.26a); from Michigan west.....*AMETROPODIDAE*...*Ametropus*

14' Claws on forelegs bifid (Fig. 11.27a); without spinous pad on forecoxae*METRETOPODIDAE*.....72

15(13') Abdominal gills on segments 2-7 either forked (Fig. 11.6), in tufts (Fig. 11.28), with all margins fringed (Fig. 11.29), or with double lamellae terminated in filaments or points (Figs. 11.30-11.32); apicolateral margin of maxillae with a dense brush of long setae (Fig. 11.33).....*LEPTOPHLEBIIDAE*.....73

- 15' Abdominal gills not as above; gills either more or less oval or heart-shaped; lamellae either single, double, or triple folded (Figs. 11.35-11.38); fringed on inner margin in one rare genus (Fig. 11.39); never terminating in filaments or points; apicolateral margin of maxillae variable, never with dense brush of long setae (Figs. 11.34, 11.43).....16
- 16(15') Labrum with a median notch on distal margin (in Nearctic: absent only in *Apobaetis*); maxilla without pectinate spines; terminal filament variable, may be shorter than tergum 10 or subequal to cerci; antennae long, two or three times or more width of head (Fig. 11.42) (including *Apobaetis*), or, antennae shorter than twice width of head.....**BAETIDAE**.....23
- 16' Labrum without a median notch on distal margin; terminal filament subequal to cerci; antennae shorter than twice width of head (Fig. 11.41), or labrum with notched distal margin and maxilla with pectinate spines (Fig. 11.43).....17
- 17(16') Tibiae and tarsi bowed; claws very long and slender, claws of hind legs about as long as tarsi (similar to Fig. 11.26); rare; large rivers; scattered distribution.....**ACANTHAMETROPODIDAE**.....18
- 17' Tibiae and tarsi not bowed; claws usually not long and slender.....19
- 18(17) Dorsum of abdomen with median hook-like tubercles; hook-like tubercle also present on each thoracic sternum (Fig. 11.23); rare Midwest and Southeast US.....***Acanthametropus pecatonica***
- 18' Dorsum of abdomen without median hook-like tubercles; hook-like tubercle absent on thoracic sterna; rare Western US and Canada.....***Analetris eximia***

- 19(17') Maxillae with crown of pectinate spines (Fig. 11.43); gills with single lamellae, more or less oval with a distinct sclerotized band along lateral margin and usually with a similar sclerotized band on (Fig. 11.35) or near mesal margin (Fig. 11.36).....*AMELETIDAE*...*Ameletus*
- 19' Maxillae without pectinate; spines gills variable, usually appearing to lack distinct sclerotized bands.....*SIPHLONURIDAE*....20
- 20(19') Abdominal gills with double lamellae on segments 1-2 (in some, double also on segments 3-7)(Fig. 11.37).....21
- 20' Gills on all abdominal segments with single lamellae, more or less oval (Figs. 11.35-11.36) or heart-shaped (Fig. 11.40).....22
- 21(20) Gills on abdominal segments 1-2 subtriangular, broadest near apex (Fig. 11.37); claws of middle and hind legs slightly longer than those of forelegs; widespread.....*Siphonurus*
- 21' Gills on abdominal segments 1-2 oval; claws of middle and hind legs distinctly longer than those of forelegs; rare, California.....*Edmundsius agilis*
- 22(20') Sterna of mesothorax and metathorax each with a median tubercle; abdominal segments 5-9 greatly expanded laterally; rare, New York to Labrador*Siphonisca aerodromia*
- 22' Sterna of thorax without tubercles; abdominal segments 5-9 not greatly expanded; uncommon; Canada or West, mountains, Wisconsin, Maine.....*Parameletus*
- 23(16) Claws distinctly spatulate with large apical denticles, tarsi distinctly bowed (Fig. 11.50); uncommon; medium to large rivers; Northwest, Southwest, and Central..*Camelobaetidius*

23' Claws sharply pointed; denticles, if present, smaller and ventral
 (Figs. 11.52-11.54).....24

24(23') Median tubercles present on anterior of abdominal terga.....25

24' Median anterior tubercles absent from abdominal terga.....26

25(24') Abdominal gills or gill sockets present on abdominal terga 1-5 only; gills extend
 ventrally from pleural region; Southwest, Texas, Utah.....*Baetodes*

25' Abdominal gills or gill sockets present on abdominal terga 1-7; gills held dorsally;
 Central and Eastern USA.....*Waynokiops dentatogriphus*

26(24') Apex of labial palpi simple and truncate (Fig. 11. 55); trachea of gills palmate
 (fig. 1.56) or asymmetrical with most branches on median side (Fig. 11.57);
 tails with distinct dark band every third to fifth segment (Fig. 11.58 a,b);
 gills simple or with dorsal flaps on one or more segments.....27

26' Apex of labial palpi variable, not truncate as above; trachea variable; tails rarely
 banded as above; gills simple or large and compound.....30

27(26) Labrum (Fig. 11.106) with deep triangular median notch at distal margin;
 paraglossae broad, longer than glossae; claws as long or longer than respective tarsi;
 gills simple; widespread.....*Pseudocentropiloides*

27' Labrum (as in Fig. 11.107) with small median notch along anterior margin;
 paraglossae subequal to glossae; claws usually shorter than respective tarsi;
 gills simple or with dorsal flaps.....28

28(27') Mandible incisors deeply cleft to base or united less than one-half height of incisors (Fig.
 11.45); length of maxillary palp segment 3 subequal to segment 2 (Fig. 11.46); lateral
 bristles of caudal filaments present on proximal three-fourths, apices of filaments

without bristles; gills simple; widespread.....**Centroptilum**... (29)

28' Mandible incisors united above base or fused to apex (Fig. 11.47); length of maxillary palp segment 3, when present, shorter than segment 2 (Fig. 11.48); lateral bristles of caudal filaments present to apices; gills simple, or with dorsal flap at least on abdominal segment 1; widespread.....**Procloeon**

29(28) Tibiae of forelegs lack patellar suture.....**Anafroptilum**

29' Tibiae of forelegs have patellar suture (**new fig #?**).....**Centroptilum or new taxon ***

* - It is likely that some Nearctic species previously known as *Centroptilum* do not fit the current criteria for *Anafroptilum* or the new restricted concept of *Centroptilum* and may need to be placed in a another taxon that has yet to be named.

30(26') Gills simple (Fig. 11.60).....32

30' Gills on one or more segments compound, with distinct large flaps (Figs. 11.56, 11.59).....31

31(30') Labial palpi apparently two-segmented, blunt apically (Fig. 11.51); hind wing pads present; gills with recurved flaps folded ventrally (Fig. 11. 59); widespread..... **Callibaetis**

31' Labial palpi three-segmented, obliquely truncate apically; hind wing pads absent; gills with recurved flaps folded dorsally (as in Fig. 11.56); East, Midwest.....**Cloeon**

32(30)Claws clearly less than half as long as respective tarsi (Fig. 11.52).....35

32' Claws one-half or more as long as respective tarsi (Figs. 11.53-11.54).....33

33(32') Head with distinct genal projections extending laterally below eyes; labial palp as in Fig. 11.49.....**Baetopus trishae**

33' Head without distinct genal projections as above; labial palps with apex rounded or broadly triangular or truncated, but not as above.....34

- 34(33') Claws almost as long as respective tarsi (Fig. 11.54); labrum without a notch on distal margin; rare; West; Southeast.....*Apobaetis*
- 34' Claws about one-half as long as respective tarsi (Fig. 11.53); labrum with notch on distal margin; widespread.....*Paracloeodes*
- 35(32) Villopore present on all or some legs (Figs. 11.109, Fig. 11.113); terminal filament subequal to cerci or reduced; mandibles without setae between prostheca and molars...36
- 35' Villopore absent on all legs; terminal filament subequal to cerci; mandibles with setae on surface between prostheca and molars or if mandibles lack setae in this area, the prostheca of the right mandible is reduced to a single simple setae.....45
- 36(32) Antennal scape with a distal lobe (Fig. 11.110); maxillary palps with subapical excavation (Fig. 11.111); Segment 2 of labial palps greatly expanded medially; villopore often reduced or absent on forefemora.....*Labiobaetis*
- 36' Antennal scape without a distal lobe; maxillary palps without subapical excavation; segment 2 of labial palps variable, but not greatly expanded as above; villopore usually well developed on forefemora.....37
- 37(36') Segment 2 of maxillary palps apically enlarged with a small apical projection; outer edge of femora, tibiae, and tarsi with row of clavate setae; terminal filament subequal to cerci; abdominal terga 2, 7 and 8 distinctly darker than other terga (Fig. 11.108); hind wing pads present; rare; Southeast.....*Barbaetis benfieldi*
- 37' Segment 2 of maxillary palps not apically enlarged and without apical projection; outer edge of leg segments without row of clavate setae; terminal filament length variable; abdominal terga variably patterned, but not as above; hind wing pads present or absent.....38

- 38(37') Terminal filament well developed; hind wing pads present.....*Baetis* (in part)
- 38' Terminal filament reduced; hind wing pads absent or present.....39
- 39(38') Tarsal claws with two rows of denticles or a row of denticles and a secondary ridge that may be serrate or not (these claw characters require viewing at 400x); terminal filament minute to a visible stub not longer than tenth tergite; procoxae with or without gills.....40
- 39' Tarsal claws with a single row of denticles; terminal filament usually reduced and as long or longer than tenth tergite; procoxae without gills.....42
- 40(39) Tibiae expanded or bowed distally (Fig. 2); tarsal claws with primary row of denticles subequal in length (except for basalmost first or second denticles) (Fig. 3); hind wing pads absent; labial palp segment 2 narrow basally and widened at apical end (Fig. 1); coxal gills absent; cerci with dark median band.....*Iswoeon*
- 40' Tibiae more or less uniformly cylindrical, not expanding distally (Fig. 5); tarsal claws with primary row of denticles becoming larger from base toward apex of claw (Fig. 6); hind wing pads present, but small to minute lobes or absent [*H.grande* lack hind wing pads]; labial palp segment 2 not as above, sides of segment about parallel (Fig. 4); coxal gills present or absent; cerci are usually unbanded [*H.grande* have banded cerci]..... *Heterocloeon*.....41
- 41(40') Procoxa with a single membranous gill (usually filaform) arising from inner articulating membrane (Fig.); tarsal claws with distinct secondary row of small denticles (observable at 400x) (Fig. 6); hind wing pads small, poorly developed lobes (Fig.7).....*Heterocloeon* (s.s.)
- 41' Procoxa without gill; tarsal claws with a low serrate ridge in place of secondary row of denticles (observable at 400x); hind wing pads small, but more well developed than above or absent (Fig. 8).....*Heterocloeon* (*Jubilatum*)*

*- There are currently only 2 species listed in this subgenus *H. amplum* and *H. grande* which can be easily separated at the mid-instar stage or later on by the presence or absence of hind wing pads.

Heterocloeon (J.) amplum has hind wing pads and have unbanded cerci, whereas, *H. (J.) grande* lacks hind wing pads and has banded cerci. Early instar nymphs should be diagnosed with caution.

