Diptera Ephydridae, Shore Flies

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Introduction

Life cycles and phenology

The eggs are deposited singly or in groups over the substrate (algae, plants or rocks). Oviposition commonly continues for 7-10 days, with 5-14 eggs being laid daily. Potentially each female can deposit 170 to 600 eggs. Females of *Hyadina*, *Coenia* and *Parydra* were observed spreading a fecal covering over each egg deposit, presumably to camouflage them. Collecting of egg-bearing females in winter shows that the adults of many species overwinter, but a few observations on overwintering habits reveal that winters also may be passed in the larval and pupal stages. Species living in moist biotopes appear during a longer part of year than those bound to dry biotopes. Documented laboratory observations of time from oviposition to emergence range from 13 to 44 days. Egg development ranged 1-4, larval development 3-17, and pupation 2-9 days.

The developmental times in relatively cool conditions in North Europe exceed those known from more temperate regions, therefore presumably a minority of species are multivoltine, passing through several generations each year. The flight period of the majority of species is limited to the warm season. North European shore flies may be divided into four groups based on adult phenology (modified from Dahl 1959):

(1) The whole year.
(2) The entire vegetation period.
(3) Late spring (end of May-June) and then under favorable conditions also in mid summer (end of July and August).
(4) A more limited flight period with one generation a year.

To the first group belong some common and widespread species described early by Fallén in the beginning of the nineteenth century: *Hydrellia griseola*, *Ephydra riparia*, *Scatella stagnalis*, *Dichaeta caudata* and *Coenia palustris*. The majority of species belong to the second and third sections. Typical representatives of the second group are various species of *Hydrellia*, *Parydra*, *Ephydra* and *Scatella*. The species of *Philygria*, *Hyadina* and *Psilopa* frequently fit to the third assemblage. Development of *Notiphila* having one generation per year suggest the placement in the fourth group. A similar limited flight period has *Discocerina obscurella* (Fallén).

Habitats

Adult shore flies usually occur in close association with moist substrates and may often be observed on all kinds of shores, in marshy habitats and also on the surface of pools (members of Ephydrini). The margins may be grassy, muddy, or rocky; the water may be muddy or clear; the bottoms may be formed from soft mud, sand, gravel, or layered with decaying vegetation. Most of the larvae are aquatic or semi-aquatic and occur in many different microhabitats. Some are uniquely adapted to such inhospitable habitats as inland alkaline or saline lakes, hot springs, and marine habitats. The most wide-spread larvae develop in semi-liquid media, feces, or moist shore mud. According to Deonier (1979) the following habitats can be recognized: (1) floating vegetation, (2) floating algal mat, (3) salt pool, (4) mud shore, (5) sand shore, (6) grass shore, (7) limnic wrack, (8) marsh reeds, (9) wet meadow, and (10) hot springs.

To the first group belong the leaf-mining larvae of *Hydrellia*, which live in internal tissue of leaves of *Lemna*, *Spirodela*, *Potamogeton*, *Nymphaea* and *Nuphar*. Larvae of Ephydrini are associated with floating or submerged filamentous algae. Larvae associated with salt pools are known in some *Psilopa*, *Glenanthe*, Atissini, *Parydra*, *Haloscatella*, *Lamproscatella* and *Scatella*. Mud shores contain an abundant microflora, especially diatoms and organic detritus. The polyphagous or detritophagous larvae of Parydrini and Scatellini show strong affinities for muddy substrates. Sandy shores are preferred by *Ptilomyia*, *Scatella* and *Scatophila*. The taxa regularly recorded from grass shores are *Hydrellia*, Hyadinini and Philygriini, which larvae are leaf-mining or feed on blue-green algae. Limnic wrack is selected by *Dichaeta caudata* (Fallén) and *Scatella*. Preferences for marsh reeds were observed in *Hydrellia*, *Notiphila* and *Philotelma*. Typical inhabitants of wet meadows are *Hydrellia*, *Notiphila*, and *Limnellia* species. Hot springs on Iceland are one of the most unusual habitat occupied by ephydrid larvae. The larva of *Scatella tenuicosta* Collin, a species widely distributed in the Western Palearctic, is also adopted to survive in hot water and represents the last group.

Trophic relationships

Many adult ephydrids are basically known to be polyphagous, feeding on yeast, various algae as diatoms, blue-greens, dinoflagellates, and other microscopic forms. Some adult mouthparts are quite broad and boot-shaped, and efficiently gather microorganisms from flat exposed surfaces. *Ochthera* adults are non-specialized predators, capturing and feeding on small terrestrial and semi-aquatic insects and occasionally midges and mosquito larvae.

Generally the larvae of shore flies require substrates

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with a high organic content, supporting a rich population of microorganisms. Most shore-fly species appear to be grazers or filter-feeders of organic material and ingest a broad spectrum of microorganisms, especially algae and bacteria. Larvae of Discocerinini and Scatellini use their filtering mechanism to separate out a broad spectrum of microorganisms. Ephydrini larvae living in algal mats feed on algae, bacteria and flagellate protozoans. Larvae of Parydrini specialize in feeding on diatoms, but additionally could utilize detritus. *Notiphila* larvae are typical detritivores, and those of *Dichaeta* feed on bacteria and yeasts which they filter from the surrounding mud. Living in oxygen deficient mud among the roots of macrophytes, larvae of *Notiphila* angle their spiracles outward in plant roots for oxygen. Breeding in dead or decaying animal tissues or excrements is presumably the ancestral trophic habit within the family. Larva of *Discomyza* develop in decaying snails, and larvae of *Athyroglossa* were reared from decaying small vertebrates. Larvae of *Hecamede albicans* (Meigen) and *Allotrichoma* were reported from dead crustaceans and molluscs mixed in with seaweed on shores. *Hydrellia* and *Psilopa leucostoma* (Meigen) larvae mine the leaves and stems of macrophytes; the two posteriormost sclerites of *Hydrellia* mouthparts are fused and the entire feeding apparatus is streamlined, allowing them to feed internally in very thin submerged leaves of the host plant. The highly specialized larvae of the tribes Hyadinini and Philygriini consume aquatic or soil-inhabiting blue-green algae occurring in wetland habitats. Larvae of *Ochthera* prey on chironomid and other soft-bodied larvae in grass and mud banks in some coastal marshes. The cephalopharyngeal skeleton including the pointed mouthhooks of *Ochthera* is rather robust and well suited for piercing exoskeletons of its prey. The larvae of *Trimerina madizans* (Fallén) feed as parasitoids within the egg cases of certain marsh-dwelling spiders. The scavengers and parasitoids, representatives of Discomyzinae (*Discomyza incurva* (Fallén) and *Trimerina madizans*) and Gymnomyzini (*Athyroglossa glabra* (Meigen) and *Mosillus subsultans* (Fabricius)) are not strictly aquatic and are not included in the key.

Eggs and larvae of mud-living species are consumed by adults of predatory insects. Adult flies are preyed upon mainly by spiders, dragonflies and birds. Ephydridae larvae are used as hosts by various parasites. Most of them were reared from the leaf-mining larvae of *Hydrellia*. The following genera are known from North European species: Braconidae: *Ademon*, *Chaenusa*, *Chorebus*, *Coelinius*, *Cyrtogaster*, *Gyrocampa Dacnusa*, *Opius*, *Pachysema*; Chalcididae: *Gonatocerus*; Eulophidae: *Chrysocharis*; Eucoilidae: *Kleidotoma*; Pteromalidae: *Polycystus*; Ichneumonidae: *Horogenes*; Diapriidae: *Basalys* and *Trichopria*. Data on the parasite fauna of other shore-fly taxa are incidental. *Urolepis* (Pteromalidae) was reared from the immature stages of *Ephydra riparia* Fallén; *Kleidotoma* sp. (Eucoilidae) and *Anaphes* sp. (Mymaridae) from *Parydra aquila* (Fallén) and *Trichopria* (Eucoilidae), *Kleidotoma* (Diapriidae), *Muscidifurax* and *Urolepis* (Pteromalidae) from *Hecamede albicans* (Meigen).

State of knowledge

The species composition of the North European fauna of Ephydridae is relatively well-known. Only a few species are still expected to be found, but the faunistic documentation of most species, especially in Norway and Denmark is inadequate. Our knowledge of the immature stages is less than impressive. Only 25% of the 150 North European species or half of the 36 genera recorded from North Europe have their immature stages described. Representatives of the following 18 genera are still neglected: *Atissa*, *Glenanthe*, *Ditrichophora*, *Gymnoclasiopa*, *Polytrichophora*, *Hecamedoides*, *Psilopa*, *Ilythea*, *Axysta*, *Hyadina*, *Eutaenionotum*, *Calocoenia*, *Limnellia*, *Lamproscatella*, *Haloscatella*, *Thinoscatella*, and *Philotelma*.

The unique key for North European, especially the Swedish species, by Wahlgren (1927) is largely out-of-date. Adults could be identified using keys constructed for the faunas of other European countries: France (Seguy 1934), Hungary (Papp 1975), and Italy (Canzoneri & Menghini 1983). The key to the flies of the European Part of the former USSR (Nartshuk 1970) was also published in an English version in 1988. All North European genera are included in the key constructed for the Nearctic Region (Wirth et al. 1986). Wirth & Stone (1956) constructed one of the few existing keys for ephydrid larvae. The keys to the Czech and Slovakian faunas of Rozkošný (1980) and to the Italian fauna of Rivosecchi (1984) are also available.

