

Preliminary key to the nymphs of the families and subfamilies of the German Auchenorrhyncha fauna (Hemiptera, Fulgoromorpha et Cicadomorpha)

Gudrun Zenner¹, Marlies Stöckmann¹ and Rolf Niedringhaus^{1*}

Kurzfassung: Vorläufiger Bestimmungsschlüssel der Larven der Zikaden-Familien und -Unterfamilien Deutschlands (Hemiptera, Fulgoromorpha et Cicadomorpha). – Für die Larven der Zikaden Deutschlands werden vorläufige Bestimmungsschlüssel präsentiert. Die Bestimmungsgänge zu den 7 Zikaden-Familien und den 4 Unterfamilien der Delphacidae und 13 Unterfamilien der Cicadellidae werden erläutert durch 60 Merkmals- und 49 Habitus-Abbildungen. Von jeder Gruppe ist mindestens ein typischer Vertreter berücksichtigt.

Abstract: A preliminary key for identification of the nymphs of German Auchenorrhyncha to the level of family and subfamily is presented. It covers 7 families and, within Delphacidae, 4 subfamilies and within Cicadellidae, 13 subfamilies. Each group is represented by at least one species. Altogether 49 species are illustrated, with 60 additional figures of diagnostic characters.

Key words: Planthoppers, leafhoppers, larval morphology, identification key

1. Introduction

In sweep net and pitfall trap samples Auchenorrhyncha nymphs are often represented in larger numbers than adults. Although most species can be identified to generic level at least in older instars, many genera remain which cannot yet be further resolved. On the other hand thorough studies of taxonomically difficult groups have shown that nymphs may be more easily identified than adults, e.g. in the genera *Macropsis* and *Balclutha* (Wagner 1950; Vilbaste 1982). Nevertheless, none of the existing keys covers the full range of central European species, and some sections are insufficient or even misleading. Therefore, considerable information is lost in many ecological research projects.

This paper is a pilot work of more extensive studies, based on a rather limited set of available species, but including all major taxa. It is meant to stimulate more attention to nymphal biology in general, and to demonstrate gaps in our knowledge. For a further and more complete version, we welcome all kinds of criticism and complements by users. Taxonomy and nomenclature follow Nickel & Remane (2002) and Holzinger *et al.* (2003).

2. Research history

So far only few specialists have intensively worked on Auchenorrhyncha nymphs, and therefore, descriptions and illustrations are rare. For the German fauna the following papers are particularly worth mentioning: (i) Wagner (1950, 1964): genus *Macropsis* (8 spp.,

¹ Carl von Ossietzky University, Institute of Biology and Environmental Sciences, Landscape Ecology Group, P.O. Box 2503, D-26111 Oldenburg, rolf.niedringhaus@uni-oldenburg.de, * = corresponding author

illustrations and descriptions), (ii) Vilbaste (1968): Delphacidae of northern Europe (ca.40 spp. relevant for the German fauna, key and descriptions, no illustrations), (iii) Logvinenko (1975): Fulgoromorpha of Ukraine (6 spp. relevant), (iv) Walter (1975, 1978): Euscelinae of central Europe (26 spp., illustrations and descriptions), (v) Wilson (1978): arboricolous Typhlocybinae of Great Britain (14 spp., illustrations and descriptions), (vi) Vilbaste (1982): Cicadomorpha of northern Europe (ca. 150 spp. relevant, illustrations and descriptions), (vii) Stewart (1986): genus *Eupteryx* (13 spp., illustrations and descriptions), (viii) Dmitriev (1999, 2001, 2002a, 2002b, 2003, 2004): mainly Deltocephalinae of European Russia (58 spp. relevant, illustrations and descriptions), (ix) Tishechkin (2002): genus *Macropsis* (16 spp. relevant, illustrations and descriptions), (x) Holzinger *et al.* (2003): especially Delphacidae (10 spp., photographs). Altogether useful descriptions and illustrations are available only for about 200 of the 620 German species (Fig. 1).

3. Morphology

Auchenorrhyncha nymphs mainly differ from adults in the absence of wings, although their oriments (wing pads) appear as early as in the second instar. The nymphal instars can be identified relatively easily by measuring the wing pad length (Fig. 2). In the last instar developing to macropterous adults the forewing pads extend to the apices of the hindwing pads (posterior margin of metanotum), in nymphs developing to brachypterous adults, forewing pads usually do not reach the hindwing pads. If wing pads are 1.5-2.0 times as long as pro- and mesothorax together, adults will become macropterous. If these lengths are nearly equal, adults will become brachypterous (Dmitriev 2002b).

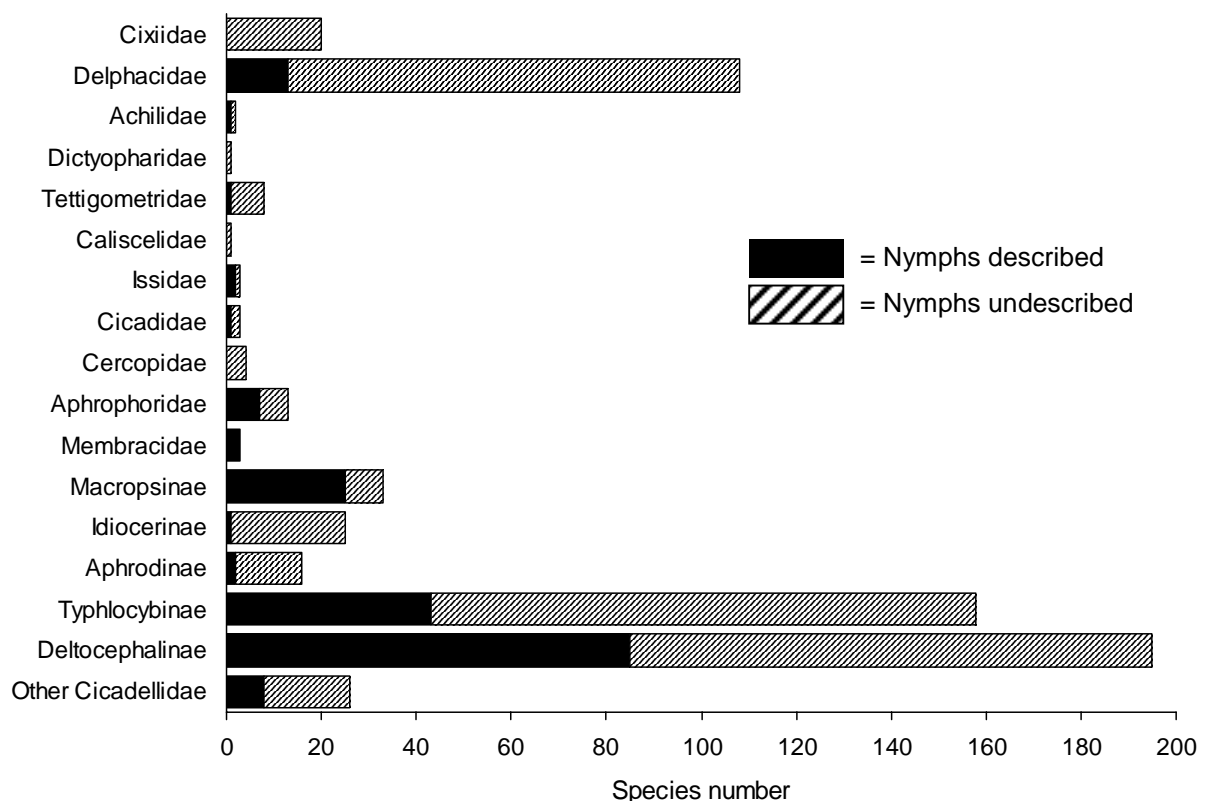


Fig. 1: State of knowledge of nymphal morphology in the German Auchenorrhyncha fauna