- 42(39') Hind wing pads present (although sometimes reduced to a small thread-like flap).....44
- 42' Hind wings absent.....43
- 43(42') Spinules on posterior margins of abdominal tergites well developed and single with either with conical or broadly rounded points (Figs.); femora, tibiae, and tarsi without a row of long setae on outer margin; labial palps as in Fig. 11.118 with inner apical edge of segment 3 more or less straight (i.e., not forming a smooth curve to apex).....*Plauditus*
- 43' Spinules on posterior margins of abdominal tergites poorly developed and may be single or with multiple points that are sharp or somewhat saw-toothed, but never broadly rounded (Figs.); femora, tibiae, and tarsi with a row of long setae on outer margins or femora and tibiae with few long setae and none on tarsi; labial palps as in Fig. 11.115 with inner apical edge of segment 3 smoothly curved.....*Acentrella* (in part)
- 44(42) Segment 2 of labial palps with well developed medially projecting corner (Fig. 11.117); Abdominal tergal scale like setae present.....*Baetis* (in part)
- 44' Segment 2 of labial palps without well developed medially projecting corner (Fig. 11.115); abdominal tergal scale like setae absent.....*Acentrella*
- 45(35') Abdominal gills on segments 2-7.....46
- 45' Abdominal gills on segments 1-7.....47
- 46(45) Segment 2 of labial palps with well developed medial digitate-lobe (Fig. 11.116); paraglossae rectangular and larger than glossae (Fig. 11.116); prostheca of right mandible robust and digitate apically.....*Americabetis*
- 46' Segment 2 of labial palps without well developed medial digitate-lobe; paraglossae not rectangular, but more broadly rounded apically; prostheca of right mandible

- slender, bifid, and minutely pectinate (Fig. 11.121).....*Dipheter hageni*
- 47(45') Claws without denticles; long, very fine setae present on tibiae and tarsi; tufts of setae present on sternites 2-6 (require viewing at 100-400x); palpi of maxillae reduced; prostheca of right mandible bifid; Arizona, New Mexico, California, Oregon.....*Cloeodes*
- 47' Claws with denticles; setae on legs short, usually blade-like; tufts of setae on sternites never present; palpi of maxillae variable, not reduced as above; prostheca of right mandible variable.....48
- 48(47') Claws with 2 symmetrical rows of denticles (Fig. 11.123) or 1 large primary row and 1 smaller secondary row.....49
- 48' Claws with only 1 row of primary denticles.....50
- 49(48) Claws with 2 symmetrical rows of denticles and lacking paired apical setae; fore femora with dorsal and ventral edges with many long setae.....*Varipes*
- 49' Claws with 1 primary row of denticles and 1 smaller secondary row of denticles and paired apical setae (New Fig.); fore femora with only a dorsal row of short spine-like setae.....*Kirmaushenkreena zarankoe*
- 50(48') Claws with 1-3 unpaired subapical setae (Fig. 11. 124); labrum distinctly narrowed posteriorly with a variety of plumose setae along anterior margin (Fig. 11.125).....*Moribaetis*
- 50' Claws without unpaired subapical setae; labrum not as above.....51
- 51(50') Segment 2 of labial palps with well developed anteriorly projecting digitate-lobe (Fig. 11.114); gill 7 slender to apically pointed; antennal scape and pedicel with few scattered, simple, setae.....*Acerpenna*
- 51' Segment 2 of labial palps without well developed anteriorly projecting digitate-lobe (if a lobe is present it is at most weakly developed); gill 7 not noticeably slender or

- apically pointed; antennal scape and pedicle with robust and simple setae.....*Fallceon*
- 52(7) Gills on segment 1 dorsolateral, similar in position and structure to other gills; fibrils shorter than gill plates; widespread and common;*ISONYCHIIDAE-Isonychia*
- 52' Gills on segment 1 ventral (Fig. 11.14); fibrils longer than plate or gill plate absent.....*OLIGONEURIIDAE*...53
- 53(52') Gill lamella oval on segments 2-7, similar to abdominal gill 1 (Fig. 11.14); claws present on forelegs.....*Lachlania*
- 53' Gill lamella slender and elongate on segments 2-7; claws absent on forelegs.....*Homoeoneuria*
- 54(12) Claws as long as or longer than tarsi; tibiae and tarsi bowed; large sandy rivers.....*PSEUDIRONIDAE*....*Pseudiron centralis*
- 54' Claws much shorter than tarsi; tibiae and tarsi straight.....55
- 55(54') Second segment of maxillary palpi longer than width of head and conspicuous at the side or behind head (Fig. 11.61); occurs in stream pools, pond margins, swamps; Midwest – Northeast.....*ARTHROPLEIDAE*....*Arthroplea bipunctata*
- 55' Second segment of maxillary palpi not greatly elongated, inconspicuous at side of head; predominately swifter flowing lotic habitats*HEPTAGENIIDAE*.....56
- 56(55') All gills ventral; gill lamellae slender; numerous gill filaments radiating out from a central plate; 3 terminal filaments; rare; large rivers; West, Midwest, Southeast and Canada.....*Raptoheptagenia cruentata*
- 56' Gills lateral in position at least on abdominal segments 4 to 6; lamellae usually broad; gill filaments variable; 2 or 3 terminal filaments.....57
- 57(56') With only two well developed caudal filaments; terminal filament vestigial

- or absent.....58
- 57' With three well developed caudal filaments.....61
- 58(57) Gills 1 and 2 inserted ventrally gills on 3 inserted ventrally or ventrolaterally;
mouthparts adapted for predation; maxillary palp thin; claws with a single tooth and no
denticles (as in Fig. 11.70)59
- 58' Gills inserted laterally on segments 2-6;may extend ventrally on segments 1
And 7 (Fgi. 11.62); claws without a toot, but with three or more subapical
denticles.....60
- 59(58) Head and thorax without paired dorsal tubercles; abdomen with very small
single dorsal tubercles medially on tergites; femora broad, flattened, subequal to
2.0-2.5 times width of respective tibiae; rare; large rivers.....*Aneporus rusticus*
- 59' Head and each thoracic segment with paired dorsal tubercles; abdomen with larger
single dorsal tubercles medially on tergites; femora relatively narrow, subequal to
1.0-1.5 times width of respective tibiae; rare; big rivers; Midwest, Southeast,
West to Utah and Saskatchewan.....*Spinadis simplex*
- 60(58') Well-developed paired tubercles present on hind margin of abdominal terga 1-9;
uncommon; Northwest.....*Ironodes*
- 60' Abdominal terga without paired tubercles.....*Epeorus*
- 61(57') Gills on abdominal segments 1 and 7 enlarged and meet or almost meet beneath
abdomen to form ventral disk (Fig. 11.62).....*Rhithrogena*
- 61' Gills on abdominal segments 1 and 7 do not meet beneath abdomen and usually smaller than
intermediate pairs.....62
- 62(61') Maxillary palpi protrude at sides of head (Fig. 11.63); front edge of head capsule with

distinct median emargination; fibrilliform portion of Gills 2-6 absent or with only a few filaments (Fig. 11.64).....*Cinygmula*

62' Maxillary palpi rarely protrude at sides of head; front edge of head capsule lacks median emargination or is only slightly indented; fibrilliform portion of gills 2-6 with many fibrils.....63

63(62') Gills on segment 7 minute, no longer than the posterolateral projections of segment 7 (Fig. 11.65); rare.....*Macdunnoa*

63' Gills on segment 7 much larger than above.....64

64(63') Gills on segment 7 reduced to slender filaments; trachea absent or with few or no lateral branches (Figs. 11.66b-11.68b).....65

64' Gills on segment 7 similar to preceding pairs but smaller; trachea of gill 7 with lateral branches.....67

65(64) Gills on abdominal segments 1-6 with apex pointed (Fig. 11.66a).....*Stenacron*

65' Gills on abdominal segments 1-6 with apex rounded (Fig. 11.67a) or truncated (Fig. 11.68a).....66

66(65') Gills on abdominal segments 1-6 with apex rounded (Fig. 11.67a)..... *Stenonema femoratum*

66' Gills on abdominal segments 1-6 with apex truncated (Fig. 11.68a).....*Maccaffertium*

67(64') Gill lamellae on segment 1 less than one-half as long as those on segment 2, with fibrilliform portion of gill 1 much longer than lamella (Fig. 11.69); labrum small, narrower at apex than at base – triangular in shape; Northwest.....*Cinygma*

67' Gill lamellae on segment 1 two-thirds as long as those on segment 2; fibrilliform portion of gill 1 usually subequal to or shorter than lamella; labrum never narrower at apex than

- at base.....68
 - 68(67')Gills on segment 7 with fibrilliform portion present and with numerous fibrils;
claws without denticles or with indistinct* denticles and with one basal tooth
(Fig. 11.70).....*Heptagenia*
 - * - At least 2 species of *Heptagenia* have minute (i.e., indistinct) denticles in late instars
 - 68' Gills on segment 7 without fibrilliform portion; claws with large distinct denticles
(Fig. 11.71).....69
 - 69(68') Caudal filaments with well developed fine interfacing setae (Fig. 11.78) or just cerci with
fine setae along inner margins and terminal filament with only sparse scattered setae;
head less than or equal to the width of the pronotum, head occasionally with a few
scattered black spots near anterior margin.....70*
 - 69' Caudal filaments without well developed interfacing setae; head often wider than
pronotum, and often with dark spots along anterior margin.....*Leucrocuta*
- *-This new couplet** will replace the previous couplet 65 because of problems in separating *E. criddlei* from *Nixes spp.* Currently the validity of *Ecdyonurus* (as defined for **Nearctic species only** by McCafferty (2004)) and *Nixe* (with its present complement of species restricted by McCafferty (2004)) is in doubt. Kluge (2004) placed both genera within the genus *Afghanurus* and listed the Palearctic taxon *Paracinygmula* as equivalent to the Nearctic taxon *Akkarion*. Recently **Jeff Webb**, who has extensively studied these groups, has stated that he believes the placement by Kluge (2004) is likely correct (personal communication). If this is supported by further study then the couplet below would collapse to the genus *Afghanurus*, which would then be **the other half of the new terminal couplet 69** [the other part of couplet 64 would terminate with *Leucrocuta* – which is not in doubt]. Lastly these potential changes would not affect the validity of the Palearctic genus *Ecdyonurus s.s.*, which is widespread in central and southern Europe.
- 70(69)Head with pair of pale spots on anterior margin widely space to about the width of antennal
bases or slightly beyond; abdominal terga mostly brown with small pale paired marks,
terga 3 and 4 usually have larger paired sublateral pale spots that may appear sub-rectangular;
distribution western North America.....*Ecdyonurus* (in part)

- 70' Head with pair of pale spots on anterior margin closely spaced within the zone between the bases of the antennae (Fig. 11.72); abdominal terga either mostly brown or with distinctly contrasting pale areas and terga 3 and 4 not as above; distribution eastern and western North America.....71
- 71(70') Body and legs mostly brown, femora usually brown with contrasting v-shaped pale mark; eggs from late instar (or black wing pad) female nymphs usually have chorion without raised ridges surrounding coiled attachment filaments allowing filaments to be more closely spaced (New Fig.), surface granules are present between filament bases or chorion with poorly developed ridges not forming a regular reticulate pattern; distribution western North America – (Rocky Mtn. in US and west and north of Great Lakes in Canada*Ecdyonurus* (in part)
- 71' Body and legs with extensive pale areas – hence appearing more pale with less contrasting brown, femora mostly pale with brown v-shaped marks (eastern & northern species *N. rusticalis* has smaller pale spots and appears mostly brown similar to *Ecdyonurus*); eggs from late instar (or black wing pad) female nymphs have chorion with reticulate surface pattern of coiled attachment filaments surrounded by rounded ridges that are about half the height of the coiled filaments (New Fig.); distribution mostly east of continental divide, but some species follow the boreal forest north to about the Arctic Circle in western Canada (exception: *N. kennedyi* occurs west of continental divide and is known only as adults from CA and OR).....*Nixe*
- 72(14') Margins of foreclaws densely covered with spines (more than thirty) that are only slightly shorter than the terminal spines (Fig. 11.73); outer margin of gill 4 with two to seven stout spines in addition to small setae; Canada, Alaska, Michigan, Wisconsin, Maine.....*Metretopus*