Morphology

Eggs

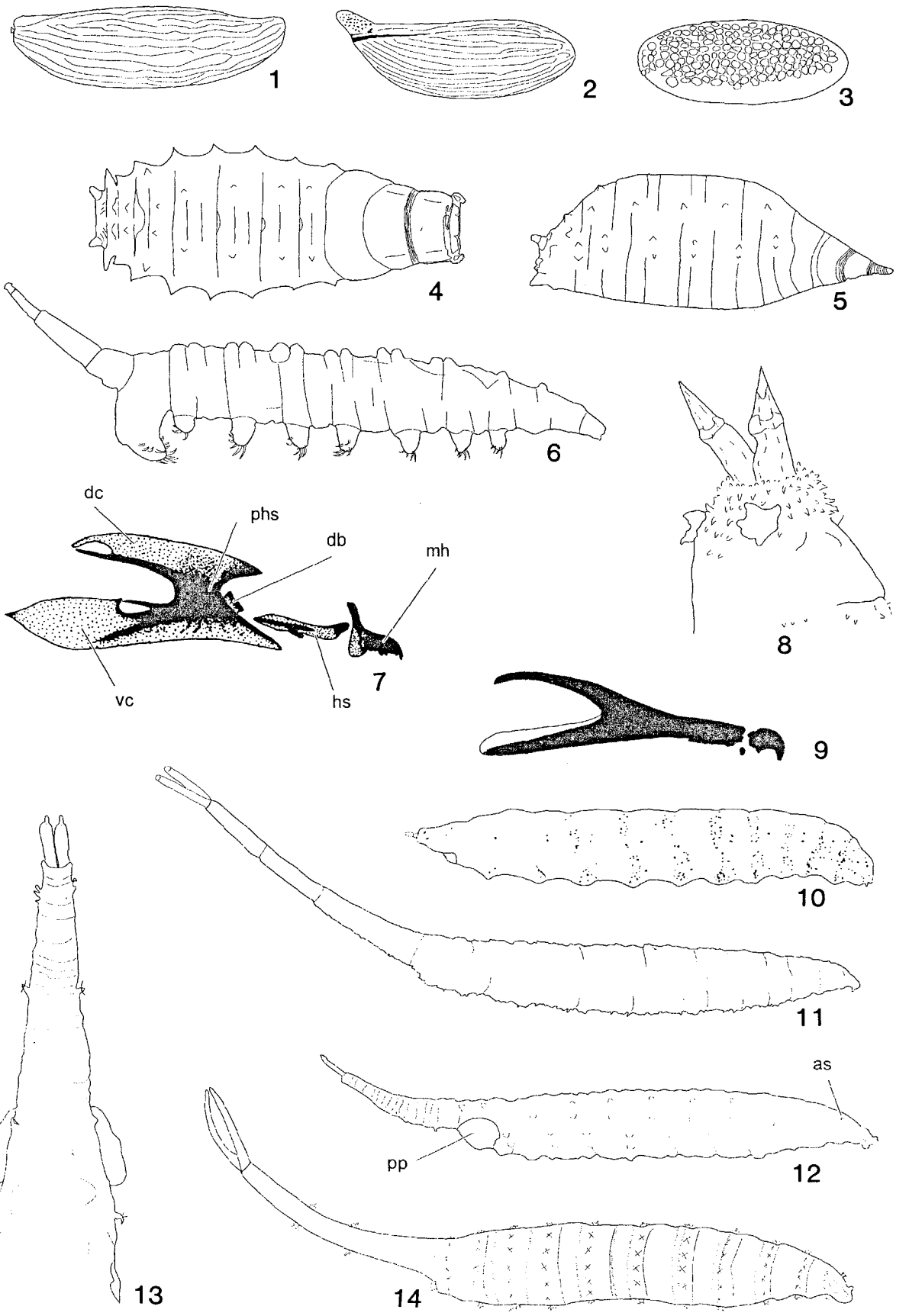
Length 0.3-0.9 mm. Colour generally white, though in various species with a greater or lesser pink tinge, sometimes brown or blackish. In most species of typical elongate ovoid form (Figs 1-3), sometimes slightly flattened dorsally. Ends mostly rounded, also with a protuberance at one or both ends. Micropylar end sometimes drawn out forming an elongate process or horn of varying length, and usually with a very small narrowly campanulate nippe. Chorion variously sculptured: deeply rugose, granulose, microreticulate, or plastron-shaped, sometimes forked. Eggs in *Paracoenia* with terminal filament half as long as to longer than the body of egg.

Larvae

Body. Length 0.3-18 mm. (including respiratory tube when present). Instar I metapneustic, instars II-III amphipneustic. Younger instars more spinulose. Shape of larva varying, from dorsoventrally flattened to cylindrical.

Head. Frequently anteriorly bilobate, retractile; anterodorsally with 2- or 3-segmented antenna. Ventral to antennae with circular sensory plates bearing few peg-like structures. Facial mask around oral opening with several rows of comblike structures (Fig. 33); absent in *Nostima*.

Mouthparts. Paired mouthhooks curved and sharply pointed; frequently not connected dorsally; in some cases with row of fine teeth; posterior margin curved and articulating with anterior arms of hypostomal sclerite.



Figs 1-14. Ephydridae, immature stages. -1-3. Egg, lateral view. -1. *Dichaeta caudata* (Fall.). -2. *Ochthera mantis* (De Geer). -3. *Nostima* sp. -4-5. *Allotrichoma* sp., puparium, dorsal and lateral aspect. -6. *Setacera micans* (Hal.), mature larva, lateral view. -7. *Notiphila nigricornis* Stenh., cephalopharyngeal skeleton: (dc) dorsal cornu, (db) dorsal bridge, (hs) hypostomal sclerite, (mh) mouthhook, (phs) pharyngeal sclerite, (vc) ventral cornu. -8-10. *Hydrellia griseola* (Fall.). -8. Posterior portion of mature larva. -9. Cephalopharyngeal skeleton. -10-12. mature larva, lateral aspect: (as) anterior spiracle, (pp) perianal pad. -11. *Ochthera mantis*. -12-13. *Dichaeta caudata* (Fall.): (pp) perianal pad. -13. Posterior portion of mature larva, dorsal aspect. -14. *Paracoenia fumosa* (Stenh.), mature larva, lateral aspect. Drawn to different scales. Figs 1, 12-13 redrawn from Eastin & Foote (1971); 2, 11 from Simpson (1975); 3 from Foote (1983); 4-5 from Runyan & Deonier (1979); 6 from Hennig (1952); 7 from Krivosheina (1993); 8-10 from Grigarick (1959); and 14 from Beyer (1939).

Triangular or clavate dental sclerite and oval epistomal sclerite (if present) located posteroventrally to mouthhooks. Hypostomal sclerite rod-like, H-shaped in dorsal view, with narrow bridge near mid-length. Pharyngeal sclerite U-shaped with conspicuous dorsal bridge. Dorsal and ventral cornua usually with one window in each. In *Notiphila* anterior portion of pharyngeal sclerite fused to posterior portion of hypostomal sclerite. Skeleton of *Hydrellia* (Fig. 9) consists of single mouthhook, small dental sclerite behind it, and slender, Y-shaped sclerite being a result of fusion of hypostomal and pharyngeal sclerites.

Body segments. Integument usually transparent, variously wrinkled, tuberculate, and covered with numerous setae or spinulae. Anterior spiracles absent in instar I, present in instars II-III of all genera except *Hydrellia* and *Notiphila*. Anterior spiracles club-shaped in Discomyzinae, Gymnomyzinae and *Dichaeta*, in Ilytheinae they are usually bifurcate into 2 slender branches and in Ephydrinae hand-like with relatively long branches. Posterior abdominal segment rather tapered, forming cap-like disc or ending in lateral processes or more or less elongate, sometimes branched or retractile respiratory tube bearing posterior spiracles and sometimes accessary filaments. Usually 3 or 4 circular or oval openings per spiracle. In Ephydrini (*Ephydra* and *Setacera*) up to 8 pairs of abdominal prolegs present, each with 2-3 rows of hooks; last pair of prolegs larger, with opposable hooks (Fig. 6).

Pupae

Length of body (including respiratory tube when present) 1.2-14 mm. Colour light to dark brown. Variously formed as the larvae. In species with more maggot-like larvae, puparium normally shorter and broader than larva (Figs 4-5). Species with elongate larvae, e.g. *Ephydra,* show relatively small change of form. Larval respiratory tube and spiracles fully extended at pupariation. In *Ephydra* and *Setacera* large anal proleg is curved forwards at pupariation to grip a piece of water plant. In some species puparium with somewhat flattened anterodorsal operculum, which opens at adult emergence. Larval spines, hooks, scales, tubercles, prolegs, etc. usually remain on puparium.

Adults

Shape and size. Body length 1.0-5.5 mm. Colour various; completely shining black or covered by grayish or brownish microtomentum.

Head. Facial profile varied, almost flat, arched, or distinctly prominent often bearing medial tubercle, carina, facial sculpture, or gaping mouth. Midface and oral margin of Ephydrini and Scatellini covered by setae. Arista mostly dorsally pectinate, rarely bare or pubescent; pedicel often bearing 1-2 distinctly larger seta dorsoanteriorly. Colour of antenna mainly brown, sometimes first flagellomere pale or rarely completely reddish or yellow. Chaetotaxy of frons variable: true postocellar setae absent, but the setae usually replaced by enlarged ocellar setulae. Post-vertical setae divergent or absent.

Thorax. Mesonotum mostly uniformly coloured; with stripes or spots in some *Notiphila*. Patterns of paler microtomentum on mesonotum distinguish species of *Limnellia* and *Scatophila*. Chaetotaxy of mesonotum: numerous acrostichal setae, 1-5 dorsocentral setae, 2-3 alar setae; Discomyzinae, Gymnomyzinae and Hyadinini lack presutural dorsocentral setae; 5 dorsocentral setae are present in Ephydrini (except in *Coenia* with 4 dorsocentral setae). Colour of pleurae frequently lighter as mesonotum; 2 setae on notopleurae (in Atissini, Ilytheini and Philygriini posterior notopleural seta much farther from notopleural suture than anterior seta), 1-3 seta on anepisternum and 0-1 seta on katepisternum; anepisternum hairy.

Wing. Venation specific. Costa with 2 distinct breaks, one at junction of humeral cross vein and one just before end of first radial vein; costa often extending to first medial vein, but sometimes only to third radial vein. Subcostal vein rudimentary; first radial vein ending before middle of the wing; discal and second basal cells united; anal cell and anal vein absent. Wing membrane transparent, or in some cases (*Ilythea*, *Parydra*, some *Philygria* and Scatellini) membrane infumated, bears white or brown spots, at least around both transverse veins.