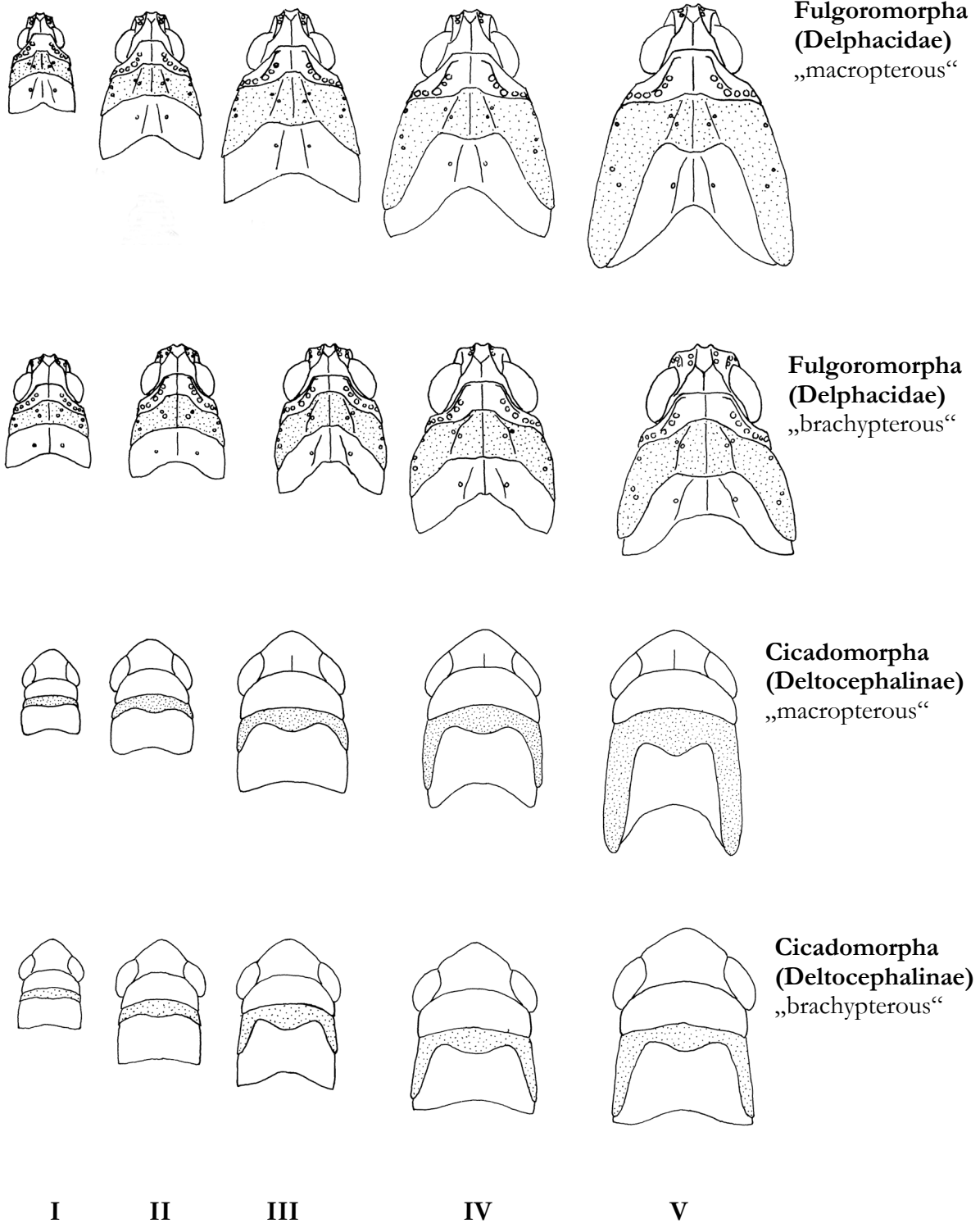


Fig. 2: Development of the five nymphal instars

Detailed descriptions of the nymphal morphology of Fulgoromorpha (Delphacidae) are given in Vilbaste (1968), of Cicadomorpha (Cicadellidae, Deltocephalinae) in Vilbaste (1982) and Dmitriev (2002a, 2002b). Therefore we only give a brief overview of terminology and most important diagnostic features (Fig. 3).

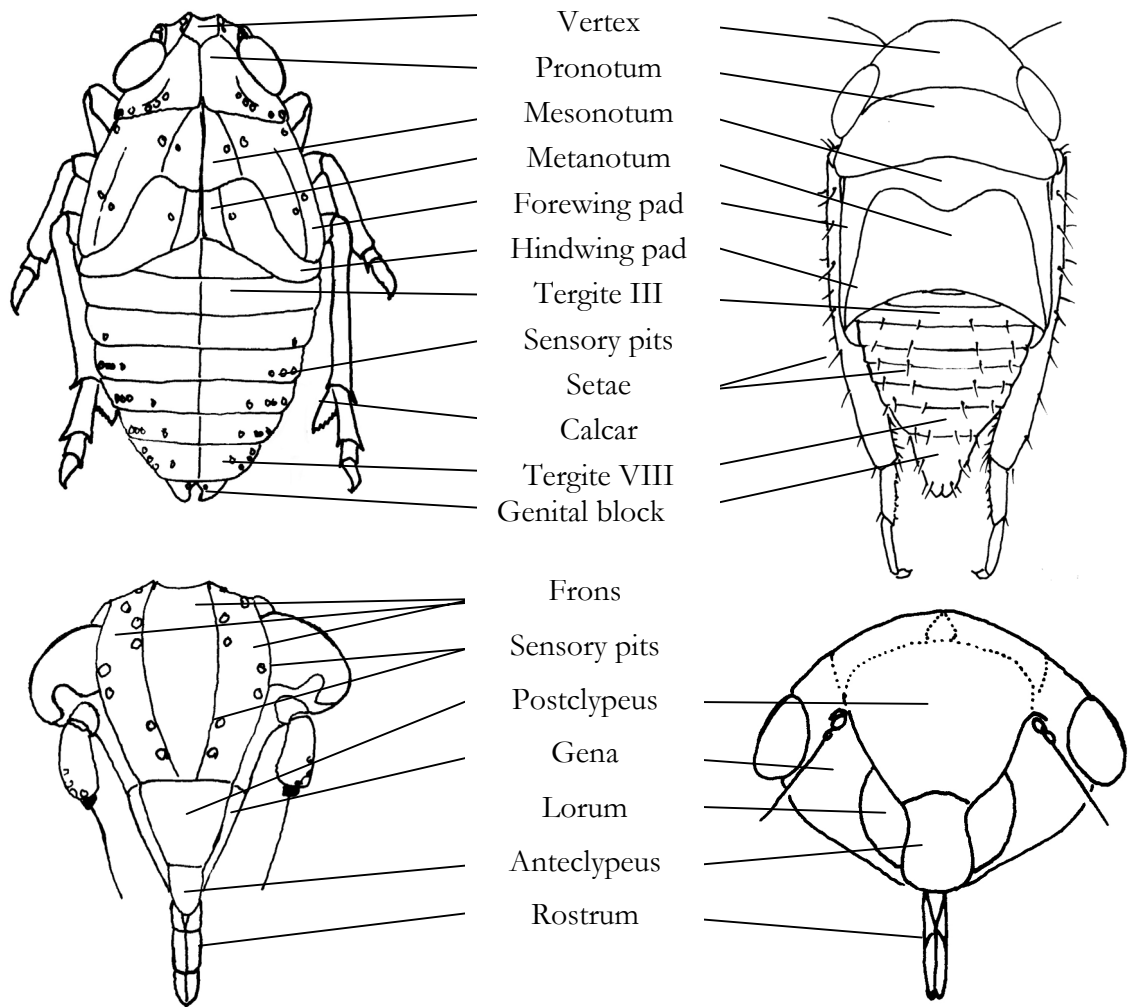


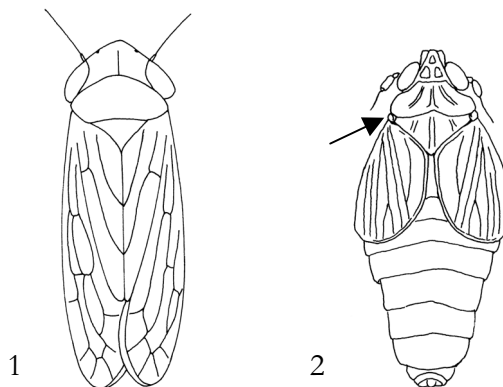
Fig. 3: General morphology of leafhopper nymphs; last instar of Fulgoromorpha (Delphacidae) and Cicadomorpha (Cicadellidae, Deltocephalinae)

| | |
|---------------|---|
| Anteclypeus | Ventral part of face, between rostrum and postclypeus |
| Calcar | Movable spur on apex of hind femur in Delphacidae |
| Frons | Middle part of face in Fulgoromorpha (“metope” <i>sensu</i> Anufriev & Emeljanov 1988), divided into interfrons and 2 laterofrontes; in Cicadomorpha usually small or absent) |
| Gena | „Cheek“, lateral facial sclerite |
| Genital block | Genital capsule at apex of abdomen, with pygofer and anal tube |
| Lorum | Sclerite laterally of anteclypeus and ventral part of clypeus (in Cicadomorpha) |
| Mesonotum | Dorsal sclerite of mesothorax (insertion of forewing pads) |
| Metanotum | Dorsal sclerite of metathorax (insertion of hindwing pads, not visible from above) |
| Pit | Circular depression in the cuticle in Fulgoromorpha (sensory organs) |
| Postclypeus | Middle part of face in Cicadomorpha; ventral part of face between anteclypeus and frons in Fulgoromorpha |
| Pronotum | Dorsal sclerite of the 1st segment of thorax |
| Rostrum | (= proboscis), stylet-shaped mouthparts |
| Setae | Hairs, especially on abdomen and legs (macrosetae = strong hairs) |
| Tergites | Eight dorsal sclerites of abdomen (usually visible only on segments III-VIII) |
| Vertex | Dorsal part of head (true boundary to face often below carina) |
| Wing pads | Wing anlagen (oriments) |