- 72' Margins of foreclaws sparsely covered with spines (less than twenty) that are thinner and slightly shorter than the long terminal spines (Fig. 11.27); Canada, Midwest and East.....*Siphloplecton*
- 73(15) Labrum as wide or wider than head capsule (Fig. 11.25).....74
- 73' Labrum much narrower than head capsule (Fig. 11.76).....75
- 74(73) Abdominal gills oval with fringed margins (Fig. 11.29); maxillae without large distinctive apical spine; widespread in large or medium sized rivers of west.....*Traverella*
- 74' Abdominal gills elongate, oval without fringed margins, but with short apical filaments; maxillae with large distinctive apical spine (Fig. 11.77).....*Hydrosmilodon*
- 75(73') Abdominal gills 2-7 consist of cluster of slender filaments (Fig. 11.28); uncommon; Eastern.....*Habrophlebia*
- 75' Abdominal gills 2-7 forked or bilamellate, not as above (Figs. 11.30-11.32).....76
- 76(75') Abdominal gill 1 either a single linear lamella (Fig. 11.30a) or asymmetrically forked lamella (Fig. 11.79a,b); gills 2-7 broadly bilamellate with apex bearing three lobes.....77
- 76' Abdominal gill 1 either symmetrically forked lamella (Fig. 11.31a) or bilamellate, either similar to or different from those on succeeding segments (Figs. 11.31b 11.32).....78
- 77(76) Abdominal gills 2-7 with dorsal lamellae larger than ventral lamellae and terminating in three lobes with the median lobe longer and often wider than lateral lobes (Fig. 11.30b); dorsal setae of labrum in two transverse rows; setae on lateral margin of mandibles limited to middle.....*Choroterpes*
- 77' Abdominal gills 2-7 with dorsal and ventral lamellae similar and terminating in three slender, subequal processes (Fig. 11.79, 11.81); dorsal setae of labrum scattered; setae on

- lateral margin of mandibles in distal half.....*Neochoroterpes*
- 78(76') Gills on abdominal segment 1 much narrower and shaped differently than those on segments 2-7 (Fig. 11.31a); each gill on segments 2-7 terminating in a single slender filament that may (Fig. 11.31b) or may not be flanked by one or two blunt lobes (Fig. 11.32).....*Leptophlebia*
- 78' Gills on abdominal segment 1 not conspicuously narrower or shaped differently than those on segments 2-7; gills on 2-7 forked or bilamellate.....79
- 79(78') Labrum with moderately deep v-shaped anterior median emargination (Fig. 11.74) without denticles ; row of distinctive spinules present on posterior margins of abdominal terga 6-10 or 7-10; gills on middle abdominal segments as in Fig. 11.80 with conspicuous lateral tracheal branches; uncommon; Midwest, Southwest, and Northeast.....*Habrophlebiodes*
- 79' Labrum with either a shallow anterior median emargination, not distinctly v-shaped or with an anterior median emargination with 3-5 denticles or without an anterior emargination with edge being nearly straight; posterior margins of abdominal terga 1-10 with or without row of minute spinules.....80
- 80(79') Labrum less than one half the width of the head anterior to compound eyes and about as wide as the anterior edge of the clypeus; widespread.....*Paraleptophlebia*
- 80' Labrum more than one half the width of the head anterior to compound eyes (Fig. 11.119) and wider than the anterior edge of the clypeus; mostly Southwest and parts of Green River, Utah.....81
- 81(80') Lateral margins of labrum rounded (Fig. 11.122); uncommon; Mexico, Texas (small warm streams with riffles).....*Farrodes*
- 81' Lateral margins of labrum angular (Fig.); uncommon; Mexico, U.S. Southwest*Thraulodes*
- 82(11) Lamellate gills present on abdominal segments 3-7(Figs. 1.19,11.44).....83

82' Lamellate gills present on abdominal segments 4-7 (Fig. 11.84).....92

83(82) Terminal filament at least 1.3 times as long as lateral cerci; Northwest.....*Caudatella*

83' Caudal filaments subequal in length.....84

84(83') Leading margin of forefemora usually armed with conspicuous tubercles (Fig. 11.83); if not (some western species), thorax, head, and abdomen with long paired dorsal tubercles (Fig. 11.44) or abdominal sterna with attachment disk of long hair.....*Drunella*

84' Leading margin of forefemora without such tubercles, without large tubercles on dorsum of head, thorax and abdomen, abdominal sterna without disk of long hair.....85

85(84') Tarsal claws with subapical denticle distinctly larger than preceding denticles (Fig. 9) [sometimes most distinctive on hind claw]; maxillary palpi absent; eastern North America.....*Teloganopsis deficiens*

85' Tarsal claws not as above with denticles gradually becoming larger or all about the same size; maxillary palpi present (although sometimes minute).....86

86(85') Body elongate and narrow with legs distinctly long and thin; abdominal tergites each with a single rounded median protuberance.....*Penelomax septentrionalis*

86' Body and legs not as above; abdominal tergites either with variable paired sharp or blunt median projections or with no projections.....87

87(86') Posterolateral projections of abdominal segment 9 large and curved dorsally (Fig. 11.126) extending well beyond segment 10; abdominal tergites without paired sharp projections.....*Caurinella idahoensis*

87' Posterolateral projections of abdominal segment 9 not as above, tips rarely extending beyond segment 10; abdominal terga usually with paired sharp or blunt median projections on some segments.....88

- 88(87') Maxillary palps minute composed of a single, extremely short subannulated segment with an apical setae (Fig. 11.86) or palps absent; western North America.....*Matriella teresa*
- 88' Maxillary palps small composed of at least 2 complete segments (Figs. 11.85, 11.87) or one elongate segment with an apical setae (e.g., *S. frisoni*).....89
- 89(88') Abdominal terga with large, long, paired, sharp median spines (Fig. 10); forefemur without distal row of long setae.....*Tsalia bernerii*
- 89' Abdominal terga with small or short paired sharp or blunt submedian spines or lacking median spines; forefemur with distal row of large setae (Fig. 11).....90
- 90(89') Maxillae with several deep serrations on large apical maxillary incisors* (Fig. 12); dorsal medial surfaces of pronotum and mesonotum with several extremely short dark brown lumps (excrescences) (Fig. 13) [on pale specimens these are virtually transparent]; western North America.....*Ephemerella* (in part *E. tibialis*, *E. nuda*)
- 90' Maxillae lack serrations on the large apical maxillary incisors* (Figs. 14a,b); dorsal medial surfaces of pronotum and mesonotum with few extremely short, dark brown lumps (excrescences) [on pale specimens these are virtually transparent] or none.....91
- * - These are large apical teeth similar in position and function to mandibular incisors, a.k.a "canines" in notation of Kluge (2004).
- 91(90') Median dorsal lobe of ventral lamella of abdominal **gill 6** deeply divided (Fig. 15); maxillary palps usually short, extending to no more than one-half the length of the galea-lacinia.....*Serratella*
- 91' Median dorsal lobe of ventral lamella of abdominal **gill 6** not as above with only a shallow medial division or only a slight apical medial indentation (Fig. 16); maxillary palps usually long, extending two-thirds or more the length of the galea-lacinia

(Fig. 11.87).....*Ephemerella* (in part)

92(82') Gills on tergum 4 operculate, largely covering those on segment 5-7 only about one-third of any following gill visible (fig. 11.84) and reaching to about the posterior margin of abdominal tergum 7.....93

92' Gills on tergum 4 not operculate, apical half of gills 5 and 6 visible and do not reach the posterior margin of abdominal tergum 7.....*Attenella*

93(92) Claws without denticles [but very early instar nymphs may have a group of minute apical denticles on tarsal claws, these are lost in development to later instars – for these specimens use maxillary palp character only]; maxillae with palpi; West, Midwest, East.....94

93' Claws with denticles; maxillae without palpi; Midwest, East, Pacific coast.....95

94(93) Filamentous gills on abdominal segment 1 originate at lateral margin of tergum; posterolateral abdominal processes not extremely developed; abdominal terga without paired tubercles on or near posterior margin; Midwest, East.....*Dannella*

94' Filamentous gills on abdominal segment 1 originate on posterior edge of tergum before the lateral margin; posterolateral abdominal processes extremely developed; abdominal terga with paired tubercles on rarely absent; Midwest, Pacific Coast.....*Timpanoga* (s.str.)

95(93') Paired tubercles present on abdominal terga 1 through 7; abdominal tergum 9 approximately 1.4 times midlength of terga 8 or 10; operculate gills relatively narrow, ovulate and broadly rounded distally.....*Eurylophella*

95' Paired tubercles present on abdominal terga 5 through 7; abdominal tergum 9 subequal to midlength of terga 8 or 10; operculate gills broad, but more narrowly rounded distally; Eastern Canada, New Hampshire.....*Dentatella coxalis*

- 96(9) Posterior margins of abdominal terga 1-6 without spinules; hind wing pads absent.....*Tricorythodes* (in part)....97
- 96’ Posterior margins of abdominal terga 1-6 with spinules (Figs. 11.93-11.94); hind wing pads present in males, sometimes absent in females.....98

Changes proposed by Baumgardner (2008) to genera of Leptohypidae would require couplets 86-90 in the key as it now appears in the book to be modified *as you see below*. However, the publication of these changes **has been delayed** and as of right now the genera *Ableptemetes*, *Asioplax*, *Tricoryhypes*, and *Homoleptohyphes* **are still in effect**. This presents the problem of what to do – in one instance there is sound evidence for the synonymy of these group names, but it has not been published constituting an official nomenclatural act, hence the changes are “unavailable” even though they more accurately represent what is more likely correct about these taxa. On the other hand nomenclatural rules should be obeyed and that means using names of taxa that misrepresent biological realities and inflate estimates of biodiversity and produce inaccuracies in biomonitoring work and associated databases. In this draft, as in the key patches, I have chosen to only include the changes expected once the monograph containing the support for these changes is published. That choice is as much one of editorial practicality as anything else, *however until the changes have been officially published for determining any of these genera I refer you back to the unmodified couplets 86-90 on page 200 of the mayfly chapter key as it now stands.*

- 97(96) Body dorsoventrally flattened; posterolateral projections of abdominal terga 7 and 8 longer than the median length of respective terga; forefemora wide, width three-quarters to subequal the length; forefemora margined with long setae; dorsal surface of forefemora with row of setae across proximal third; inner lobe of ventral lamella of gill 2 present or absent, when present inner lobe length variable up to one-half of outer lobe (Fig. 11.95).....*Tricorythodes* (*Asioplax*)

- 97’ Body not distinctly dorsoventrally flattened; posterolateral projections of abdominal terga 7 and 8 subequal to length of respective terga; forefemora not wide, with width not more than two-thirds the length; forefemora without marginal setae; dorsal surface of forefemora with row of setae across midpoint of segment; inner lobe of ventral lamella of

- gill 2 present and one-half of two-thirds the length of outer lobe
 (Fig. 11.96).....*Tricorythodes (Tricorythodes)*
- 98(96') Elevated longitudinal ridge present on middle and hind tibiae (Fig 11.102); ventral lamellae of gill 2 distally constricted; outer and inner lobes subequal in length; outer lobe of ventral lamellae with a beak-like process.....*Leptohyphes*
- 98' Elevated longitudinal ridge absent on all tibiae, but plumose setae may be present in this position; ventral lamellae of gill 2 not distally constricted; outer lobe longer than inner lobe and lacks beak-like process.....99
- 99(98') Dorsal longitudinal row of plumose setae present on middle and hind tibiae (Fig. 11.103); forefemora with dorsal row of spatulate setae as in Fig. 11.104.....*Allenhyphes*
- 99' Dorsal longitudinal row of plumose setae absent on middle and hind tibiae; forefemora with dorsal row of spatulate setae as in Fig. 11.105.....*Vacupernius*
- 100(10') Head with three prominent ocellar tubercles; maxillary and labial palpi two segmented; forelegs distinctly shorter than middle and hind legs.....101
- 100' Head without ocellar tubercles; maxillary and labial palpi three segmented; forelegs subequal in length to middle and hind legs.....105
- 101(100) Operculate gill 2 with posterior margin not parallel to anterior margin (Fig. 17), posterior edge slopes laterally to broadly rounded posterolateral corner.....*Brachycercus*
- 101' Operculate gill 2 with posterior margin parallel to anterior margin, posterior margin may be straight or broadly rounded to both inner and outer corners but not sloping as above (Figs. 8a,b).....102
- 102(101') Meso and metathoracic sterna with medial sternal tubercles (Fig. 19a); median ocellar tubercle curved forward (anteriorly and/or ventrally) (Fig. 19b).....*Susperatus*