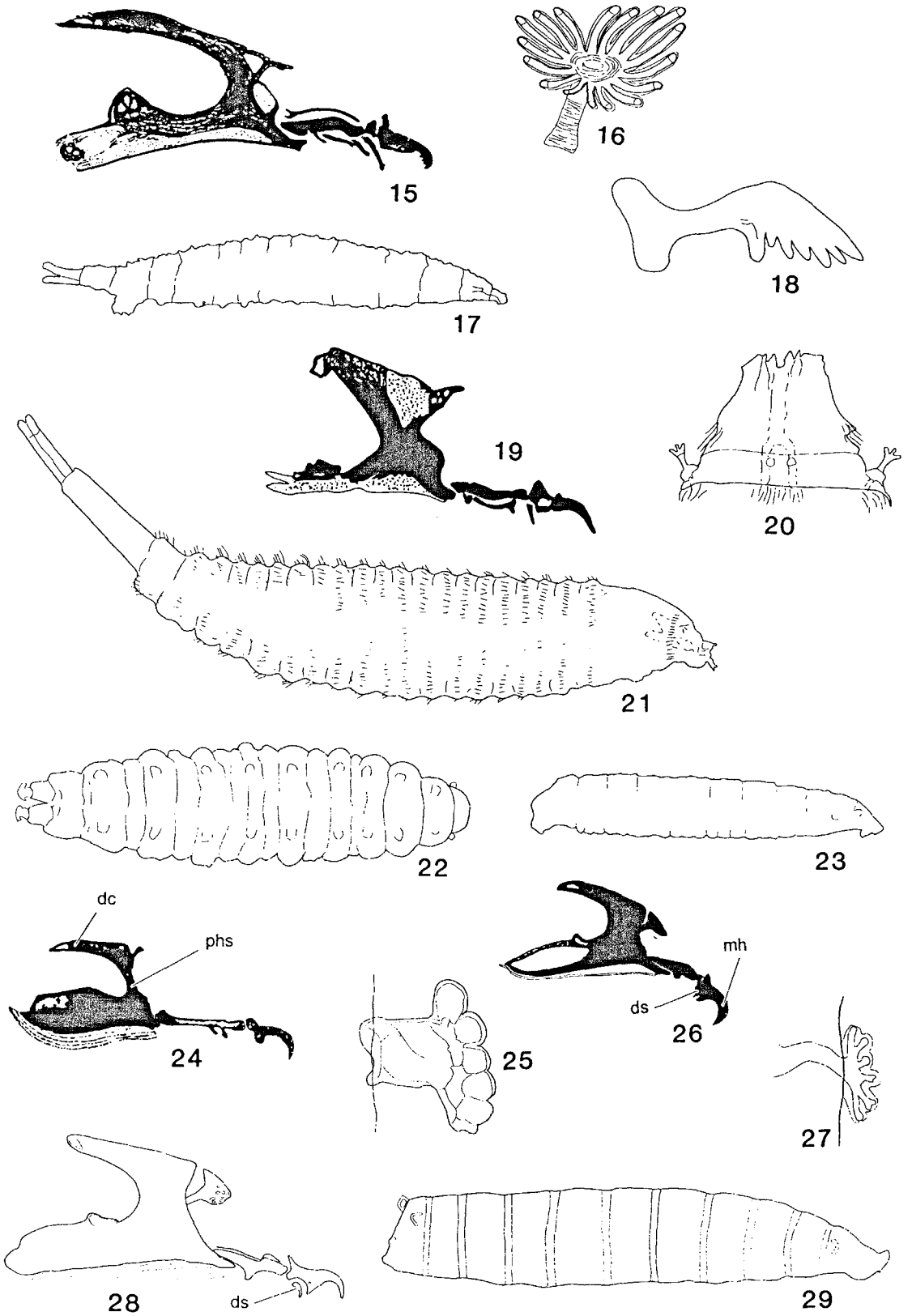
Legs. Generally slender and simple, although often profemur with ventral row of spinulae. Preapical dorsal seta lacking on pro- and metatibiae. Fore leg of *Ochthera* strongly modified, mantid-like with enlarged femur.

Abdomen. Mainly subconical, oval or more elongated. Male commonly with 5; female with 6-7 exposed segments. Spiracles of segments 2-5, and sometimes 1 and 6 located in tergites. Male terminalia symmetric, externally consisting of paired cerci surrounded posterolaterally by epandrium, the latter tergite bears distally a pair of clasping lobes called dististyli (= surstyli). Usually hemispherical and depressed sclerite (hypandrium), one pair of homogeneous or divided ventral processes (called gonites, or if divided, pre- and postgonites), aedeagal apodeme, and aedeagus form the internal structures. The clasper (presumably second clasping lobe) and subepandrial plate were found in representatives of Discomyzinae and ejaculatory apodeme in Gymnomyzinae, Ilytheinae and Ephydrinae. Members of the 2 latter subfamilies characterized by both fusing gonites with hypandrium and dististyli with epandrium (except in *Limnellia* species having secondarily developed clasping lobes). Female terminalia consist of segments 6-9 plus paired cerci. Spermathecae reduced and its function replaced by sclerotised ventral receptacle. The receptacle is mushroom-like with rounded operculum and extending rod-shaped process.

Methods

Collecting

Adults are easily collected with a suitable handnet with fine meshes and a wide bottom. An aspirator is a good device for removing minute individuals from the net. An efficient method for obtaining immature stages is the collecting of portions of the suspected larval habitat. In



Figs 15-29. Ephydridae, larva. -15. *Coenia curvicauda* (Meig.), cephalopharyngeal skeleton. -16. *Teichomyza fusca* (Mcq.), anterior spiracle. -17. *Scatella silacea* Loew, mature larva, lateral aspect. -18. *Scatella stagnalis* (Fall.), cephalopharyngeal skeleton, lateral aspect. -19-21. *Parydra aquila* (Fall.). -19. Cephalopharyngeal skeleton. -20. Anterior portion of larva, dorsal aspect. -21. Mature larva, lateral aspect. -22. *P. pusilla* (Meig.), mature larva, dorsal aspect. -23-25. *Discocerina obscurella* (Fall.). -23. Mature larva, lateral view. -24. Cephalopharyngeal skeleton: (dc) dorsal cornu, (phs) pharyngeal sclerite. -25. Anterior spiracle. -26. *Allotrichoma* sp., cephalopharyngeal skeleton: (ds) dental sclerite, (mh) mouthhook. -27-29. *Hecamede albicans* (Meig.). -27. Anterior spiracle. -28. Cephalopharyngeal skeleton: (ds) dental sclerite. -29. Mature larva, lateral aspect. Drawn to different scales. Fig. 15 redrawn from Foote (1990); 16 from Vogler (1900); 17 from Terry (1952); 18 from Tuxen (1936); 19-21 from Krivosheina (1987); 22 from Nielsen et al. (1954); 23-25 from Foote & Eastin (1974); 26 from Runyan & Deonier (1979); and 27-29 from Norrbom (1983).

the laboratory, the substrate should be placed under light and its contents aerated, then checked for larvae and puparia. Another useful method is provided by the stirring up of the substrate and searching the water's surface for floating larvae and puparia.

Rearing

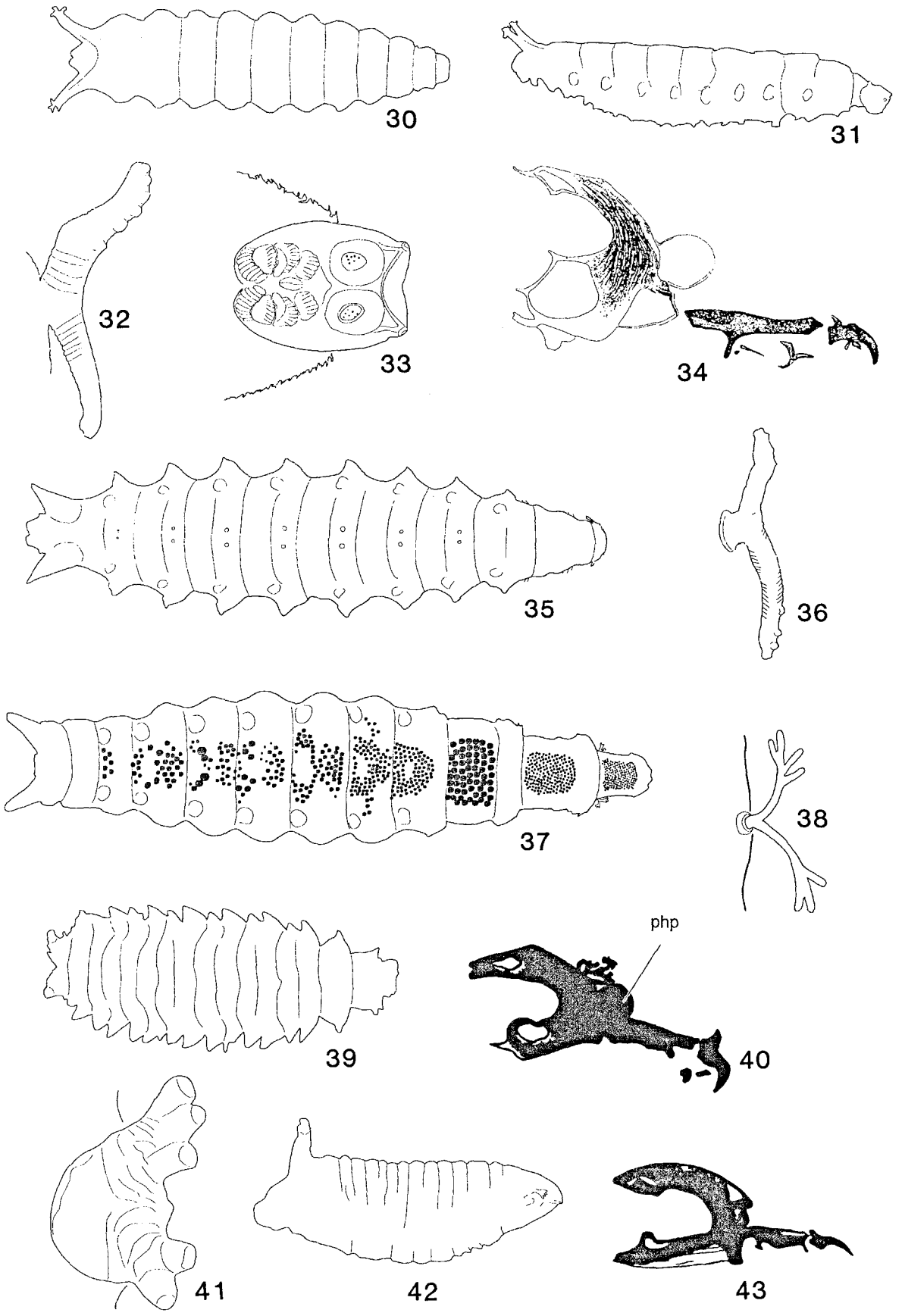
The collected egg-bearing females are placed singly in each jar to assure that immature stages of only one species were obtained. The bottom substrate should consist of a portion of moist peat moss and field-collected substrate. Affix to the jar a dab of honey and brewers' yeast past, as a diet supplement. Eggs should be removed from the jars and transferred to small plastic rearing boxes fitted with moist gauze or wood-wool. Isolated larvae are kept on small pieces of the original substrate in small culture dishes. Larvae are usually segregated into individual rearing boxes and checked daily for development and provided with fresh food. After puparia are formed, they should be transferred to small vials with moist cotton at the bottom and plugged with cotton. The vials are then check daily for emerged adults.