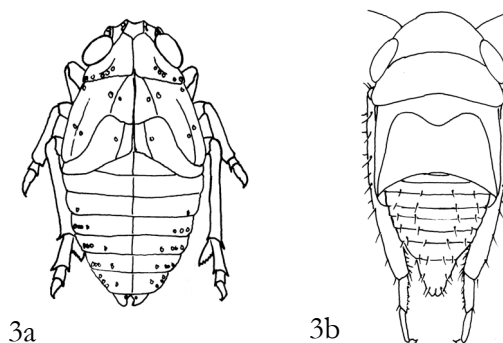
4. Identification key

4.1 Key to family level (fifth instar)

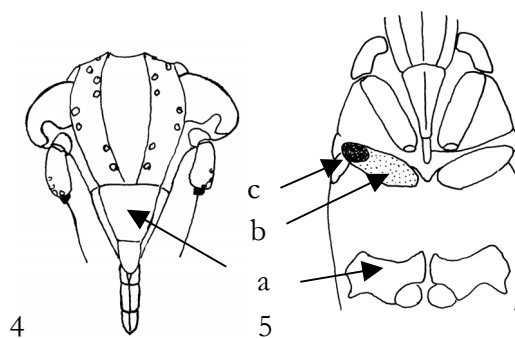
1 Fore wings fully developed (Fig. 1), if short-winged (brachypterous), then wings usually connected with the body by a small basal joint (Fig. 2 ↑); fore wings usually clearly veined**Adult**



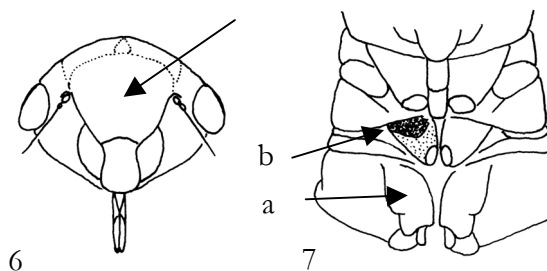
- Wings absent or short, rigid wing pads visible, and basally fully connected with thorax (Fig. 3a, b); no distinct veins on wings visible**Nymph 2**



2(1) Postclypeus in lower part of face, situated distinctly below the eyes (Fig. 4 ↑); hind coxae rigidly connected with metathorax (Fig. 5 ↑a), median coxae long (Fig. 5 ↑b); insertions widely separated from each other (Fig. 5 ↑c); body with sensory pits (except in Tettigometridae)**Fulgoromorpha 3**



- Postclypeus in central part of face (Fig. 6 ↑); hind coxae movable (Fig. 7 ↑a), median coxae short, insertions close to each other (except in Cicadidae) (Fig. 7 ↑b); body without sensory pits**Cicadomorpha 9**



3(2) Head with longitudinal keels on frons (Fig. 8 ↑) **5**

- Head without distinct longitudinal keels on frons (Fig. 9, 10) **4**

4(3) Body dorsoventrally flattened; head and body without sensory pits (Fig. 9) **Tettigometridae**

- Body not flattened; head and body with sensory pits (Fig. 10 ↑); tergites VI-VIII with whitish wax spots **Cixiidae**

5(3) Hind tibia apically with a distinct movable spur (Fig. 11 ↑) **Delphacidae**

- Hind tibia without spur (Fig. 12) **6**

6(5) Vertex more than twice as long as broad, lateral keels very high (Fig. 13 ↑); body usually light green; length of fifth instar > 6,5 mm **Dictyopharidae**

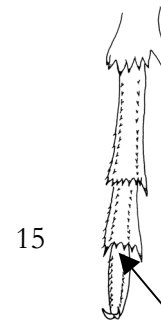
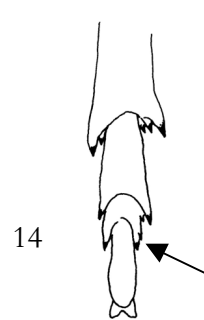
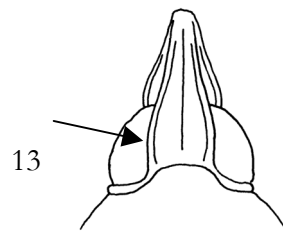
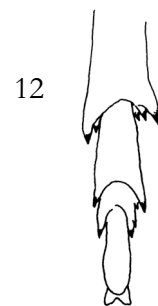
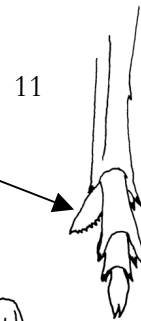
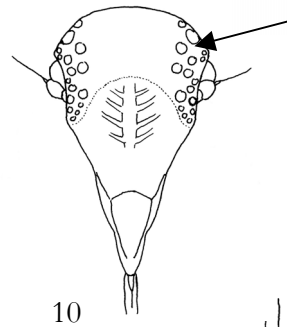
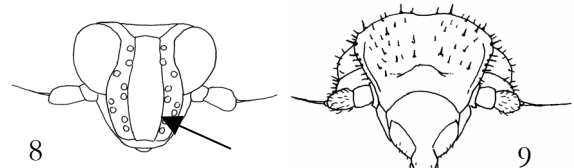
- Vertex shorter, body not green **7**

7(6) Second segment of hind tarsus laterally on each side with a single tooth (Fig. 14 ↑) **8**

- Second segment of hind tarsus ventrally with a row of teeth (Fig. 15 ↑). (Usually in fissures or under bark of dead wood, feeding on fungal mycelium) **Achilidae**

8(7) Body with reddish longitudinal stripe; length of fifth instar < 4 mm .. **Caliscelidae**

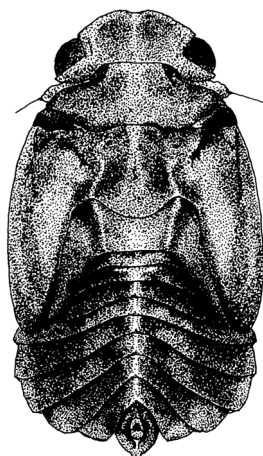
- Body without reddish stripe; length of fifth instar > 5 mm **Issidae**



Tettigometridae

8 species

Tettigometra spec.

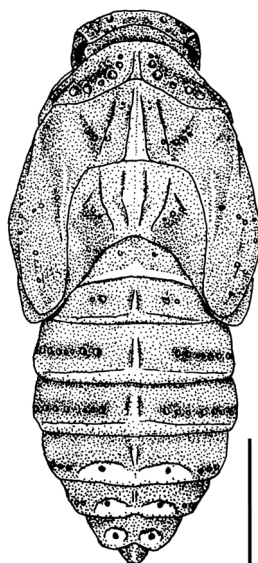


mm

Cixiidae

20 species

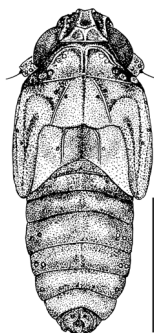
Cixius spec.