- 102' Meso and metathoracic sterna without medial tubercles (Fig. 20a): median ocellar tubercle straight or curved upward (dorsally) (Fig. 20b).....103
- 103(102')Posterolateral projections of abdominal segment 6 not curved medially toward midline of the body (Fig. 21); hind leg segments with few sparsely scattered long setae (Fig. 22); lateral ocellar tubercles usually distinctly pointed apically.....*Sparbarus*
- 103' Posterolateral projections of abdominal segment 6 distinctly curved medially toward midline of body (Fig. 23); hind leg segments with many closely spaced long setae along outer and inner margins of segments (Fig. 24a); lateral ocellar tubercles usually short and broadly rounded (Fig. 24b).....104
- 104(103')Lateral margins of labrum nearly straight* such that labrum appears trapezoidal in shape; ventral surface of segment 1 of labial palpus without patch of long hair-like setae.. *Latineosus*
- 104' Lateral margins of labrum distinctly rounded (convex) such that labrum appears oval in shape; ventral surface of segment 1 of labial palpus with a patch of long hair-like setae.....*Cercobrachys*
- * - Figure of *Sparbarus* or *Brachycercus* labrum good example of this character.
- 105(100') Inner margin of foretibiae and tarsi with row of stout spines; segment 3 of labial palpi subequal to or shorter than segment 2, with few long setae and spines; outer margin of operculate gills fringed with long setae; widespread.....*Caenis*
- 105' Inner margin of foretibiae and tarsi densely covered with long setae; segment 3 of labial palpi twice as long as segment 2, densely covered with long setae; outer margin of operculate gills fringed with short bifurcate setae; Southeast, Midwest, Northeast ..*Amercaenis*
- 106(6) Mandibular tusks with a distinct lateral keel that is more or less toothed and with some spurs; infrequently collected; large rivers (Fig. 11.7).....*PALINGENIIDAE*....*Pentagenia vittegera*

- 106' Mandibular tusks without a distinct toothed keel (Fig. 11.10)... ..**EPHEMERIDAE**...107
- 107(106') Antennae with whorls of long setae on most segments (Fig. 11.10); the small gills on segment 1 forked and lacking fringe.....108
- 107' Antennae with only short setae; the small gills on segment 1 single; uncommon; Northeast and northern parts of Midwest.....**Litobrancha recurvata**
- 108(107) Frontal process of head forked (similar to Fig. 11.7).....**Ephemera**
- 108' Frontal process of head rounded, not forked; abundant; widespread.....**Hexagenia**
- 109(6') Mandibular tusks with numerous tubercles on upper surface (Fig. 11.11); foretarsi rounded and clearly demarcated from foretibiae; locally abundant and widespread in large river channels and lakes.....**Ephoron**
- 109' Mandibular tusks with one to three tubercles on inner margin, foretarsi flattened and broadly fused with tibiae.....110
- 110(109')Tubercles present almost at apex of inner margin of tusks; abundant; Midwest, Southeast, Texas.....**Tortopus**
- 110' Tubercles present in basal half of tusks only; uncommon; Texas.....**Campsurus**



List of Captions for New Figures: [Last Updated 2013]

[Nymphs]

Figure 1: *Iswaeon anoka* labium.Figure 2: *Iswaeon anoka* foreleg.Figure 3: *Iswaeon anoka* foreclaw showing large and small denticles.Figure 4: *Heterocloeon curiosum* labium.Figure 5: *Heterocloeon curiosum* foreleg.Figure 6: *Heterocloeon curiosum* foreclaw showing large and small denticles.Figure 6a: *Acentrella parvula* and *Plauditus dubius* spines on posterior margin of abd. tergites.Figure 6b: Egg Chorion features of *Ecdyonurus criddlei* (photo from Jeff Webb)Figure 6c: Egg Chorion features of *Nixe lucidipennis*, *N. rusticalis* and *N. inconspicua* (photo of *N. inconspicua* from Flowers 1980)Figure 7: *Heterocloeon curiosum* nymph thorax showing hind wing pad.Figure 8: *Heterocloeon amplum* nymph thorax showing hind wing pad.Figure 9: *Teloganopsis deficiens* fore, mid, and hind claw.Figure 10: *Tsalia bernerii* nymph abdomen.Figure 11: *Ephemerella needhami* forefemur.Figure 12: *Ephemerella tibialis* maxilla. **[Modified Arrow Position -2011]**Figure 13: *Ephemerella tibialis* nymph showing dorsal surface of thorax.Figure 14a: *Ephemerella needhami* maxilla. **[Modified Arrow Position -2011]**Figure 14b: *Serratella serratooides* maxilla. **[Modified Arrow Position -2011]**Figure 15: *Serratella serratooides* ventral lamella of gill 6.Figure 16: *Ephemerella needhami* ventral lamella of gill 6.Figure 17: *Brachycercus nitidus* operculate gills (2).Figure 18a: *Sparbarus maculatus* operculate gills (2).Figure 18b: *Sparbarus nasutus* operculate gills (2).Figure 19a: [Upper] side of thorax of *Susperatus prudens* , [Lower] *Susperatus tuberculatus* showing sternal projections.Figure 19b: Ocellar tubercles of *Susperatus* spp. based on *S. tuberculatus*.Figure 20a: [Upper] side of thorax of *Sparbarus maculatus*, [Lower] *S. Choctaw* showing absence of sternal projections.Figure 20b: Ocellar tubercles of typical of *Sparbarus* spp. and *Brachycercus* spp.Figure 21: Posterolateral projection of segment 6 of *Sparbarus maculatus*.Figure 22: Hind leg of *Sparbarus maculatus*.Figure 23: Posterolateral projection of segment 6 of *Cercobrachys etowah*.Figure 24a: Hind leg of *Cercobrachys etowah*.Figure 24b. Blunt ocellar tubercles typical of *Cercobrachys* spp.

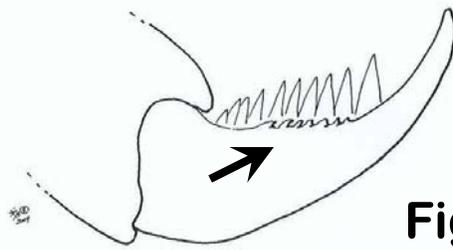
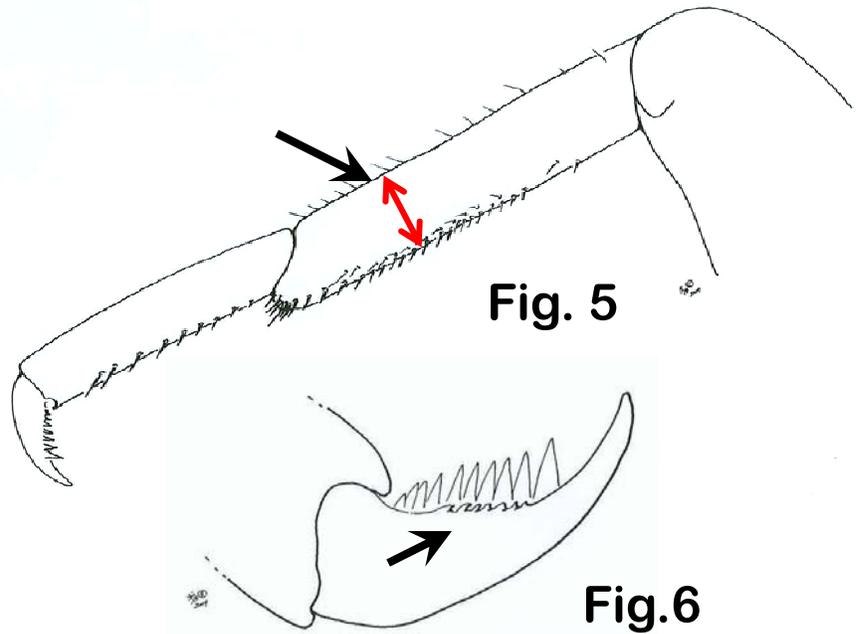
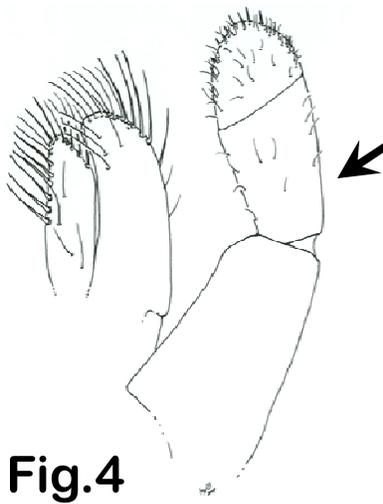
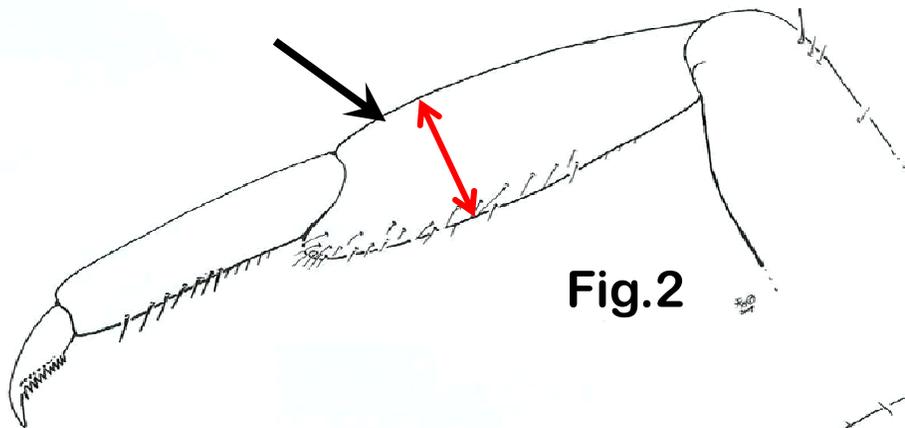
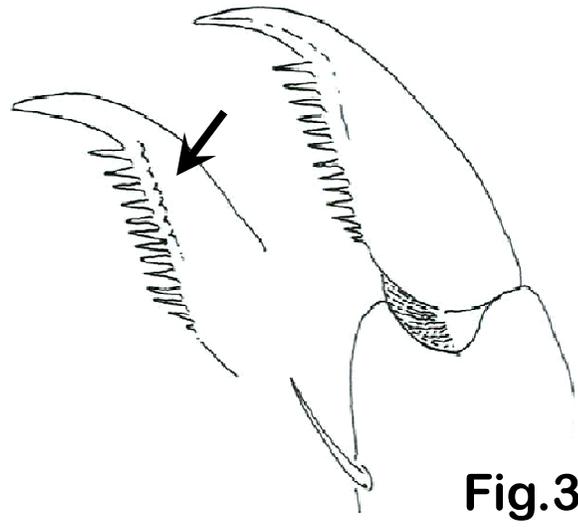
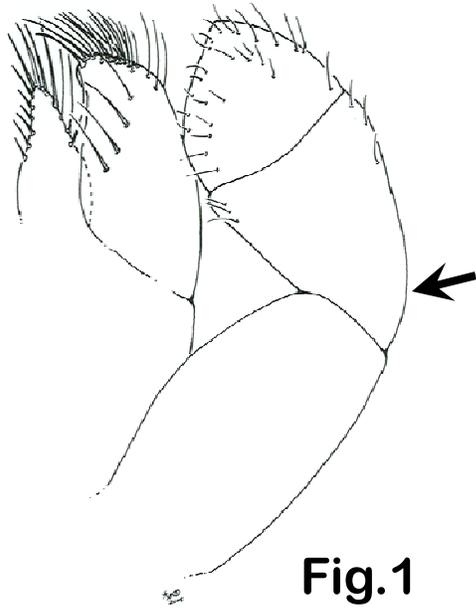
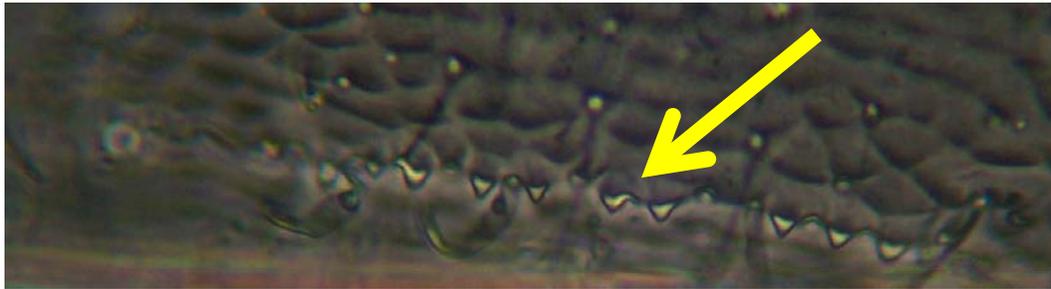
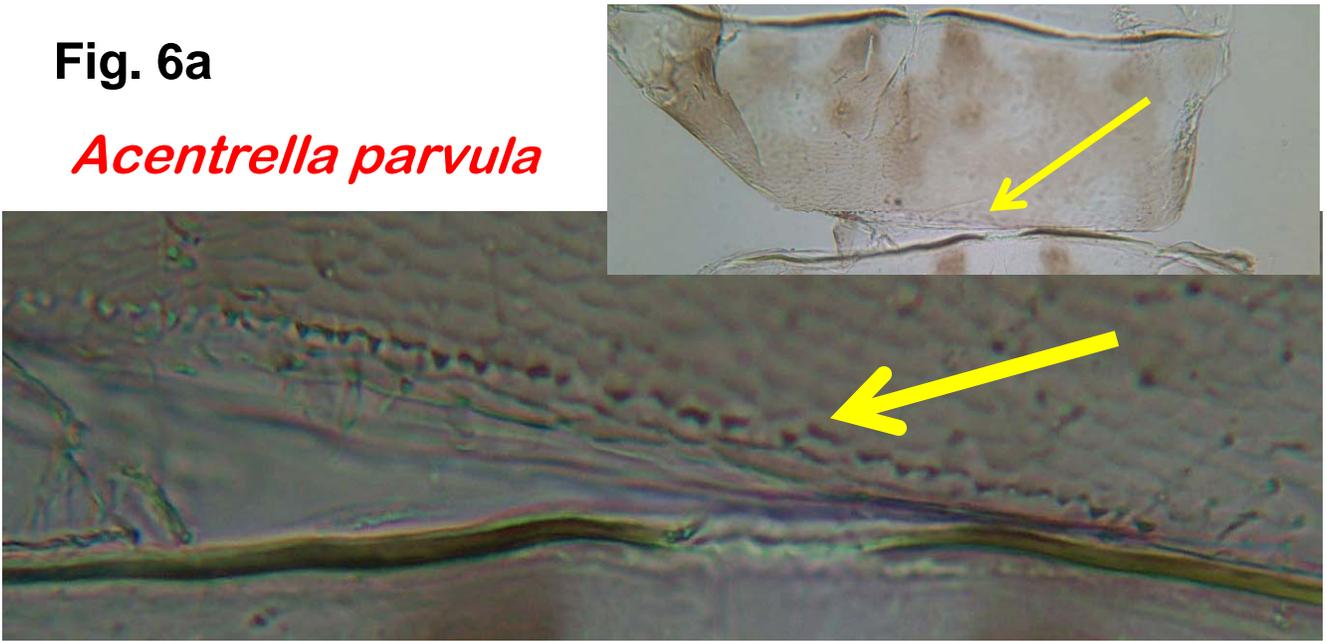