Preparation and conservation

Larval specimens should be killed and fixed in hot water, then preserved in plastic microvials with glycerol or mounted on microscope slides. Cast exuviae of larvae after decomposing of soft parts are placed in glycerine on microscope slides. Puparia should be punctated several times with an insect pin and placed in 70 % ethanol. Recently emerged adults are killed 2-4 days after emergence, thus allowing sufficient time for the completing of integument sclerotisation. Puparia which had produced imagines are placed in plastic microvials and pinned beneath their respective adults.

Key to genera for instar III larvae

1. Abdominal segments with prolegs (Fig. 6) 2
- Abdominal segments without prolegs (Figs 10, 12, 18) 3
2. Body with dorsal patterns of flattened spines. Inhabitants of saline, alkaline and/or thermal waters ..... *Ephydra*
- Boy dorsally with numerous spines and spinules, but none are flattened to form distinct dorsal patterns. Inhabitants mainly of fresh waters ..... *Setacera*
3. Prothorax without anterior spiracle. Each posterior spiracular plate ending in sharp pointed spur (Fig. 8) 4
- Prothorax with anterior spiracle present (Fig. 12). Each posterior spiracular plate flat or cap-shaped, not ending in a spur-shaped process (Figs 14, 17) 5
4. Head with pharyngeal sclerite with separate, small hypostomal sclerites, a well-differentiated dorsal bridge and broad both dorsal and ventral cornua (Fig. 7); paired mouthhooks present. Body lenght about 8-9 mm. Larva usually attached to roots of aquatic plants . *Notiphila*
- Head with pharyngeal skeleton with dorsal bridge and hypostomal sclerites fused in a slender, common sclerite, both cornua rodlike (Fig. 9); mouthhooks usually fused. Body lenght about 3 mm. Larvae miners in aquatic plants ..... *Hydrellia*
5. Body stepwise tapered posteriorly, forming single or paired elongated breathing tube (Figs 11, 13, 14, 17, 21) 6
- Body obtuse posteriorly, if breathing tubes conspicuous then with projections arising from posterodorsal portion of body (Figs 29, 30, 34) 12
6. Breathing tube divided into 3-4 segments (Fig. 11) .... *Ochthera*
- Breathing tube uniform, not segmented (Figs 12, 14) 7
7. Body with segment 12 bearing distinctly bilobed perianal pad on venter, which is broader than segment (Figs 12-13) ..... *Dichaeta*
- Body with segment 12 bearing perianal pad as ventral stigma, not broader than segment (Figs 14, 17) 8
8. Prothorax with anterior spiracle with two branches slightly widened apically. Air tube and its branches more than 1/2 as long as body of larva (Fig. 14) .... *Paracoenia*
- Prothorax with anterior spiracle with 3 or more tapered branches (Fig. 20). Air tube and its branches less than 1/3 as long as body of larva (Figs 17, 19) 9
9. Head with mouthhooks with row of fine teeth apicoventrally (Fig. 19) 10
- Head with mouthhooks sickle-shaped without row of fine teeth apicoventrally (Figs 15, 18) 11
10. Body lenght 7.2-8.0 mm ..... *Coenia*
- Body lenght less than 5.5 mm ..... *Scatella*
11. Prothorax with anterior spiracle with 16-18 branches (Fig. 16) ..... *Teichomyza*
- Prothorax with anterior spiracle with 3-7 branches (Fig. 20) ..... *Parydra*
12. Prothorax with anterior spiracle cauliflower-shaped, with blunt, round ending branches (Figs 24, 27)... 13
- Prothorax with anterior spiracle with long finger-like branches (Fig. 32, 41) 15
13. Head with dental sclerite absent; pharyngeal sclerite narrow, its width is less than 1/4 of dorsal cornu (Fig. 25) ..... *Discocerina*
- Head with dental sclerite present; pharyngeal sclerite broad, its width is about 1/2 of dorsal cornu (Figs 26, 28) 14
14. Head with basal part of mouthhook reaching below dental sclerite; ventral cornu with window (Fig. 26).. ..... *Allotrichoma*
- Head with basal part of mouthhook reaching above dental sclerite; ventral cornu without window (Fig. 28)..... ..... *Hecamede*
15. Prothorax with anterior spiracle bifurcate, outer surface with papillae (Figs 32, 35) 16
- Prothorax with anterior spiracle divided into 4 or more branches (Fig. 37) 17
16. Head with facial mask with several darkened, comb-like structures near oral aperture (Fig. 33). Abdomen with breathing tubes elongate, extending behind posterior edge of larva (Figs 30-31). Anterior spiracle with 6 papillae on dorsal branch (Fig. 32). Body length over 3.0 mm ..... *Lytogaster*



Figs 30-43. Ephydridae, larva. -30-33. *Lytogaster abdominalis* (Stenh.). -30-31. Mature larva, dorsal and lateral aspect. -32. Anterior spiracle. -33. Anterior portion of larva, ventral aspect. -34-36. *Nostima* sp. -34. Cephalopharyngeal skeleton. -35. Mature larva, dorsal aspect. -36. Anterior spiracle. -37-38. *Pelina* sp. -37. Mature larva, dorsal aspect. -38. Anterior spiracle. -39-41. *Philygria* sp. -39. Mature larva, dorsal aspect. -40. Cephalopharyngeal skeleton: (php) pharyngeal process. -41. Anterior spiracle. -42-43. *Scatophila iowana* (Wheeler). -42. Mature larva, lateral aspect. -43. Cephalopharyngeal skeleton. Drawn to different scales. Figs 30-33 redrawn from Foote (1981b); 34-36 from Foote (1983); 37-38 from Foote (1981a); 39-41 from Froese (1993); and 42-43 from Deonier (1974).

- Head with facial mask lacking comb-like structures. Abdomen with breathing tubes short, not extending beyond end of larva (Fig. 35). Anterior spiracle with 3 papillae on dorsal branch (Fig. 36). Body length less than 2.5 mm ..... *Nostima*

17. Body dorsally with distinct pattern formed by blackened scales and spinules (Fig. 37). Prothorax with anterior spiracle with elongate branches (Fig. 38). Body lenght 4.0-5.5 mm ..... *Pelina*
- Body dorsally unpatterned, uniformly coloured. Prothorax with anterior spiracle with short branches (Fig. 41). Body lenght less than 2.8 mm 18

18. Thoracic and abdominal segments armed with lateral appendices (Fig. 39). Pseudocephalic segment bears 3 horizontal rows of spines dorsad to oral opening; pharyngeal slerite bears pharyngeal process antero-ventrally (Fig. 40) ..... *Philygria*
- Thoracic and abdominal segments without lateral appendices (Fig. 42). Pseudocephalic segment without rows of spines; pharyngeal slerite without pharyngeal process (Fig. 43) ..... *Scatophila*

Key to genera for adults

1. Fore leg raptorial with femur greatly enlarged and tibia ending in spur (Fig. 47) ..... *Ochthera* Latreille
- Fore leg normal with femur slender and tibia not ending in spur 2

2. Wing with costal vein extended to or just beyond apex of third radial vein (Fig. 48) 3
- Wing with costal vein extended to first medial vein (Fig. 54) 6

3. Mesotibia with dorsal setae (Fig. 49) 4
- Mesotibia lacking dorsal setae 5

4. Head with 2 strong facial setae; proclinate fronto-orbital setae distinct (Fig. 51). Body black *Dichaeta* Meigen
- Head with 3-7 facial setae, hair-like or short; proclinate fronto-orbital setae weak or absent. Body ocherous to cinereous ..... *Notiphila* Fallén

5. Abdominal terga with surface smooth; tergum 4 not more than twice as long as tergum 5. Head with midface and lower facial margin setose; only one orbital seta present (Fig. 50) ..... *Scatophila* Becker
- Abdominal terga with surface pitted; tergum 4 at least 3 times as long as tergum 5 (Fig. 52). Head with midface and lower facial margin without setae; 2 orbital seta present ..... *Axysta* Haliday

6. Head with midface and lower facial margin without setae; facial setae inserted in vertical series, parallel with parafacial (Figs 58, 62, 65) 7
- Head with midface and lower facial margin setose, the latter often with long setae; insertions of facial setae variable (Figs 82, 87) 25

7. Antenna with arista distincly pectinate dorsally (Figs 55, 59, 64, 66) 8
- Antenna with arista bare to macropubescent; if pectinate, hairs shorter than 1/2 width of first flagellomere (Fig. 58) 19

8. Thorax with posterior notopleural seta much farther from notopleural suture than anterior seta (Fig. 53) 9
- Thorax with anterior and posterior notopleural setae equidistant from notopleural suture (Fig. 60) 12