Delphacidae

108 species

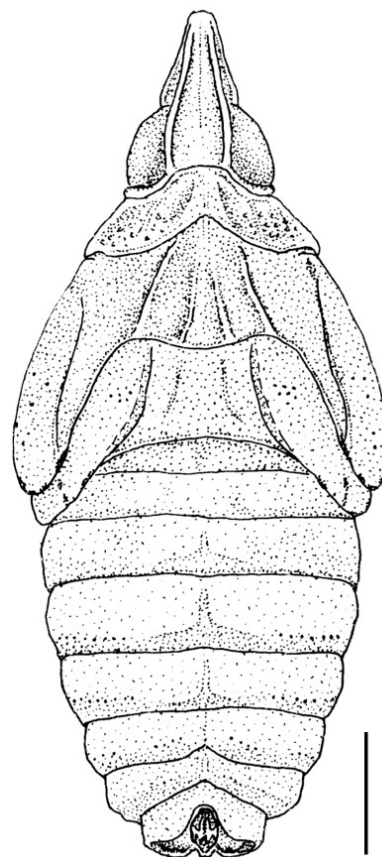
Javesella pellucida



Dictyopharidae

1 species

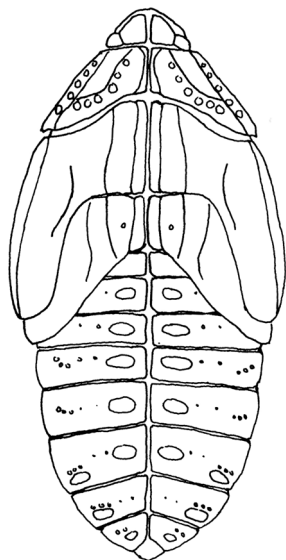
Dictyophara europaea



Achilidae

2 species

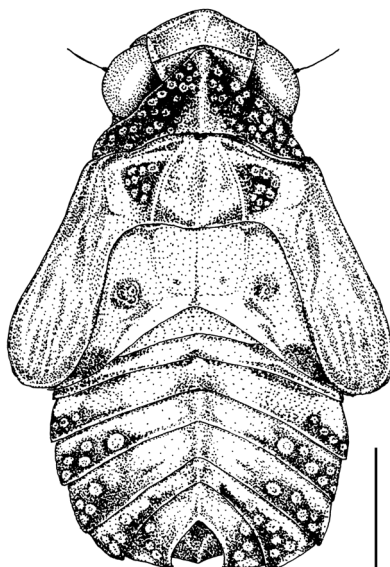
*Cixidia lapponica**
(after Linnavuori 1951)



Issidae

3 species

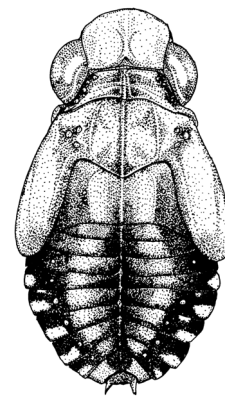
Issus coleoptratus



Caliscelidae

1 species

Ommatidiotus dissimilis



* = not known from the German fauna

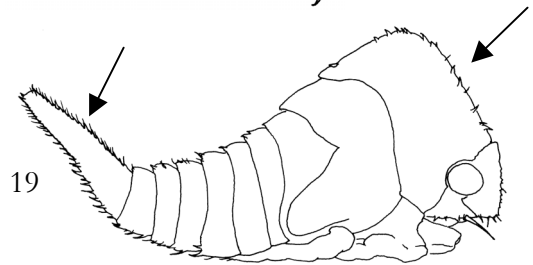
9(2) Fore legs modified into a strong digging tool (Fig. 17), resembling front pincers of a crab. (Nymphs endogeic, feeding on roots, development takes several years)

..... **Cicadidae**

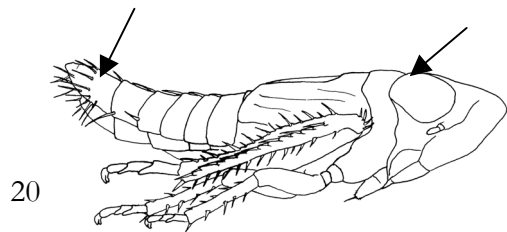
- Legs different (Fig. 18) **10**



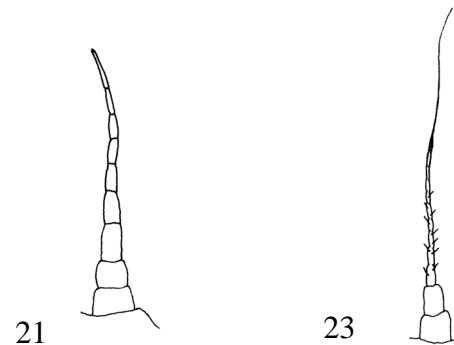
10(9) Pronotum strongly elevated and vaulted, steeply sloping forward (Fig. 19 ↑); last abdominal segment thin and conical, at least as long as the preceding 3 segments together (↑) **Membracidae**



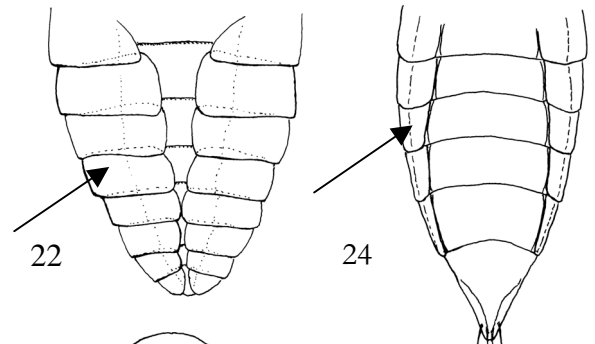
- Pronotum not strongly elevated and not steeply sloping (Fig. 20 ↑); last abdominal segment shorter than the preceding 3 segments (↑) **11**



11(10) Flagellum of antennae thick and divided into several segments (Fig. 21); abdominal segments III-IX laterally with dilatations, ventrally enclosing a tube-like cavity (Fig. 22 ↑); frontal part of head distinctly swollen, forming a bulge. (In spittle masses) **12**



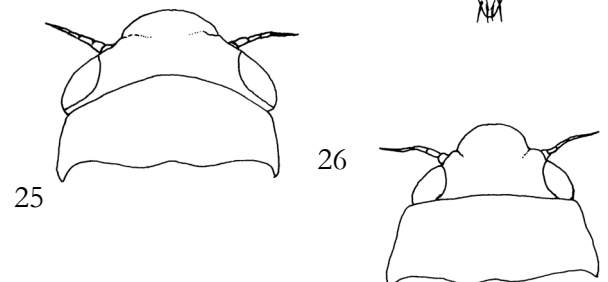
- Flagellum of antennae thin and filiform (Fig. 23); lateral parts of abdominal tergites not dilatated (Fig. 24 ↑). (Not in spittle) **Cicadellidae**



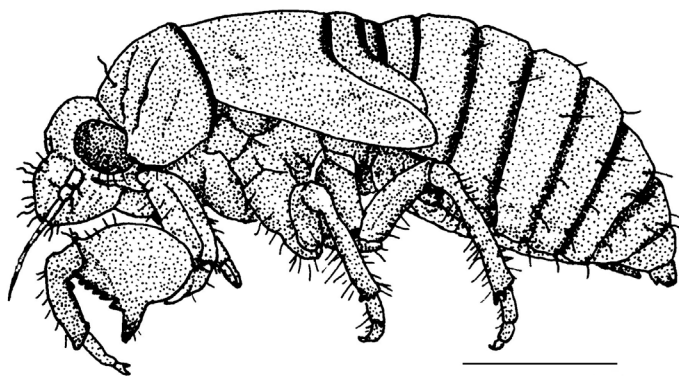
12(11) Head usually as wide as pronotum (Fig. 25). (In spittle masses [“cuckoo spit”] above-ground)

..... **Aphrophoridae**

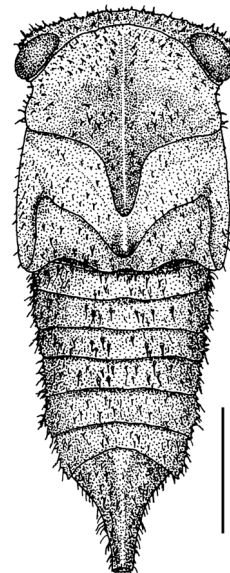
- Head narrower than pronotum (Fig. 26). (In subterranean spittle masses, feeding on roots) **Cercopidae**



Cicadidae
3 species
Cicadetta spec.