Fig. 6a

Acentrella parvula



Plauditus dubius



Fig. 6b

Ecdyonurus criddlei – Western Canada
(Photo From Jeff Webb)

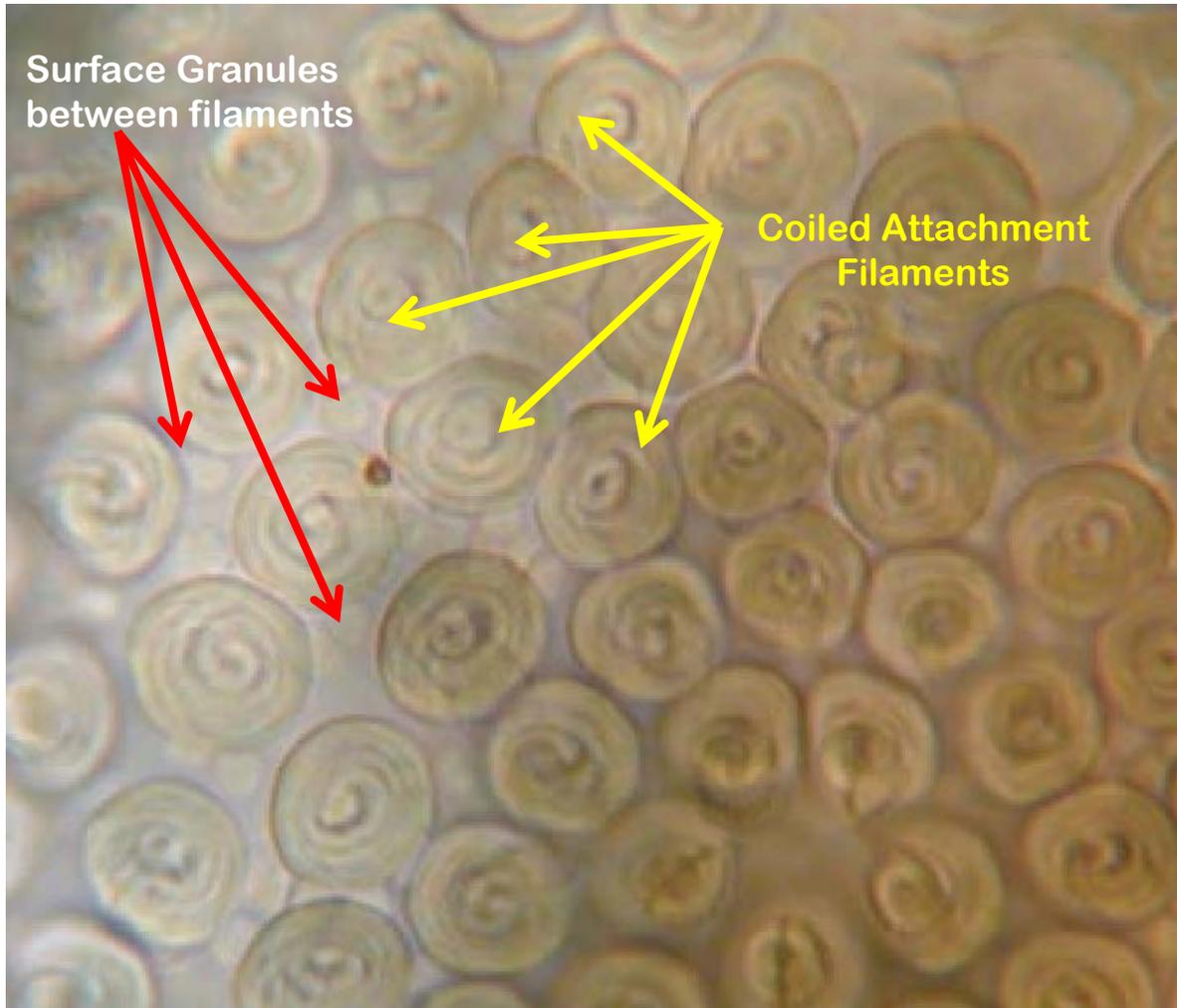
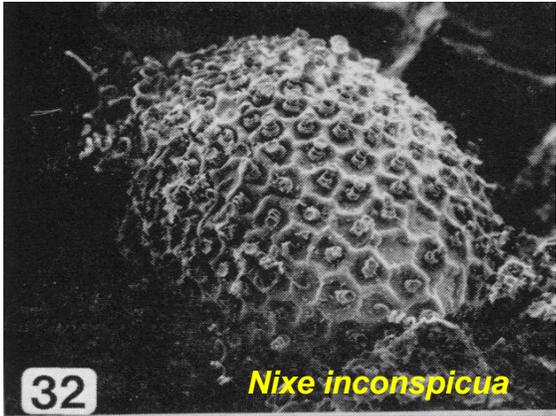
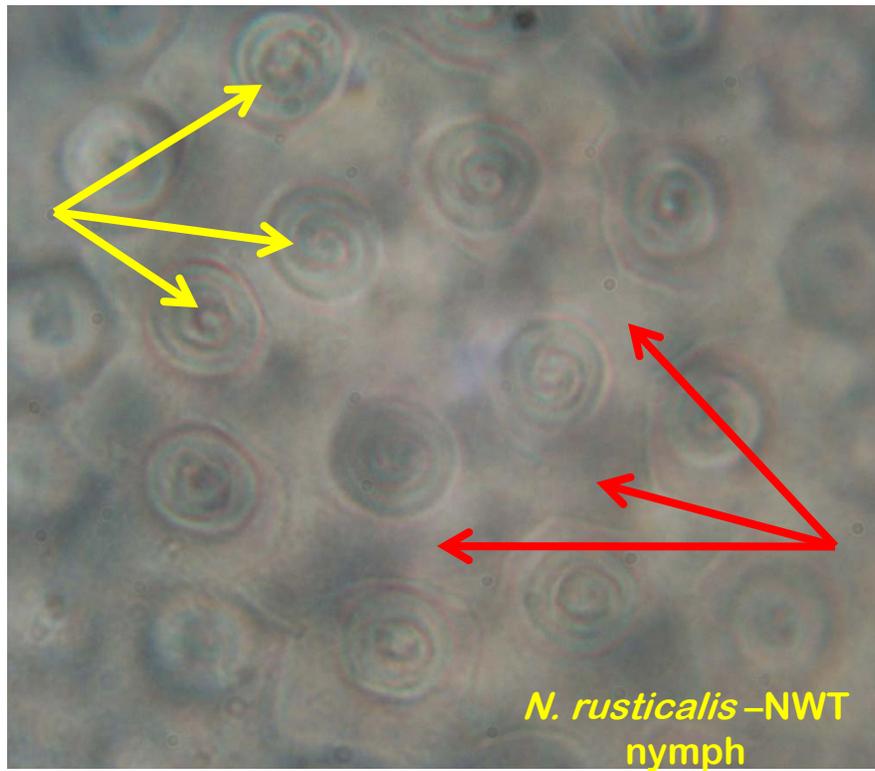
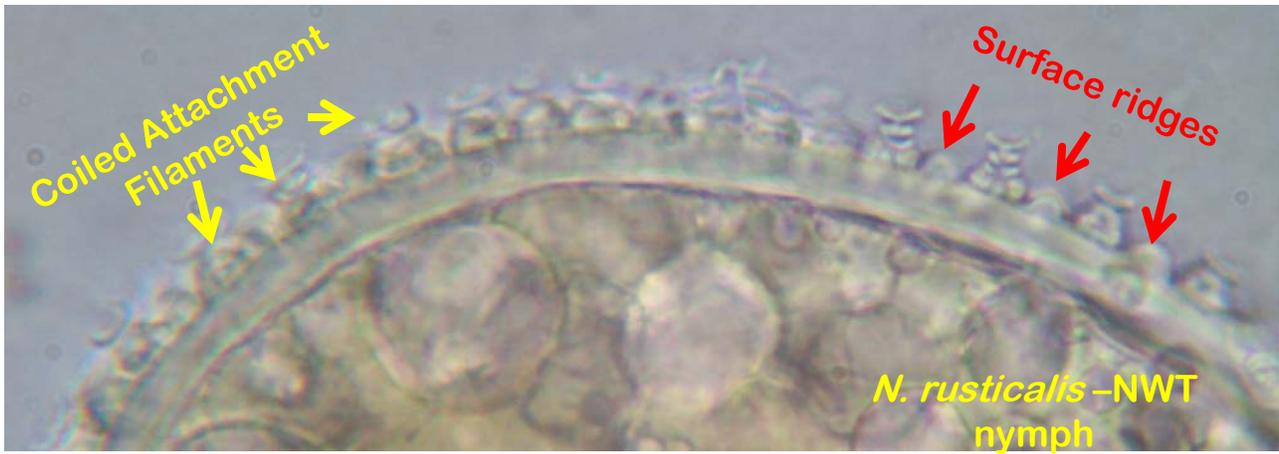