9. Thorax with presutural or sutural dorsocentral seta present, conspicuous 10
- Thorax with presutural or sutural dorsocentral seta inconspicuous or absent 11

10. Wing uniformly spotted (Fig. 54) .... *Ilythea* Haliday
- Wing not spotted ..... *Nostima* Coquillett

11. Head with face concave in profile, most prominent at oral margin (Fig. 55). Wing slightly pointed at apex of third radial vein (Fig. 56) ..... *Atissa* Haliday
- Head with face convex in profile, most prominent near its middle (Fig. 57). Wing evenly rounded apically .... *Allotrichoma* Becker

12. Head with face with a conspicuous shiny black median tubercle; gena high, much more than 1/2 eye height, setulose; parafacial and frontal vitta setulose (Fig. 58). Thorax with scutellum with three marginal setae .... *Hecamede* Haliday
- Head with face without shiny median tubercle; gena low, less than 1/2 eye height, not setulose; parafacial and frontal vitta not setulose. Thorax with scutellum with two marginal setae 13

13. Thorax with presutural or sutural dorsocentral seta present, conspicuous ... *Hydrellia* Robineau-Desvoidy
- Thorax with presutural or sutural dorsocentral seta absent 14

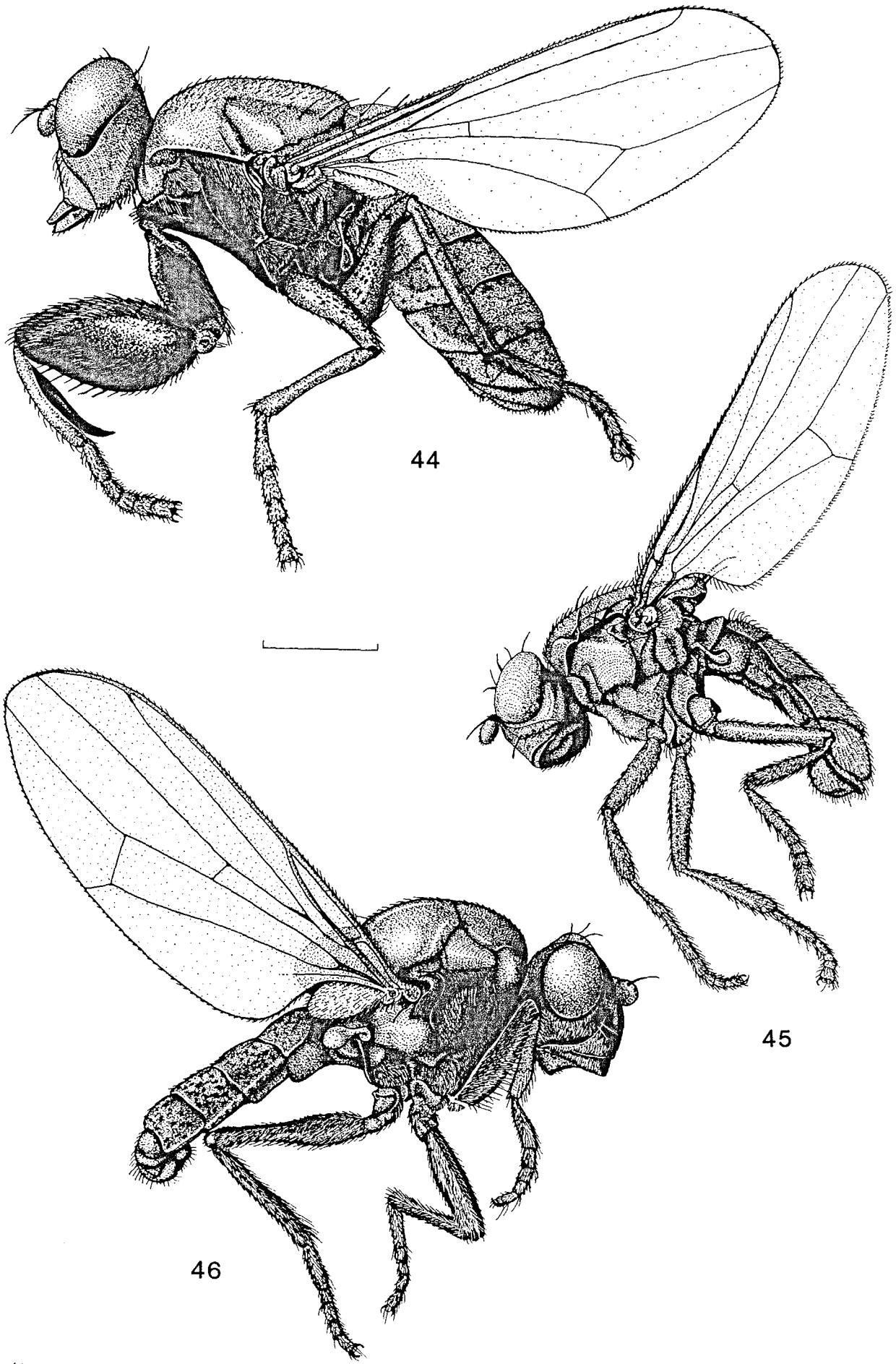
14. Head with face usually shining centrally, rarely somewhat carinate above; ocellar setae inserted behind anterior ocellus; pseudo-postocellar setae, if distinguishable, lateroclinate (Fig. 59) ..... *Psilopa* Fallén
- Head with face usually pollinose to cinereous, usually carinate above, at least slightly; ocellar setae inserted in front of anterior ocellus; pseudopostocellar setae proclinate, or parallel (Figs 61-62, 65) 15

15. Thorax with notopleuron with short setulae around anterior seta (Fig. 60) 16
- Thorax with notopleuron without setulae 17

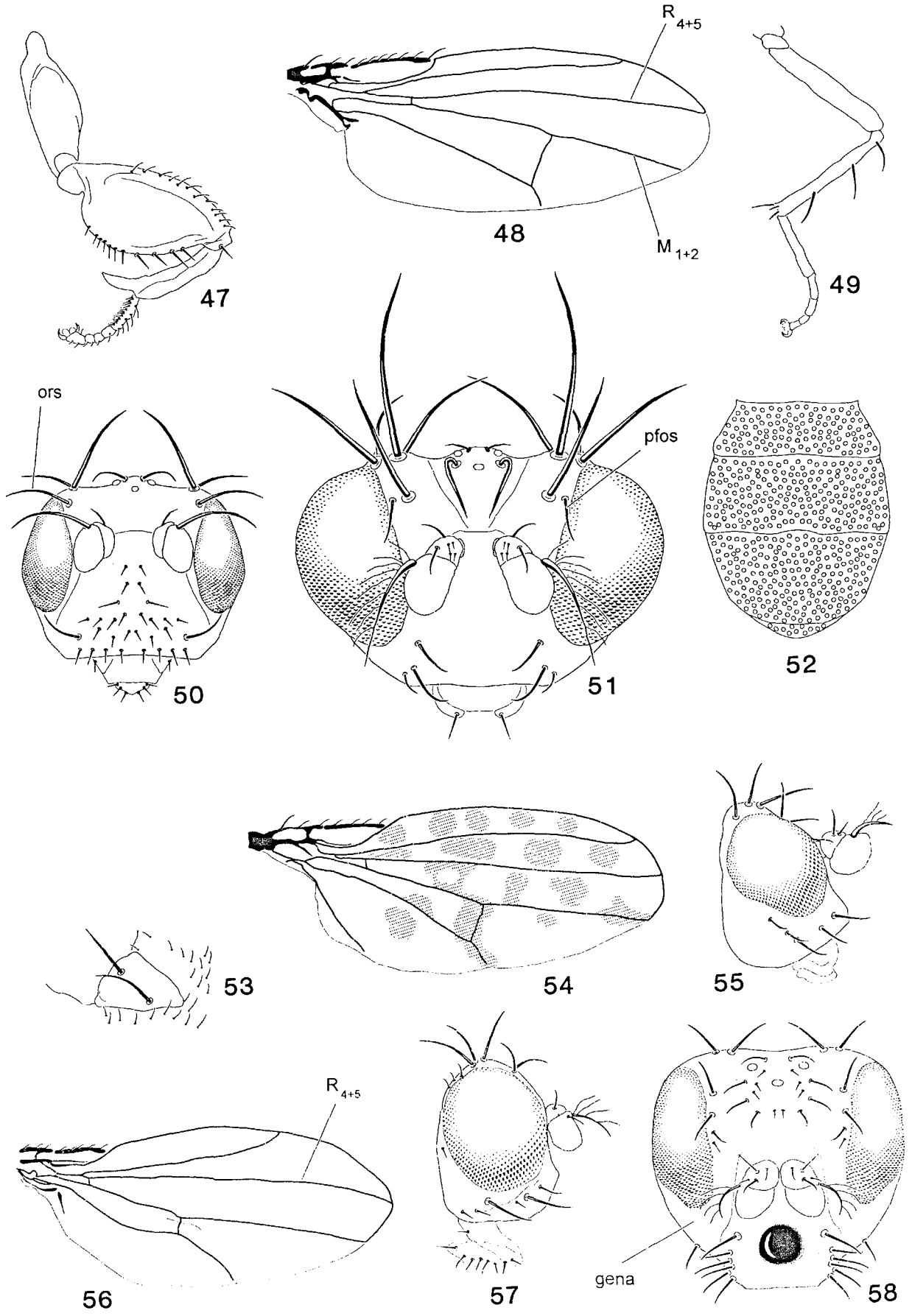
16. Head with face with a series of upcurved seta in addition to the usual facial setae (Fig. 61) .... *Polytrichophora* Cresson
- Head with face without a series of upcurved bristles in addition to the usual facial setae *Discocerina* Macquart

17. Head with upper facial seta laterally paired with a larger, inner seta, each on a small but distinct shiny papilla (Fig. 62). Metatibia with preapical ventral spur (Fig. 63) ..... *Hecamedoides* Hendel
- Head with facial setae ordered in one straight line, upper facial setae not on papillae. Metatibia without preapical ventral spur 18