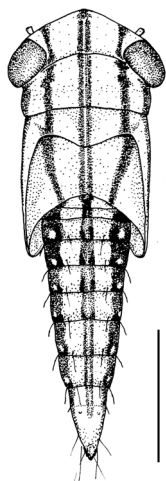
Membracidae
3 species
Gargara genistae



Cicadellidae
453 species

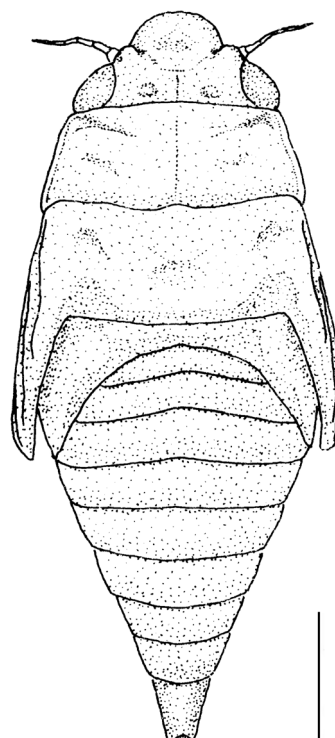
Cicadula quadrinotata

Macropsis scutellata



Cercopidae
4 species

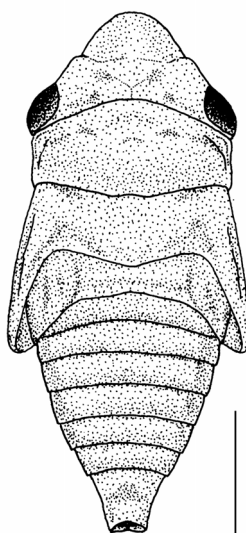
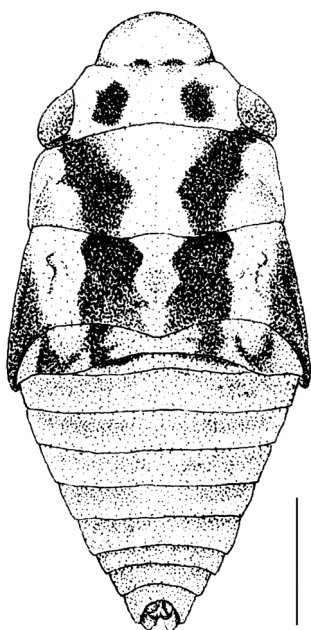
Haematoloma dorsatum



Aphrophoridae
13 species

Lepyronia coleoptrata

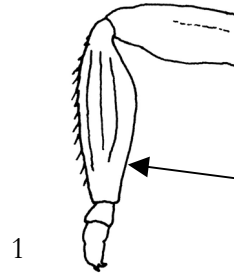
Neophilaenus lineatus



4.2 Key to nymphs of the subfamilies of the German Delphacidae

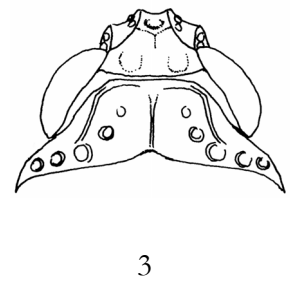
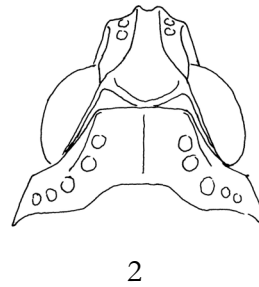
1 Fore legs, especially tibia, strongly flattened (Fig. 1 ↑) **Asiracinae**

- Fore legs not strongly flattened 2



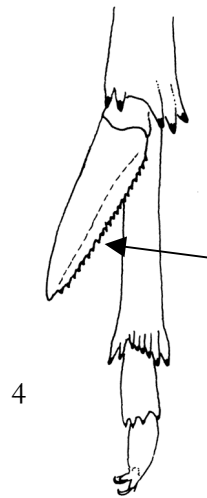
2 (1) Head considerably longer than its width between eyes (Fig. 2) 3

- Head as long as its width between the eyes or wider than long (Fig. 3) ...
Delphacinae (group 1 “broad head”)



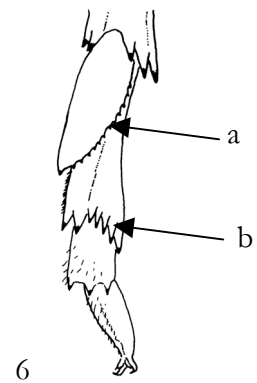
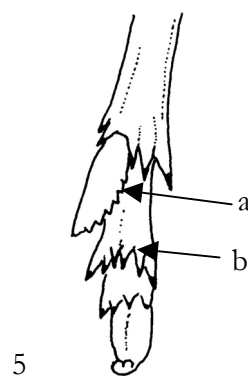
3 (2) Body dark with light spots (*Megamelus*) or light, then post-tibial spur with ≥ 20 teeth (*Chloriona*, Fig. 4 ↑; living on reed)
Delphacinae (group 2 “long head”)

- Ground colour not dark, spur with ≤ 16 teeth (Fig. 5a, 6a) 4

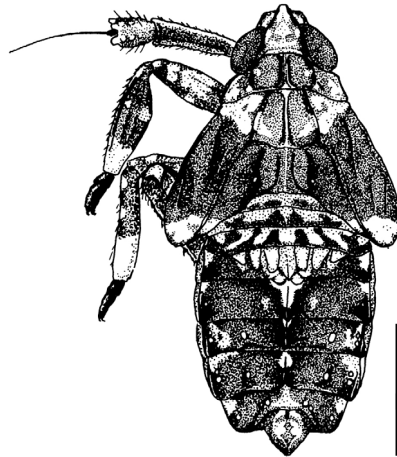


4(3) First segment of hind tarsi with 2 strong teeth and four teeth in a row (Fig. 5b ↑); length ca. 2 mm
..... **Kelisiinae**

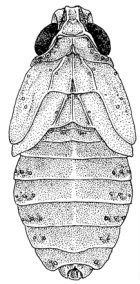
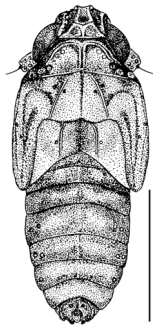
- First segment of hind tarsi with 2 strong teeth and five teeth in a row (Fig. 6b ↑); length ca. 3 mm
..... **Stenocraninae**



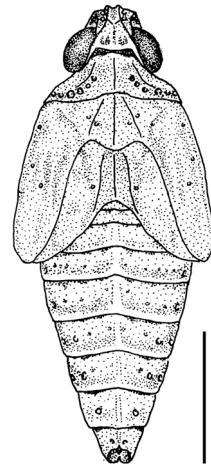
Asiracinae
1 species
Asiraca clavicornis



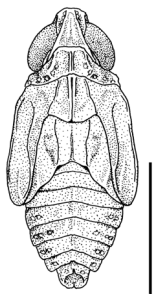
Delphacinae “broad head”
78 species
Javesella pellucida *Muirodelphax aubei*



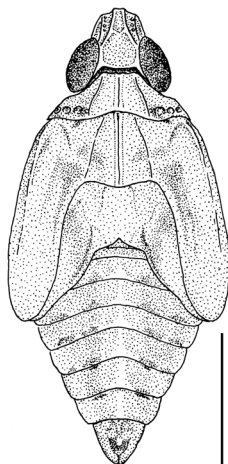
Delphacinae “long head”
8 species
Megamelus notula *Chloriona* spec.



Kelisiinae
18 species
Kelisia sabulicola



Stenocraninae
4 species
Stenocranus minutus



4. 3 Key to nymphs of the subfamilies of the German Cicadellidae

1 Subgenal sutures present (constrictions below eyes): genae forming separate plates beneath antennae (Fig. 1 ↑) **Ulopinae**

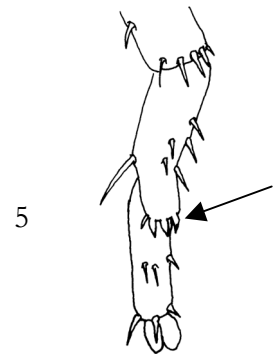
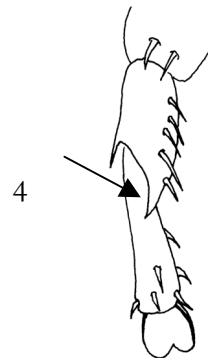
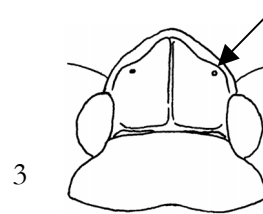
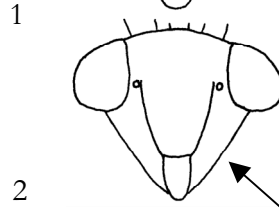
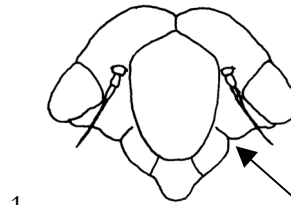
- Subgenal sutures absent: genae connected with maxillary plates (Fig. 2 ↑)..... **2**