Fig. 6c *Nixe* Eggs



[Scanning EM egg photo from Flowers 1980]



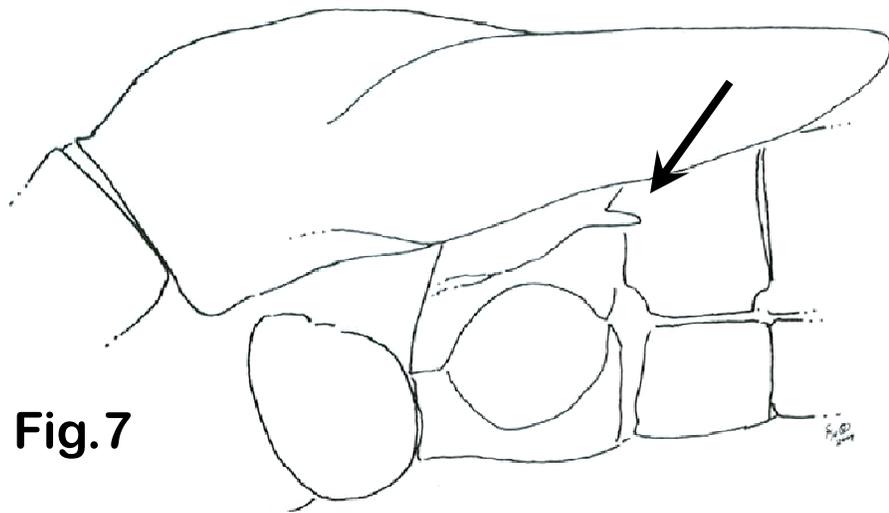


Fig.7

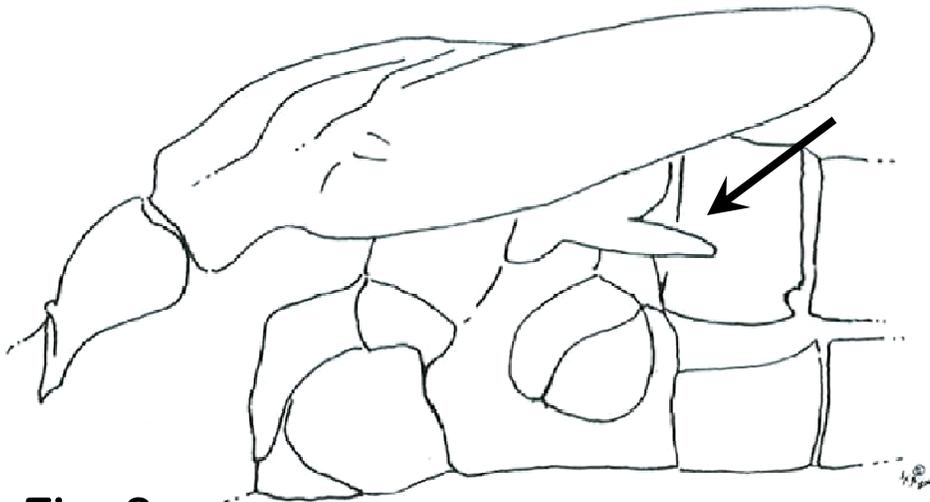


Fig. 8

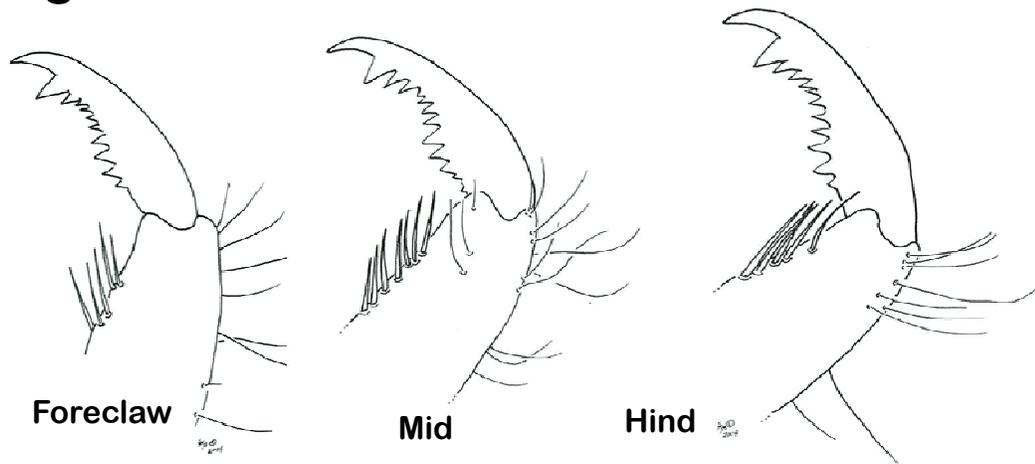


Fig.9

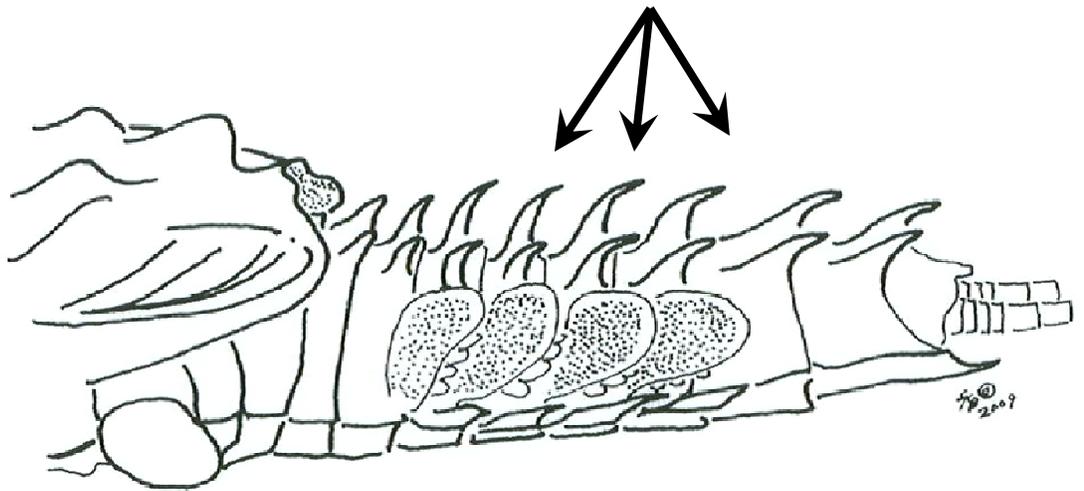


Fig.10