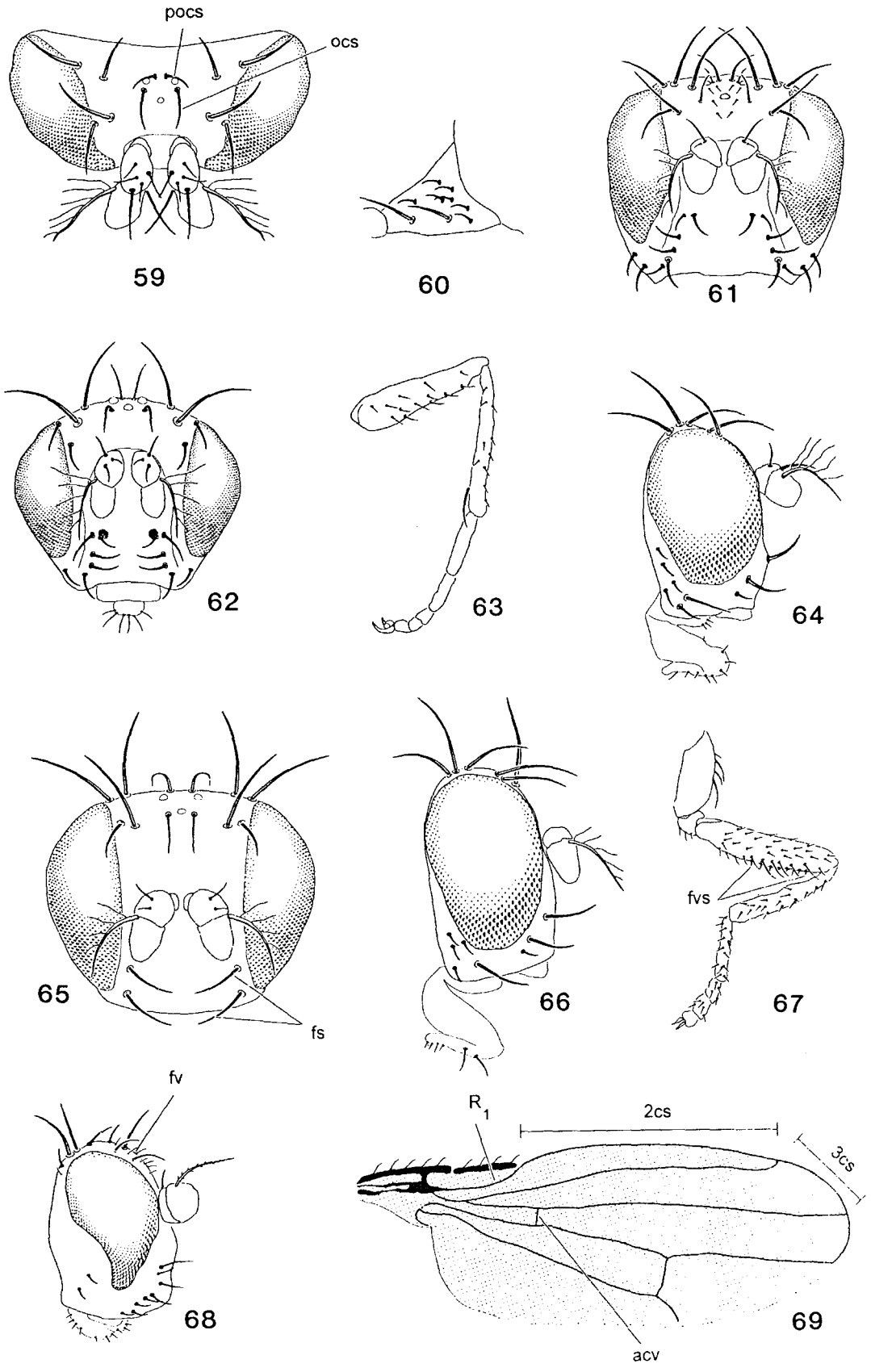
18. Head with face nearly flat; facial setae widely separated (Fig. 65). Profemur without ventral row of spines .... *Gymnoclasiopa* Hendel
- Head with face concave below antennae; generally 3 closer facial setae (Fig. 64). Profemur with ventral row of spines (Fig. 67) ..... *Ditrichophora* Cresson



Figs 44-46. Ephydridae, male habitus, lateral aspect. -44. *Ochthera mantis* (De Geer). -45. *Pelina aenea* (Fall.). -46. *Parydra aquila* (Fall.). Del. G. Marklund.



Figs 47-58. Ephydridae, adult. -47. *Ochthera mantis* (De Geer), fore leg, lateral aspect. -48-49. *Notiphila cinerea* (Fall.). -48. Wing: (M1+2) first medial vein, (R4+5) third radial vein. -49. Mid leg, lateral aspect. -50-51. Head, anterior aspect: (ors) orbital seta, (pfos) proclinate frontoorbital seta. -50. *Scatophila despecta* (Hal.). -51. *Dichaeta caudata* (Fall.). -52. *Axysta cesta* (Hal.), abdomen, dorsal aspect. -53-54. *Ilythea spilota* (Curtis). -53. Notopleural region, lateral view. -54. Wing. -55-56. *Atissa pygmaea* (Hal.). -55. Head, lateral aspect. -56. Wing: (R4+5) third radial vein. -57. *Allotrichoma lateralis* (Loew), head, lateral aspect. -58. *Hecamede albicans* (Meig.), head, anterior aspect. Drawn to different scales.



Figs 59-69. Ephydridae, adult. -59. *Psilopa nitidula* (Fall.), head, dorsal aspect: (ocs) ocellar seta, (pocs) pseudoocellar seta. -60. *Discocerina obscurella* (Fall.), notopleura, lateral aspect. -61. *Polytrichophora duplosetosa* (Becker), head, anterior aspect. -62-63. *Hecamedoides glaucellus* (Stenh.). -62. Head, anterior aspect. -63. Hind leg. -64. *Ditrichophora calceata* (Meig.), head, dorsal aspect. -65-66. *Gymnoclasiopa nigerrima* (Strobl), head, anterior and lateral aspects: (fs) facial setae. -67. *Ditrichophora calceata* (Meig.), fore leg: (fvs) femoral ventral setae. -68. *Glenanthe ripicola* (Hal.), head, lateral aspect: (fv) frontal vitta. -69. *Eutaenionotum guttipennis* (Stenh.), wing: (2cs) second costal section, (3cs) third costal section, (acv) anterior crossvein, (R1) first radial vein. Drawn to different scales.

19. Head with eye pyriform, strongly narrowed below; frontal vitta covered by many short fine to coarse hairs (Fig. 68) ..... *Glenanthe* Haliday
- Head with eye round; frontal vitta without hairs 20
20. Thorax with posterior notopleural seta much farther from notopleural suture than anterior seta ..... *Philygria* Stenhammar
- Thorax with posterior and anterior notopleural setae equidistant from the notopleural suture 21
21. Head with facial prominence large, gaping (Fig. 73) 22
- Head with facial prominence small to moderately large (Figs 72, 74) 23
22. Wing with anterior crossvein located directly below or slightly beyond junction of first radial vein and costal vein; second costal section 3.5-5 x as long as third section (Fig. 69) ..... *Eutaenionotum* Oldenberg
- Wing with anterior crossvein located distinctly beyond junction of first radial vein and costal vein; second costal section 0.7-3.3 x as long as third section(Fig. 70) ..... *Parydra* Stenhammar
23. Wing with third radial vein long: second costal section nearly 3 x as long as third section (Fig. 71). Head with face flat or weakly carinate, not medially prominent (Fig. 72) ..... *Pelina* Haliday
- Wing with third radial vein short; second costal section less than twice as long as third section. Head with face with low conical median prominence (Fig. 74) 24
24. Abdomen with tergum 4 from 1.3 to 2 x as long as tergum 5 (Fig. 75) ..... *Lytogaster* Becker
- Abdomen with terga 4 and 5 subequal in length ..... *Hyadina* Haliday
25. Thorax with 3-4 postsutural dorsocentral setae present; proepisternum with few to many fine setulae (Fig. 76) 26
- Thorax with 2 postsutural dorsocentral setae; proepisternum bare 30
26. Tarsus with pulvilli much reduced or absent; claws long and nearly straight (Fig. 77). Thorax with prosternum setulose (Fig. 76) 27
- Tarsus with pulvilli well-developed; claws short and distinctly curved. Thorax with prosternum bare 28
27. Antenna with outer surface of flagellomere 1 with large seta inserted just below insertion of arista (Fig. 78) ... *Setacera* Cresson
- Antenna with outer surface of flagellomere 1 without lateral seta ..... *Ephydra* Fallén
28. Thorax with 1 presutural and 3 postsutural dorsocentral setae present (Fig. 80); postpronotal seta absent or very short and weak ..... *Coenia* Robineau-Desvoidy
- Thorax with 1 presutural and 4 postsutural dorsocentral setae present; postpronotal seta distinct, at least half as long as posterior notopleural seta 29
29. Wing with stem vein with 1-2 setulae above, inserted beyond transverse septum (Fig. 79). Metacoxa with row of setae posteriorly along ventral margin (Fig. 81). Scutellum with dorsum convex . *Paracoenia* Cresson
- Wing with stem vein bare above. Metacoxa bare posteriorly along ventral margin. Scutellum with dorsum almost flat ..... *Calocoenia* Mathis
30. Antenna with arista pectinate above ..... *Philotelma* Becker
- Antenna with arista bare to macropubescent 31
31. Head with 1 orbital seta (Fig. 82). Wing with pattern of many white and dark spots (Fig. 83) ..... *Limnellia* Malloch
- Head with 2-3 orbital setae (Figs 86, 88, 89). Wing with pattern of white spots or unmarked (Fig. 85) 32
32. Head with gena with a distinct seta among fine hairs 33
- Head with gena with a series of fine hairs, but without distinct seta (Fig. 87) 34
33. Wing without pale spots. Scutellum with dorsum setose; with 3 marginal setae (Fig. 84) *Teichomyza* Macquart
- Wing with distinct to very obscure pale spots (Fig. 85). Scutellum with dorsum bare; with 2 marginal setae ... *Scatella* Robineau-Desvoidy
34. Thorax with posterior notopleural seta much farther dorsad from notopleural suture than anterior seta. Head with eye longer than high, oriented at slightly oblique angle to lower margin of gena (Fig. 87) ..... *Haloscatella* Mathis
- Thorax with anterior and posterior notopleural setae equidistant from ventral notopleural suture. Head with eye slightly higher than long, appearing round 35
35. Head with posterior orbital seta closer to inner vertical seta than to anterior orbital seta (Fig. 86); gena at least 1/3 x as high as eye; frontal vitta shiny ..... *Thinoscatella* Mathis
- Head with posterior orbital seta closer to anterior orbital seta than to inner vertical seta (Fig. 89); gena at most 1/4 x as high as eye; frontal vitta dull, at most subshiny ..... *Lamproscatella* Hendel