2(1) Ocelli on ventral side of the head or absent (often barely visible) **3**

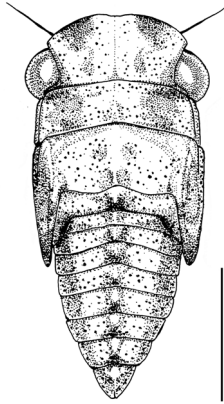
- Ocelli on dorsal side of head or on its anterior border, usually visible from above (Fig. 3 ↑) **9**

3(2) First joint of hind tibia apically with a sharp tip (at least in older instars) (Fig. 4 ↑); body bare or covered with rows of spines or hairs; ocelli usually absent; usually small insects with long antennae ... **Typhlocybinae**

- First joint of hind tibia with obtuse tip, usually with rows of spines (Fig. 5 ↑) **4**

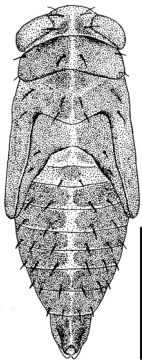


Ulopinae
3 species
Ulopa reticulata

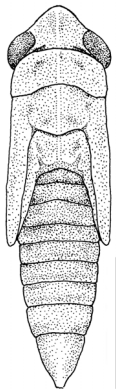


Typhlocybinae
158 species

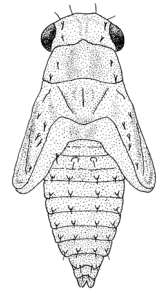
Alebrini
Alebra albostriella



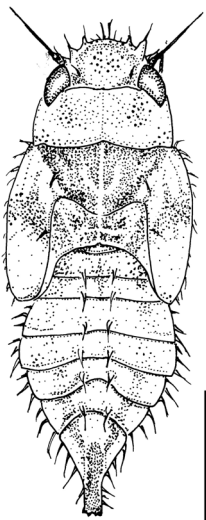
Dikraneurini
Notus flavipennis



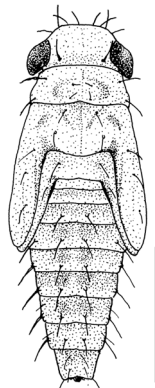
Empoascini
Austroasca vittata



Typhlocybini
Eurbadina kirschbaumi



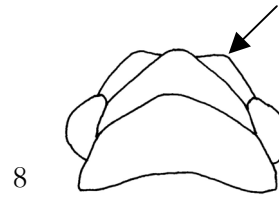
Typhlocybini
Eupteryx spec.



Erythroneurini
Zygina spec.

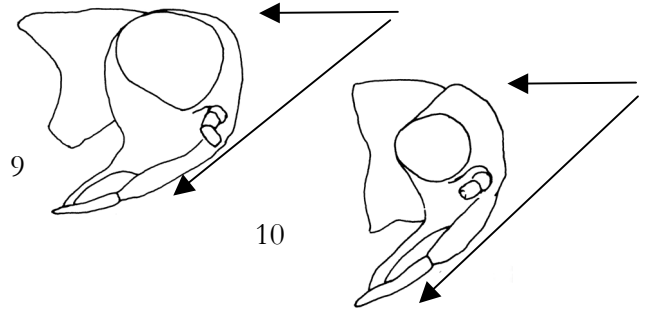


4(3) Head with elevated keel-like sutures (Fig. 8 ↑); hind tibia with less than 5 spines **Megophthalminae**

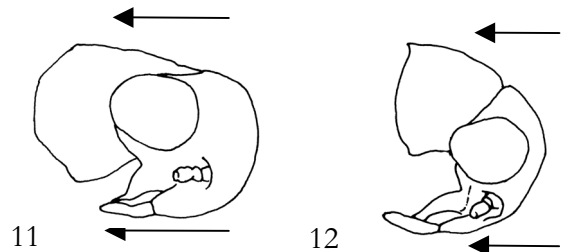


- Head without elevated sutures; hind tibia usually with more than 7 spines 5

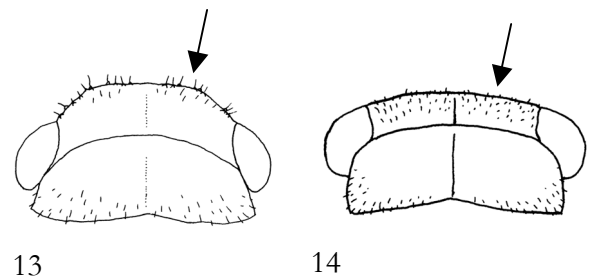
5(4) Ventral part of postclypeus and anteclypeus in lateral view at an angle with longitudinal axis of the body, anterior rim of head slightly curved (Fig. 9 ↑, 10 ↑) 6



- End of postclypeus and anteclypeus, in lateral view nearly horizontal, parallel to longitudinal axis of the body, anterior rim of head strongly curved (Fig. 11 ↑, 12 ↑) 7



6(5) Anterior rim of head in dorsal view more or less angular (Fig. 13 ↑), head medially longer than laterally; abdomen short and high, nearly as high as long **Agalliinae**

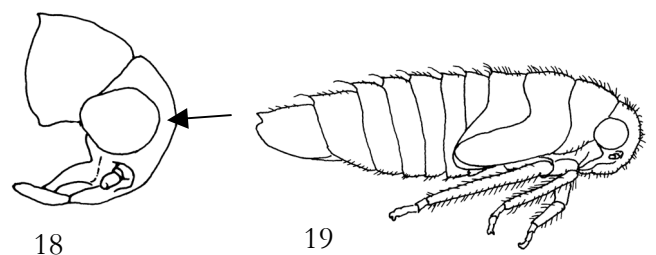


- Anterior rim of head more or less rounded (Fig. 14 ↑), head medially not longer than laterally; abdomen flattened, much broader than high **Idiocerinae**

7(5) Space between anterior rim of head and eye in lateral view larger (Fig. 15 ↑); abdomen flattened, dorsally without longitudinal median keel 8



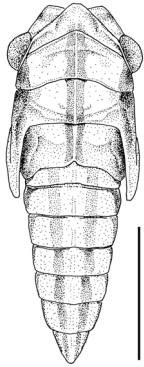
- Space between anterior rim of head and eye in lateral view narrower (Fig. 18 ↑); abdomen with distinct longitudinal median keel (Fig. 19); body hairs, if present, sharp-tipped **Macropsinae**



Megophthalminae

2 species

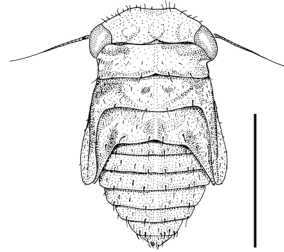
Megophthalmus scanicus



Agalliinae

8 species

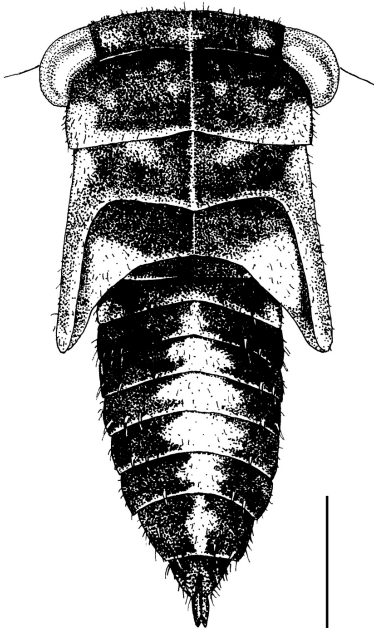
Anaceratagallia spec.