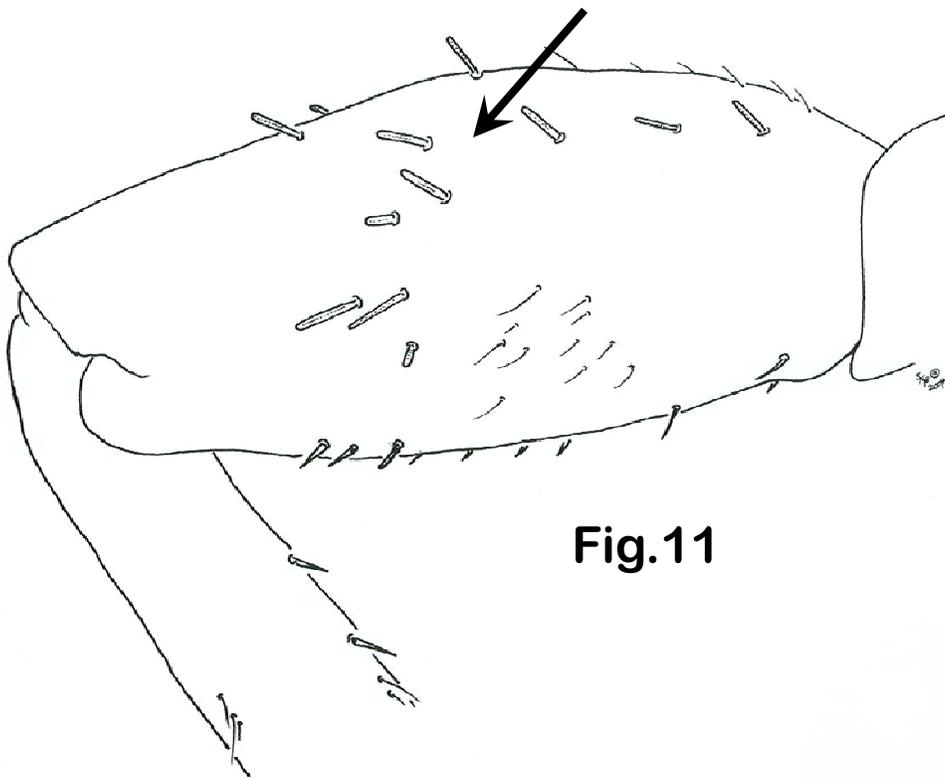


Fig.11

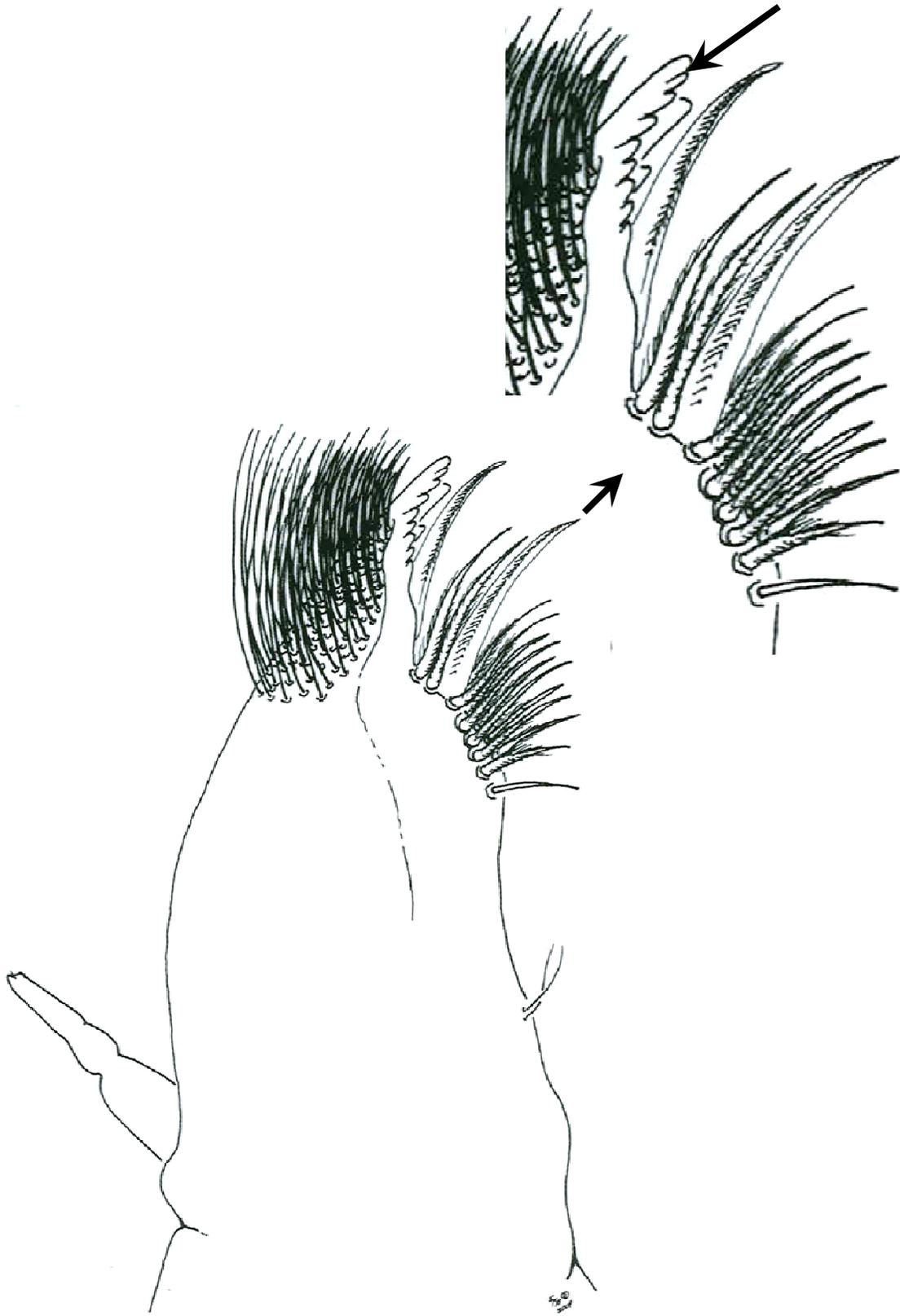
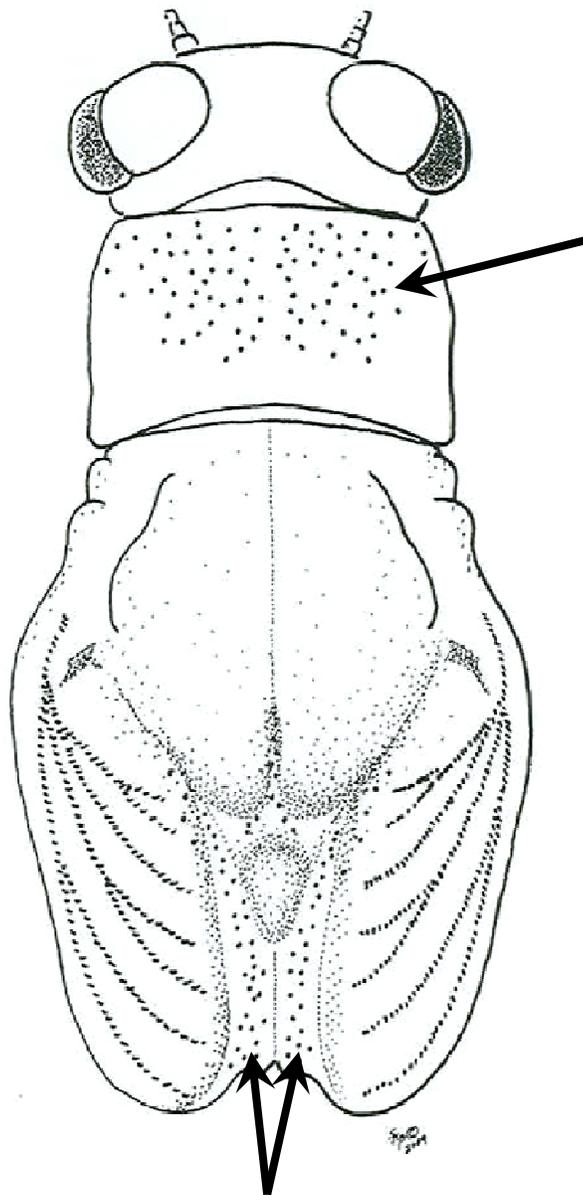


Fig.12

Fig.13



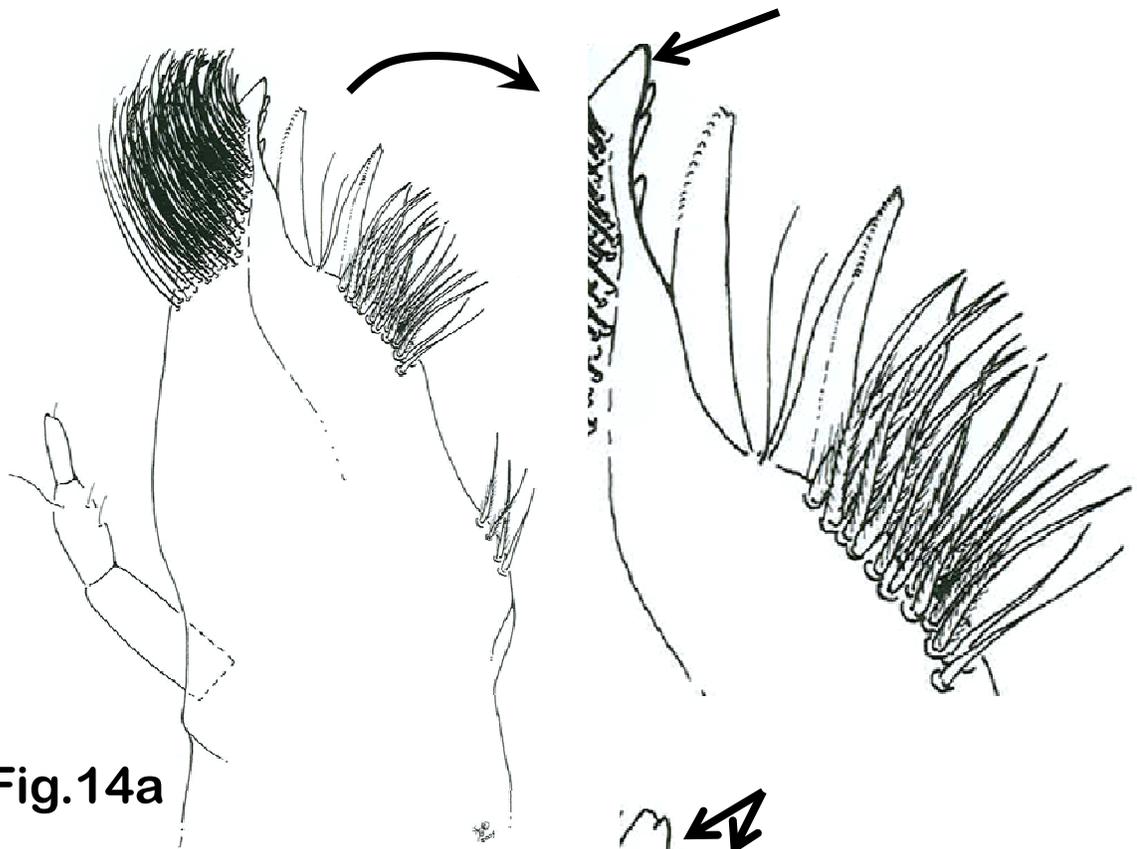


Fig. 14a

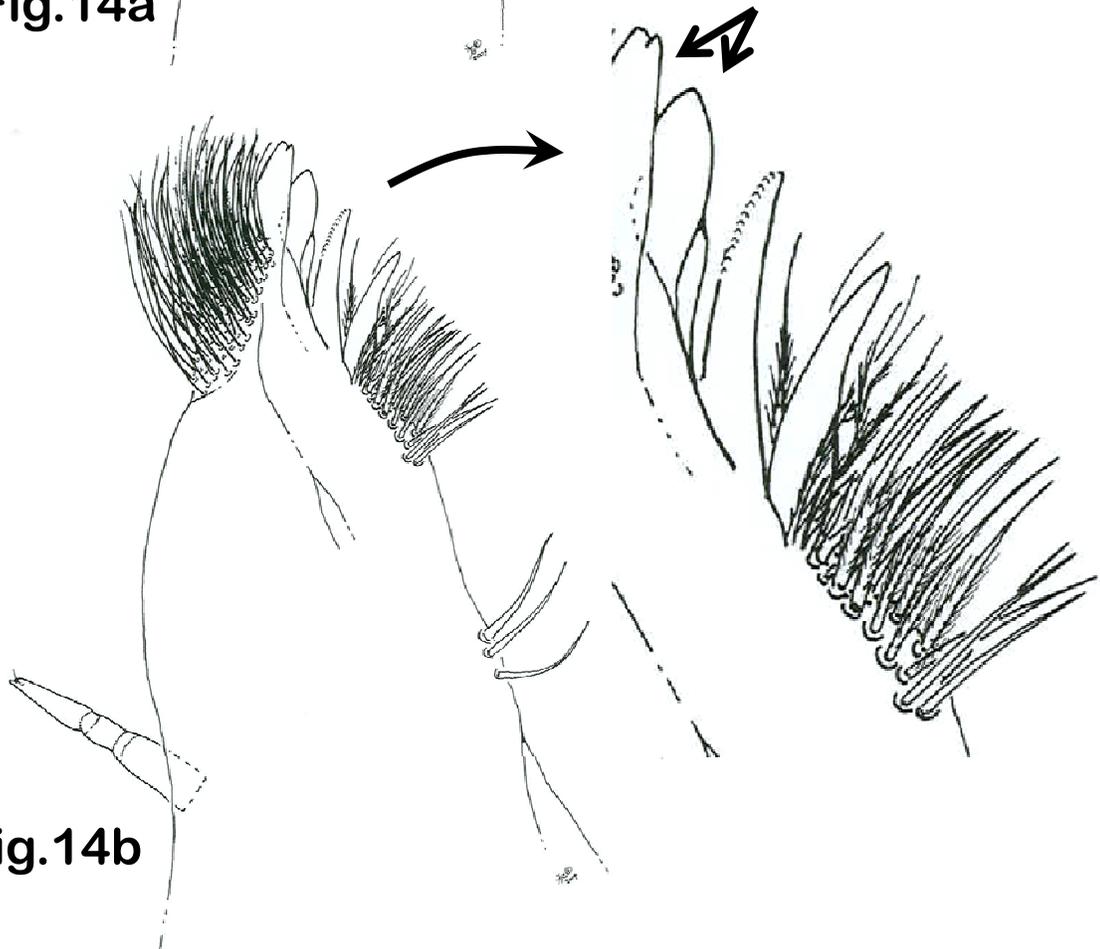
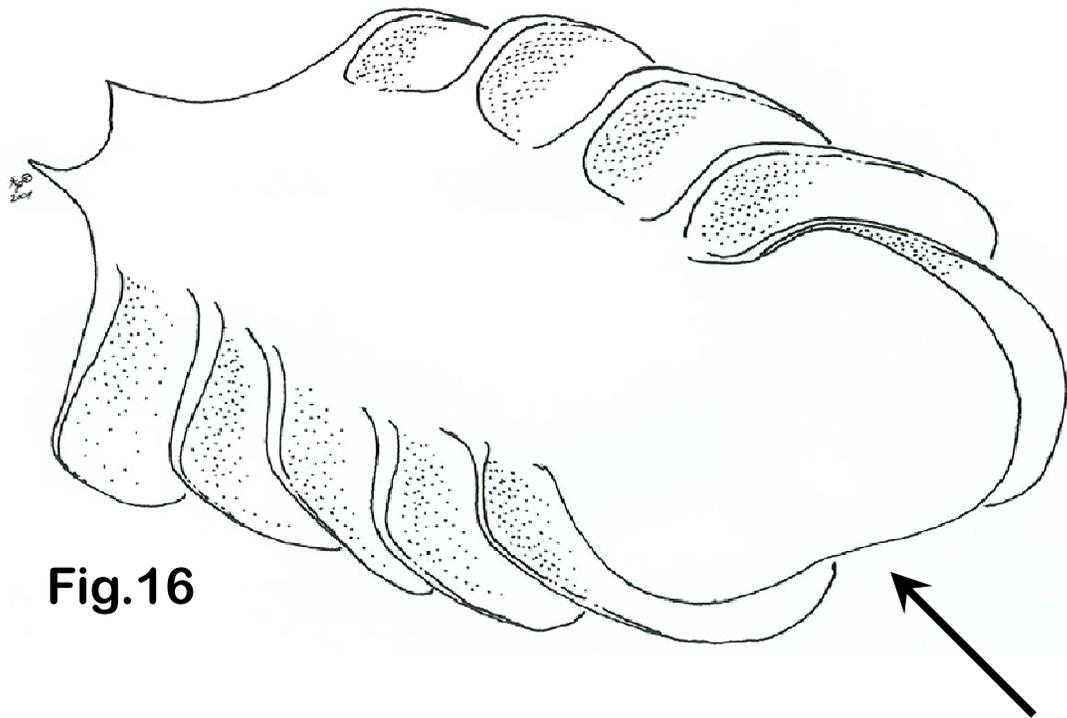