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Larvae

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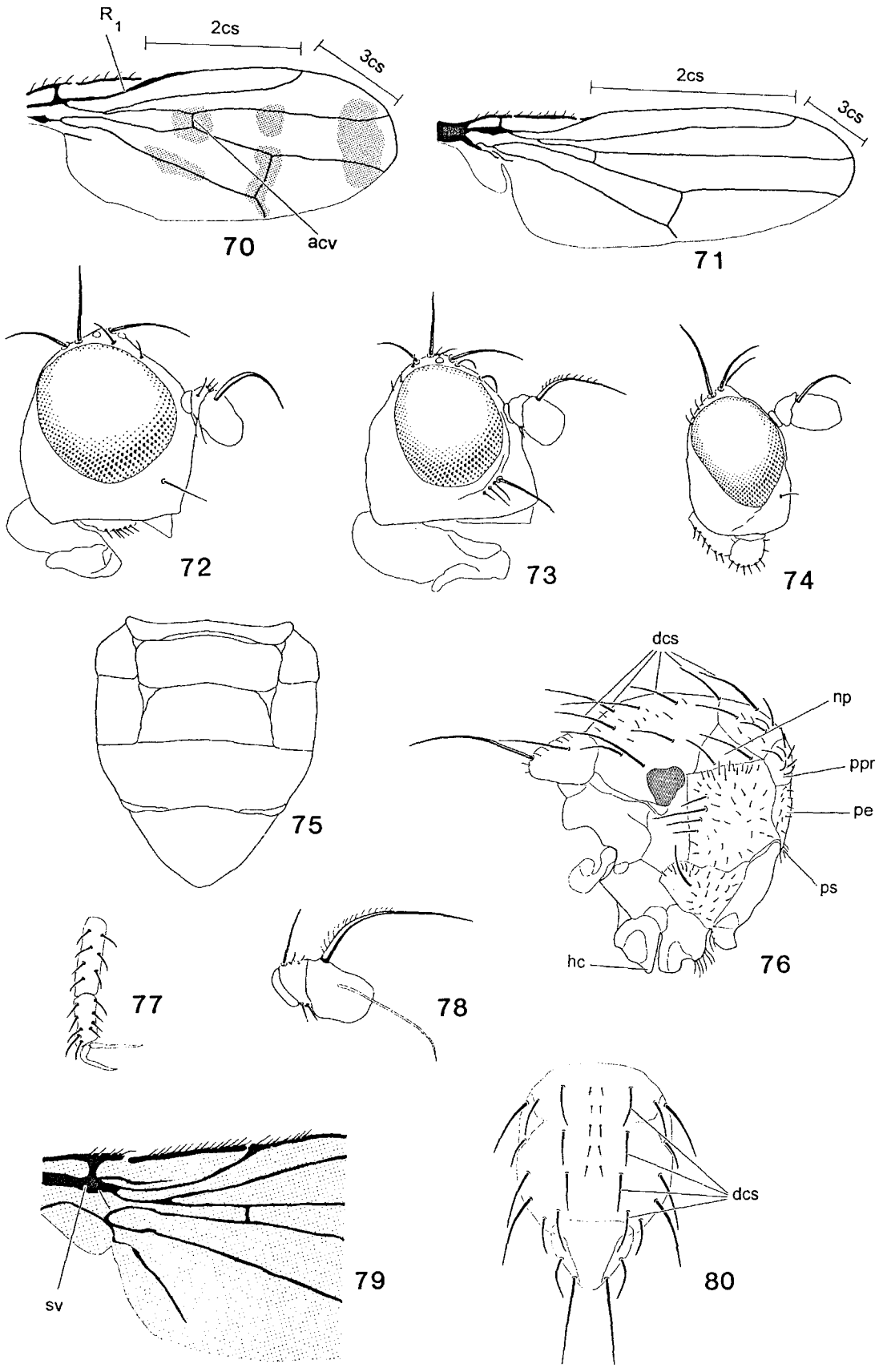

Figs 70-80. Ephydridae, adult. -70. *Parydra nubecula* Beck., wing: (2cs) second costal section, (3cs) third costal section, (acv) anterior crossvein, (R1) first radial vein. -71-72. *Pelina aenea* (Fall.). -71. Wing -72-74. Head, lateral aspect. -73. *Parydra fossarum* (Hal.). -74. *Hyadina guttata* (Fall.). -75. *Lytogaster abdominalis* (Stenh.), abdomen, dorsal aspect. -76-77. *Ephydra riparia* (Fall.). -76. Mesonotum and coxae, lateral aspect: (dcs) dorsocentral setae, (hc) hindcoxa, (np) notopleura, (pe) proepisternum, (ps) prosternum, (ppr) postpronotum. -77. Tarsus and claws. -78. *Setacera aurata* (Stenh.), antenna, lateral aspect. -79. *Paracoenia fumosa* (Stenh.), basal portion of wing: (sv) stem vein. -80. *Coenia curvicauda* (Meig.), thorax, dorsal view: (dcs) dorsocentral setae. Drawn to different scales.

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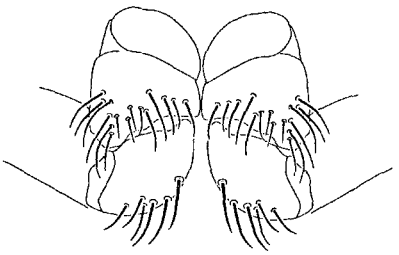

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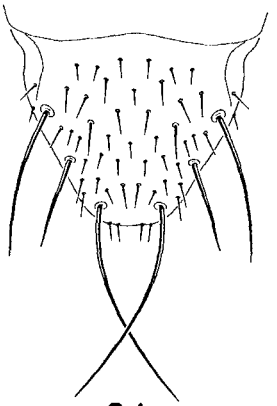

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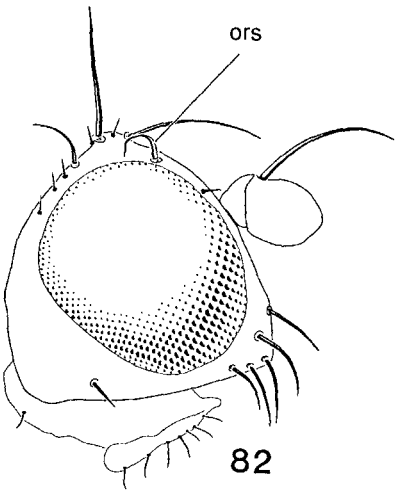

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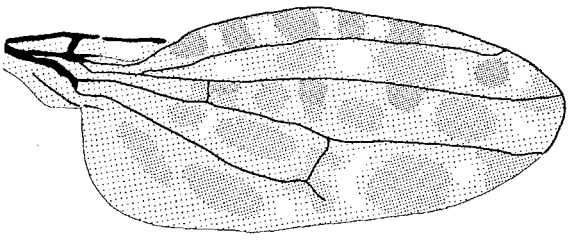

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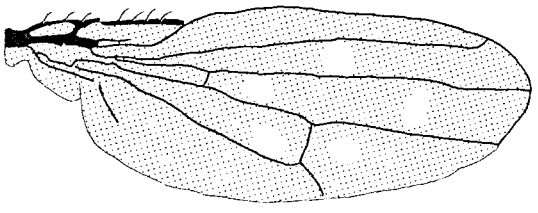

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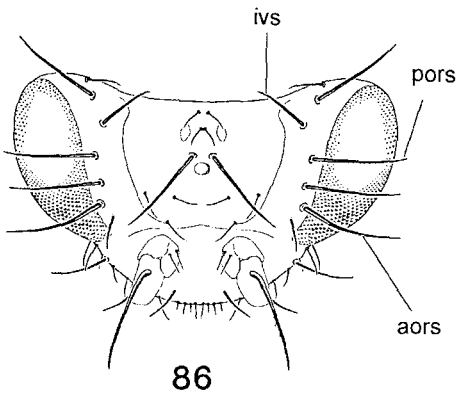

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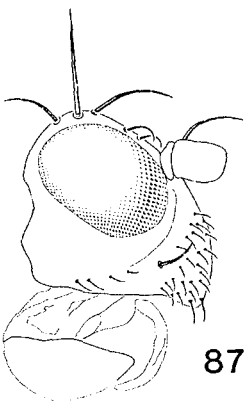
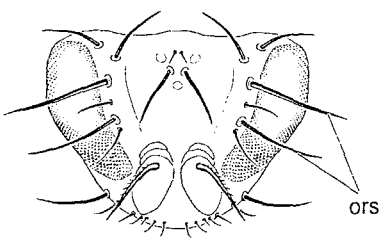
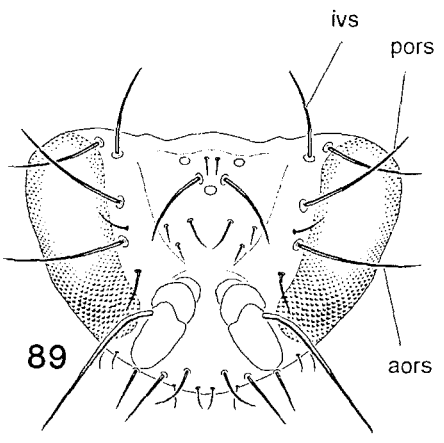


87



88



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Figs 81-89. Ephydridae, adult.. -81. *Paracoenia fumosa* (Stenh.). procoxa, posterior aspect. -82-83. *Limnellia quadrata* (Fall.). -82. Head, lateral aspect: (ors) orbital seta. -83. Wing. -84. *Teichomyza fusca* (Macq.), scutellum, dorsal aspect. -85. *Scatella stagnalis* (Fall.), wing. -86. *Thinoscatella* sp., head, dorsal aspect: (aors) anterior orbital seta, (ivs) inner vertical seta, (pors) posterior orbital seta. -87-88. *Haloscatella dichaeta* (Loew), head, lateral and dorsal aspect: (ors) orbital setae. -89. *Lamproscatella sibilans* (Hal.), head, dorsal aspect. Drawn to different scales. Fig. 86 redrawn from Mathis (1979).