Idiocerinae

25 species

Acericerus heydenii

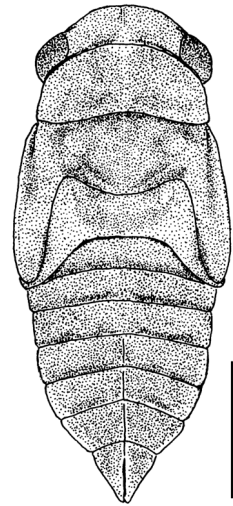
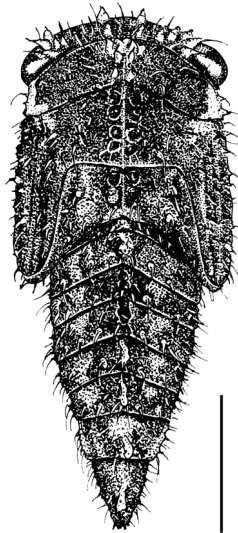


Macropsinae

33 species

Macropsis scutellata

Oncopsis flavicollis



8(7) Body broad and stout: ratio length to width about 1.5 : 1 ..**Penthimiinae**

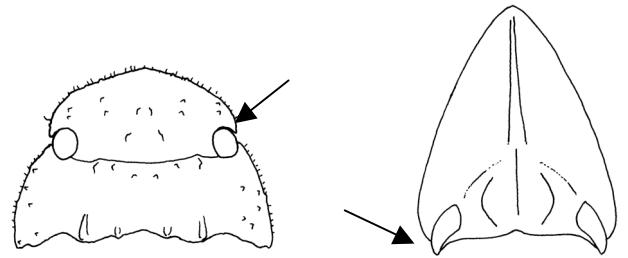
- Body more slender: ratio length to width about 3 : 1**Iassinae**

9(2) Fore margin of head very sharp, partially enclosing eyes (Fig. 20, 21 ↑) **10**

- Margin of head in lateral view usually rounded, if sharp (some Aphrodinae), not enclosing eyes (Fig. 22).....**11**

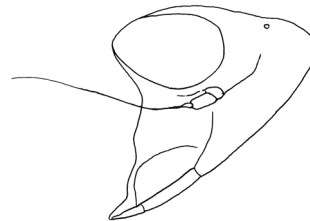
10(9) Corticolous. Body strongly dorso-ventrally flattened (Fig. 23); face in lateral view concave, without keel; hind tibiae broad, blade-like with strong spines on margins (Fig. 24) **Ledrinae**

- Distinctive. Lateral margins of head and body sharp-edged (Fig. 21); anterior margin of head extends keel-like to eyes, face in lateral view with strong keel; hind tibiae in sectional view more or less square, with short spines (Fig. 25) **Dorycephalinae**

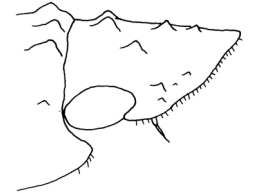


20

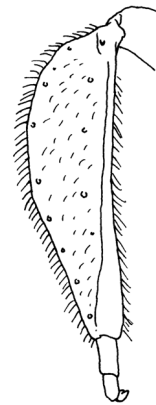
21



22



23



24

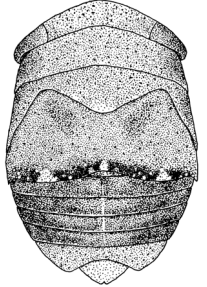


25

Penthimiinae

1 species

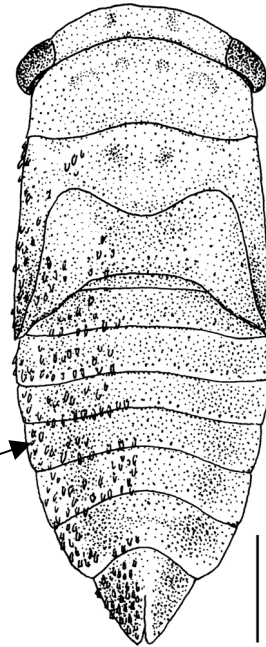
Penthimia nigra
(4th instar)



Iassinae

4 species

Iassus lanio

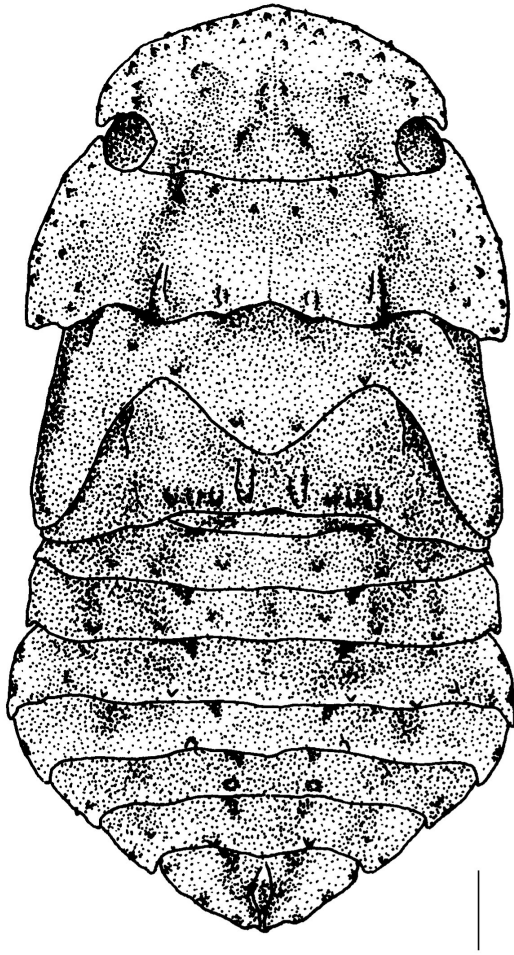


Scale-like hairs

Ledrinae

1 species

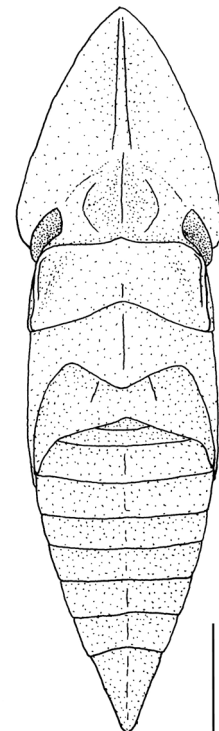
Ledra aurita



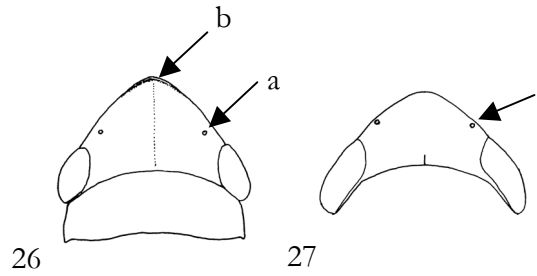
Dorycephalinae

1 species

Eupelix cuspidata

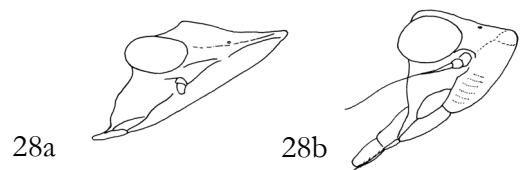


11(9) Ocelli situated away from anterior margin of head, if on anterior margin then further away of epistomal sutures than their own diameter (Fig. 26 ↑ a); abdomen usually regularly covered with hairs (rarely with additional rows of stronger spines) or nearly bare **12**

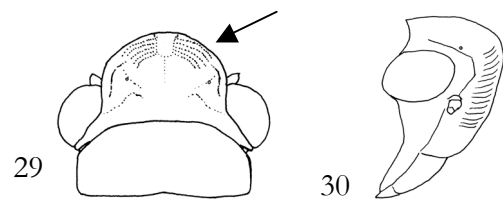


- Ocelli situated on anterior margin of head, close to epistomal sutures (closer than their own diameter) (Fig. 27 ↑); abdomen usually with longitudinal rows of hairs, rarely bare..... **Deltocephalinae**

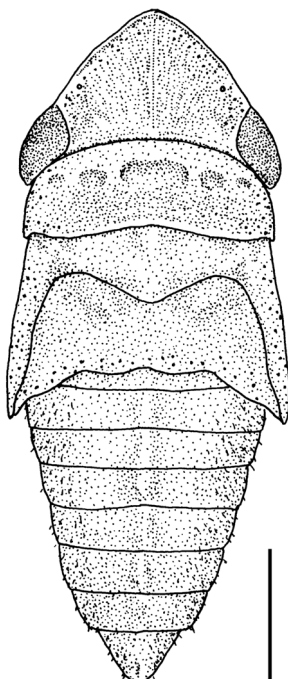
12(11) Anterior margin of head in dorsal view more or less pointed (Fig. 26 ↑ b), in lateral view sharp-edged (Fig. 28a) or narrowly rounded (Fig. 28b)..... **Aphrodinae**