Fig. 14b

Fig.15



Fig.16



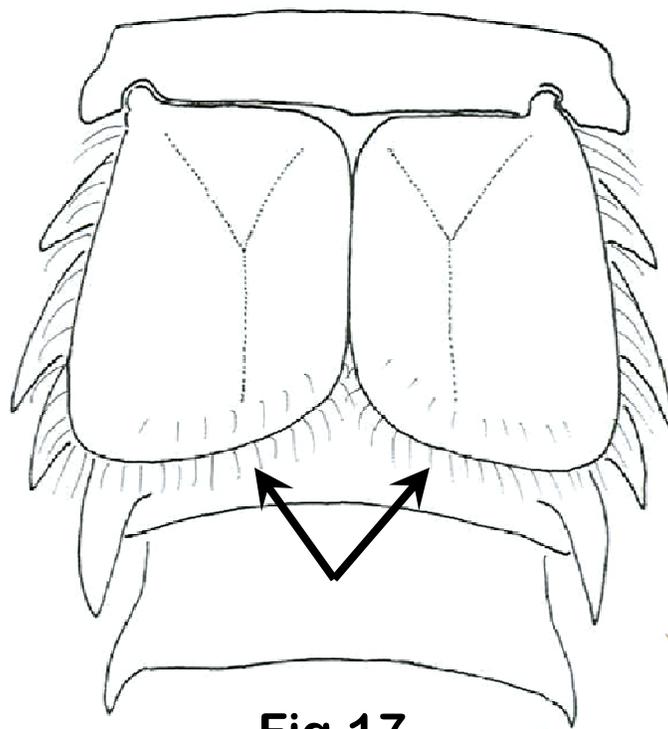


Fig.17

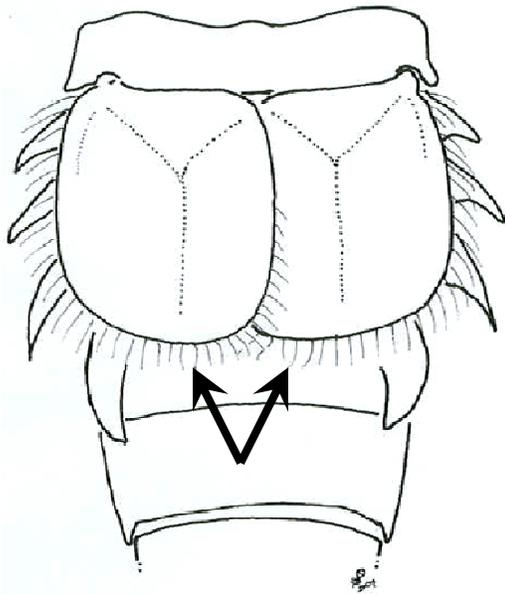


Fig.18a

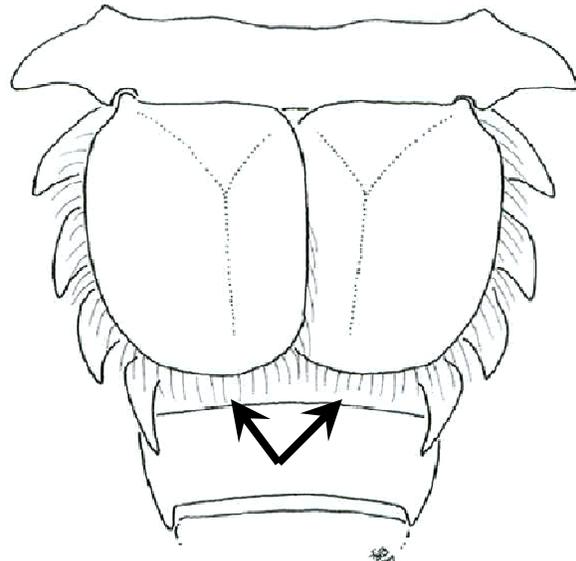
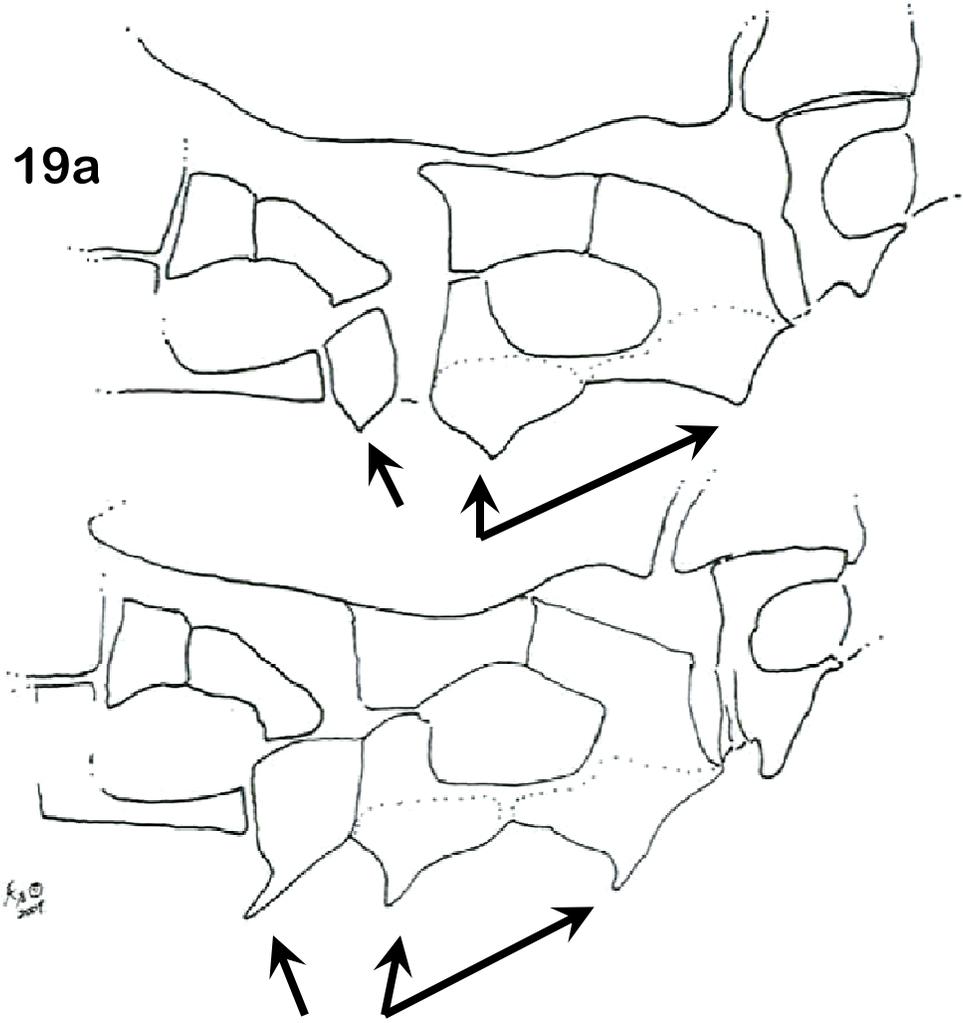


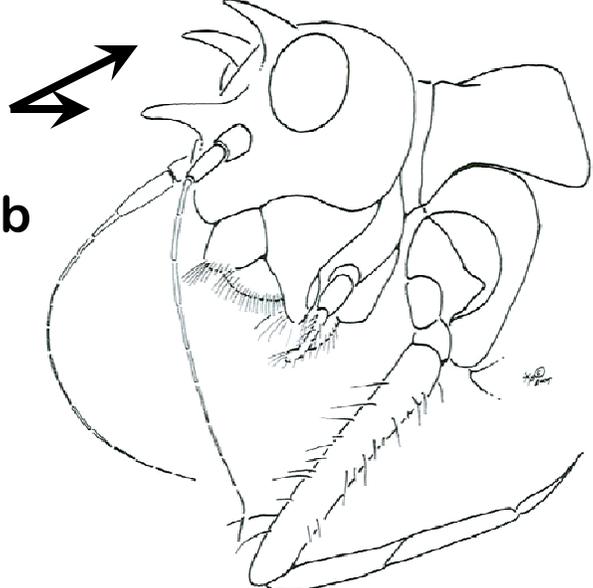
Fig.18b

Fig. 19a



*K. O.
2007*

Fig. 19b



*K. O.
2007*

Fig.20a

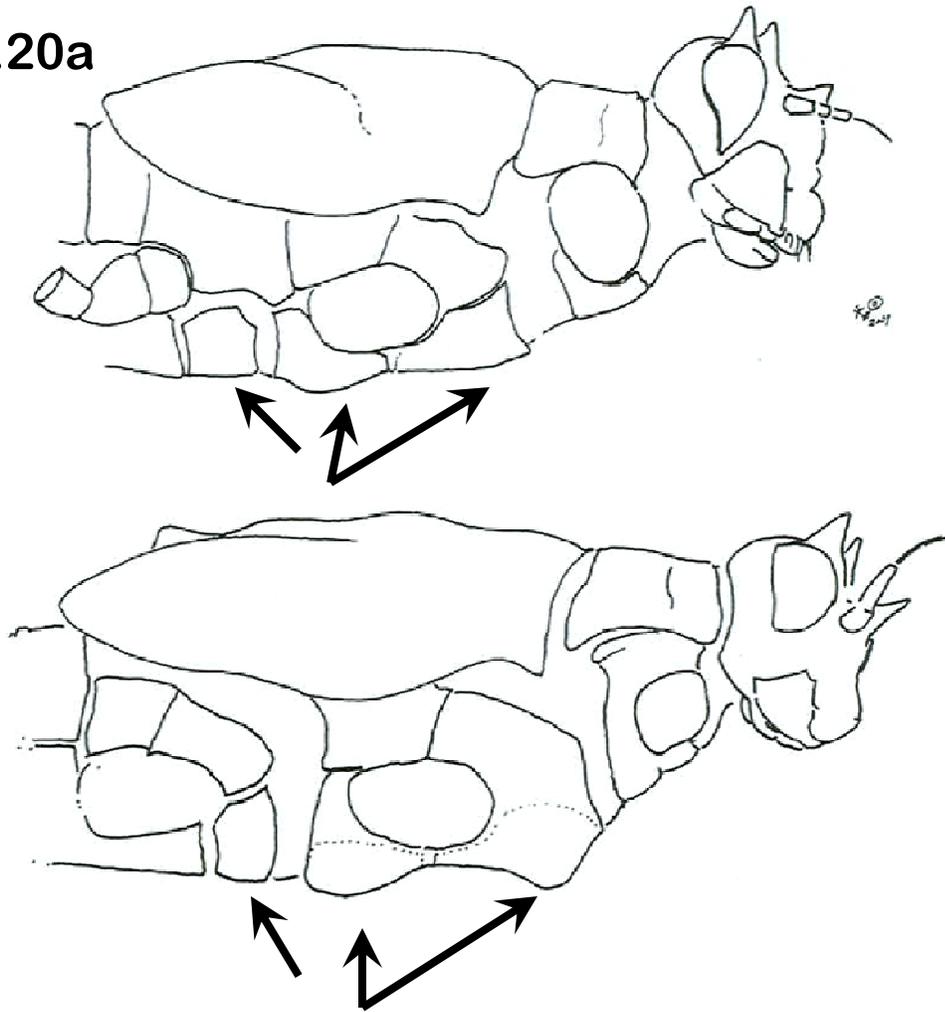


Fig.20b