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Check list

[Parts of North Europe coded as: D= Denmark, N= Norway, S= Sweden, F= Finland, K= Fennoscandian parts of Russia, I= Iceland, Fa= Faroes, Sv= Svalbard.]

Discomyzinae

Discomyza incurva (Fallén, 1823) ..... DNSF
Psilopa bornholmi Becker, 1926 ..... DS
P. compta (Meigen, 1830) ..... DSFK
P. girschneri von Roeder, 1889 ..... S
P. leucostoma (Meigen, 1830) ..... DNSF
P. marginella Fallén, 1823 ..... NSF
P. nigritella Stenhammar, 1844 ..... DSF
P. nitidifacies Frey, 1958 ..... F
P. nitidula (Fallén, 1813) ..... DNSF
P. polita (Macquart, 1835) ..... SF
P. pulicaria (Haliday, 1839) ..... F
Trimerina madizans (Fallén, 1813) ..... SF

Hydrelliinae

Atissa limosina Becker, 1896 ..... NF
A. pygmaea (Haliday, 1839) ..... S
Notiphila annulipes Stenhammar, 1844 ..... DNSFK
N. aquatica Becker, 1896 ..... SF
N. brunipes (Rob.-Desv., 1830) ..... DSF
N. cinerea Fallén, 1813 ..... DNSFKFa
N. dorsata Stenhammar, 1844 ..... SF
N. guttiventris Stenhammar, 1844 ..... S
N. maculata Stenhammar, 1844 ..... SF
N. major Stenhammar, 1844 ..... S
N. nigricornis Stenhammar, 1844 ..... DS
N. riparia Meigen, 1830 ..... DSF
N. uliginosa Haliday, 1839 ..... DNSF
N. venusta Loew, 1860 ..... S
Dichaeta caudata (Fallén, 1823) ..... DSF
Hydrellia albifrons (Fallén, 1813) ..... SFa
H. albilabris (Meigen, 1830) ..... NSF
H. argyrogenis Becker, 1896 ..... F
H. caesia (Stenhammar, 1844) ..... S
H. cardamines Haliday, 1839 ..... SFK
H. concolor (Stenhammar, 1844) ..... SF
H. fascitibia (von Roser, 1840) ..... SF
H. flaviceps (Meigen, 1830) ..... SF
H. flavicornis (Fallén, 1823) ..... SFK
H. fulviceps (Stenhammar, 1844) ..... S
H. fusca (Stenhammar, 1844) ..... SF
H. geniculata (Stenhammar, 1844) ..... S
H. griseola (Fallén, 1813) ..... DNSFKIFa
H. lapponica (Stenhammar, 1844) ..... Fa
H. maura Meigen, 1838 ..... SFFa
H. meigeni Zatwarnicki, 1988 ..... SFK
H. mutata (Zetterstedt, 1846) ..... S
H. nigricans (Stenhammar, 1844) ..... S
H. nympheae (Stenhammar, 1844) ..... SF
H. obscura (Meigen, 1830) ..... SF
H. pilitarsis (Stenhammar, 1844) ..... SF
H. propinqua Wahlgren, 1947 ..... S
H. stratiotella Wahlgren, 1947 ..... S
H. subalbiceps Collin, 1966 ..... S
H. svecica Zatwarnicki, 1988 ..... S
H. thoracica Haliday, 1839 ..... SF
H. tibialis Cresson, 1916 ..... F

Gymnomyzinae

Athyroglossa glabra (Meigen, 1830) ..... NSF
Mosillus subsultans (Fabricius, 1794) ..... DSF
Allotrichoma laterale (Loew, 1860) ..... SF
A. bezzii Becker, 1896 ..... S
Hecamede albicans (Meigen, 1830) ..... DS
Glenanthe ripicola (Haliday, 1839) ..... SF
Ochthera manicata (Fabricius, 1794) ..... DSF
O. mantis (De Geer, 1776) ..... NSF
O. palearctica Clausen, 1977 ..... D
Discocerina obscurella (Fallén, 1813) ..... DSFK
Ditrichophora calceata (Meigen, 1830) ..... DS
D. fuscella (Stenhammar, 1844) ..... DNSF
D. glabricula (Fallén, 1813) ..... S
D. lambi (Collin, 1943) I
D. nigrithorax (Becker, 1896) ..... S
D. psilopina (Frey, 1933) ..... F
D. sia Dahl, 1959 ..... N
Gymnoclasiopa aurifacies (Strobl, 1893) ..... SF
G. aurivilli (Becker, 1896) ..... SF
G. bohemanni (Becker, 1896) ..... SFI
G. cinerella (Stenhammar, 1844) ..... SFK
G. nigerrima (Strobl, 1893) ..... S
G. plumosa (Fallén, 1813) ..... NS
G. pulchella (Meigen, 1830) ..... S
Polytrichophora duplosetosa (Becker, 1896) ..... SF
Hecamedoides glaucellus (Stenhammar, 1844) ..... DSFK

Ilytheinae

Ilythea spilota (Curtis, 1832) ..... NSFFa
Philygria albidipennis (Stenhammar, 1844) ..... S
Ph. flavipes (Fallén, 1813) ..... NSF
Ph. interstincta (Fallén, 1813) ..... S
Ph. maculipennis (Rob.-Desv., 1830) ..... SF
Ph. nigricauda (Stenhammar, 1844) ..... SFK
Ph. obtecta Becker, 1896 ..... F
Ph. posticata (Meigen, 1830) ..... DSF
Ph. punctatonervosa (Fallén, 1813) ..... DNS
Ph. stictica (Meigen, 1830) ..... DS
Ph. vittipennis (Zetterstedt, 1838) ..... SI
Nostima picta (Fallén, 1813) ..... DSF
Axysta cesta (Haliday, 1833) ..... NSF
Hyadina guttata (Fallén, 1813) ..... SF
H. humeralis Becker, 1896 ..... SF
H. nigricornis Frey, 1930 ..... F
H. nitida (Macquart, 1835) ..... NSFK
H. scutellata (Haliday, 1839) ..... SF
H. vockerothi Clausen, 1984 ..... DS
Lytogaster abdominalis (Stenhammar, 1844) ..... DSF
Pelina aenea (Fallén, 1813) ..... NSF
P. aenescens (Stenhammar, 1844) ..... DNSFFa
P. norvegica Dahl, 1975 ..... N

Ephydrinae
Eutaenionotum guttipennis (Stenhammar, 1844) ..... SF
Parydra aquila (Fallén, 1813) ..... DNSF
P. coarctata (Fallén, 1813) ..... NSFFa
P. cognata Loew, 1860 ..... S
P. fossarum (Haliday, 1833) ..... DNSFFa
P. littoralis (Meigen, 1830) ..... DS
P. mitis (Cresson, 1930) ..... S
P. nigritarsis Strobl, 1893 ..... DS
P. nubecula Becker, 1896 ..... F
P. quadripunctata (Meigen, 1830) ..... SFFa
P. undulata Becker, 1896 ..... S
P. pusilla (Meigen, 1830) ..... DSFIFa
Ephydra macellaria alandica Frey, 1909 ..... SF
E. riparia Fallén, 1813 ..... DNSF
E. scholtzi Becker, 1896 ..... DSF
Setacera aurata (Stenhammar, 1844) ..... NSF
S. breviventris (Loew, 1860) ..... S
S. micans (Haliday, 1833) ..... NSF
Paracoenia fumosa (Stenhammar, 1844) ..... DNSF
Calocoenia paurosoma (Sturt. & Wheel., 1954) ..... S
Coenia borealis Dahl, 1975 ..... S
Coenia curvicauda (Meigen, 1830) ..... DS
Coenia palustris (Fallén, 1823) ..... DNSF
Limnellia fallax (Czerny, 1910) ..... SF
L. quadrata (Fallén, 1813) ..... NSFFa
L. stenhammari (Zetterstedt, 1848) ..... DNSIF
L. surturi Andersson, 1971 I
Scatophila caviceps (Stenhammar, 1844) ..... DNSF
S. contaminata (Stenhammar, 1844) ..... SF
S. cribrata (Stenhammar, 1844) ..... SF
S. despecta (Haliday, 1839) ..... DNSF
S. mesogramma (Loew, 1896) ..... S
S. iowana Wheeler, 1961 ..... S
S. noctula (Meigen, 1830) ..... DSF
S. planiceps Boheman, 1853 ..... S
S. quadriguttata (Meigen, 1830) ..... F
S. signata (Loew, 1860) ..... D
S. unicornis Czerny, 1900 ..... D
Lamproscatella brunneifrons (Malloch, 1923) ..... NS
L. sibilans (Haliday, 1833) ..... DNSFIFa
Haloscatella dichaeta (Loew, 1860) ..... SF
Thinoscatella quadrisetosa (Becker, 1896) ..... N
Philotelma nigripenne (Meigen, 1830) ..... DNSF
Scatella crassicosta Becker, 1896 ..... NSF
S. lutosa (Haliday, 1833) ..... SF
S. obsoleta Loew, 1862 ..... DNSF
S. paludum (Meigen, 1830) ..... DNSFIFa
S. stagnalis (Fallén, 1813) ..... DNSFIFa
S. silacea Loew, 1860 ..... DSF
S. subguttata (Meigen, 1830) ..... DSFIFa
S. tenuicosta Collin, 1930 ..... DNSFI
Teichomyza fusca (Macquart, 1835) ..... SF