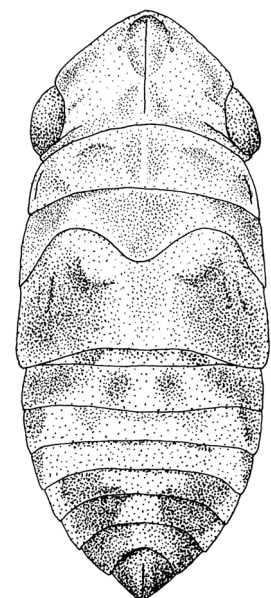
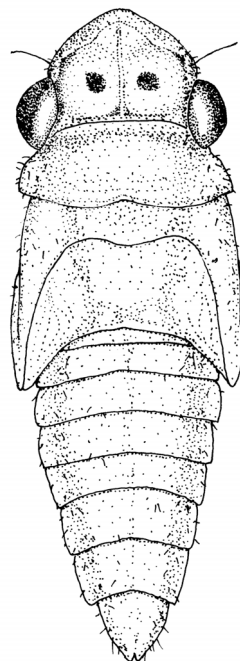
- Anterior margin of head in dorsal view (Fig. 29 ↑) and lateral view (Fig. 30) rounded..... **Cicadellinae**



Aphrodinae
16 species
Aphrodes bicincta

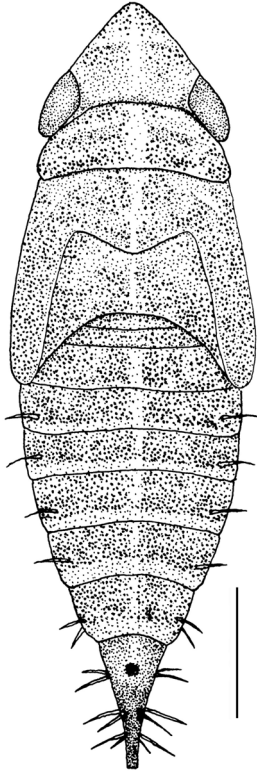


Cicadellinae
6 species
Evacanthus interruptus *Errhomenus brachypterus*

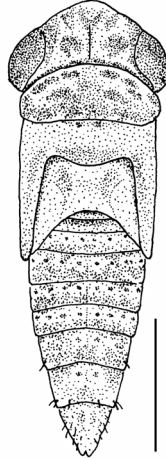


Deltocephalinae
195 species

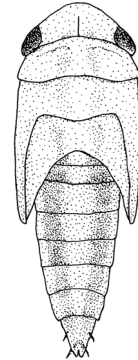
Fieberiellini
Fieberiella spec.



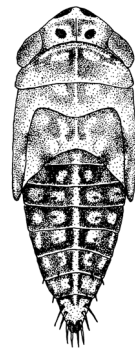
Grypotini
Grypotes puncticollis



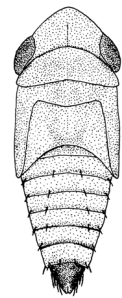
Balcluthini
Balclutha punctata



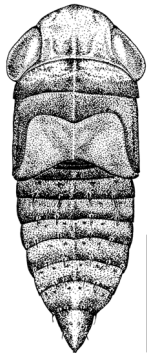
Macrostelini
Macrosteles sexnotatus



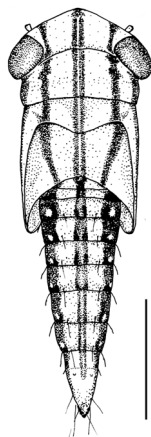
Deltocephalini
Deltocephalus pulicaris



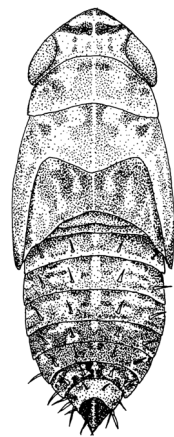
Doraturini
Doratura borvathi



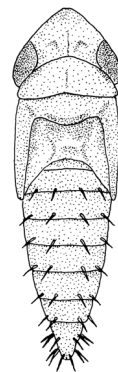
Athysanini
Cicadula quadrinotata



Athysanini
Lamprotettix nitidulus



Paralimnini
Psammotettix nodosus



Acknowledgements

We are grateful to Elke Freese and Nora Lange, both Oldenburg, for providing material, and to Dr. Dmitri Dmitriev, Champaign (Illinois), for a lot of helpful comments, and to PD Dr. Robert Biedermann, Oldenburg, Dr. Herbert Nickel, Göttingen, and Prof. Dr. Reinhard Remane, Marburg, for providing material and reading of the manuscript.

5. References

- Dmitriev D.A. 1999. Larvae of European species of *Elymana* DeLong (Homoptera: Cicadellidae). – Zoosyst. Rossica 8(1): 77-78.
- Dmitriev D.A. 2001. Larvae of some species of the subfamily Eupelicinae (Homoptera: Cicadellidae). – Zoosyst. Rossica 9(2): 353-357.
- Dmitriev D.A. 2002a. General morphology of leafhopper nymphs of the subfamily Deltocephalinae (Hemiptera: Cicadellidae). – Acta entomologica slovenica 10(1): 65-82.
- Dmitriev D.A. 2002b. Larvae of the leafhopper subfamily Deltocephalinae (Homoptera, Cicadellidae) from European Russia and adjacent territories: 1. A key to the tribes Drabescini, Scaphytopiini, Hecalini, Limotettigini, and Opsiini. – Entomol. Rev. 82(8): 975-1002.
- Dmitriev D.A. 2003. Larvae of leafhoppers of the subfamily Deltocephalinae (Homoptera, Cicadellidae) from European Russia and adjacent territories: II. Tribes Grypotini, Selenocephalini, Goniagnathini, Fieberiellini, Tetartostyliini, Macrostelini, and Doraturini. – Entomol. Rev. 83(6): 665-695.
- Dmitriev D.A. 2004. Larvae of leafhoppers of the subfamily Deltocephalinae (Homoptera, Cicadellidae) from European Russia and adjacent territories: III. Tribes Deltocephalini, Stirelini, and Paralimnini. – Entomol. Rev. 84(1): 31-53.
- Holzinger W.E., Kammerlander I., Nickel H. 2003. The Auchenorrhyncha of Central Europe – Die Zikaden Mitteleuropas. Vol. 1: Fulgoromorpha, Cicadomorpha excl. Cicadellidae. – Brill, Leiden. 673 pp.
- Linnavuori R. 1951. Hemipterological observations – 18. *Cixidia confinis* Zett. and *Helicoptera lapponica* Zett. – Ann. ent. Fenn 17(2): 51-65.
- Logvinenko V.N. 1975. Fulgoroidny cikadovy Fulgoroidea. – Fauna Ukrainy 20(2): 1-287.
- Nickel H., Remane R. 2002. Artenliste der Zikaden Deutschlands, mit Angaben zu Nährpflanzen, Nahrungsbreite, Lebenszyklen, Areal und Gefährdung (Hemiptera, Fulgoromorpha et Cicadomorpha). – Beitr. Zikadenkde. 5: 27-64.
- Stewart A.J.A. 1986. Descriptions and key to the nymphs of *Eupteryx* (Curtis) leafhoppers (Homoptera: Cicadellidae) occurring in Britain. – Syst. Entomol. 11: 365-376.
- Tishechkin D.Y. 2002. Review of the species of the genus *Macropsis* Lewis, 1834 (Homoptera: Cicadellidae: Macropsinae) from European Russia and adjacent territories. – Russian Entomol. J. 11(2): 123-184.
- Vilbaste J. 1968. Preliminary key for the identification of the nymphs of North European Homoptera Cicadinea. – Ann. Ent. Fennici 34: 65-74.
- Vilbaste J. 1982. Preliminary key for the identification of the nymphs of North European Homoptera Cicadinea. II. Cicadelloidea. – Ann. Zool. Fennici 19: 1-20.
- Walter S. 1975. Larvenformen mitteleuropäischer Euscelinae (Homoptera, Auchenorrhyncha). – Zool. Jb. Syst. 102: 241-302.
- Walter, S. 1978. Larvenformen mitteleuropäischer Euscelinae (Homoptera, Auchenorrhyncha) Teil II. – Zool. Jb. Syst. 105: 102-130.
- Wilson, R.W. 1978. Descriptions and key to the genera of the nymphs of British woodland Typhlocybininae (Homoptera). – Syst. Entomol. 3: 75-90.
- Wagner W. 1950. Die salicicolen *Macropsis*-Arten Nord- u. Mitteleuropas. – Not. Ent. 30: 81-114.
- Wagner W. 1964. Die auf Rosaceen lebenden *Macropsis*-Arten der Niederlande. – Ent. Ber. Amsterdam 24: 123-136.