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Illustrated identification guide to the Nordic aphids feeding on Conifers (Pinophyta) (Insecta, Hemiptera, Sternorhyncha, Aphidomorpha)

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Abstract

Keys and diagnoses of North European aphids (Hemiptera, Aphidoidea) feeding on conifers are given, including species from nearby areas of Central and Western Europe, based on live and freeze-dried material. Externally visible informative characters, such as body shape, colours, wax coating, and pigmentation pattern are utilized, in addition to characters traditionally used in the literature. Rich illustrations with photographs of live colonies and freeze-dried specimens, supported by drawings where needed, are presented. The combination of colour images and diagnoses, utilizing easily observed characters, allows the identification of a large number of species already in the field, and many more at home with the aid of a stereo microscope. Host plant relationships and aphid-ant associations are presented.

Keywords. Nordic aphids on conifers, identification keys, colour images, Adelgidae, Cinarinae.

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Introduction

This is the second article presenting the Nordic Aphidomorpha. The purpose of this work is to display them in a way that is closer to their natural appearance than how aphid handbooks traditionally present them. This is intended to facilitate the study of this fascinating group of insects. The present study focuses on conifer-feeding aphids of Finland and Scandinavia, including Iceland, Greenland, The Faroes and Svalbard. Most of the species occurring in adjacent parts of north-eastern Europe, the Baltic region and northern central Europe, including the British Isles are also covered. For a more complete introduction, see Albrecht (2015).

The aphid fauna on conifers is quite different from that of angiosperms. The Aphidinae are clearly under-represented in favour of Adelgidae and Lachninae, and to some extent Eriosomatinae (family

Aphididae). These taxa form three distinct identities regarding life cycles and feeding habits. Adelgids are characterised by being oviparous in all female morphs, by a two-year life cycle (when holocyclic) with a gall-forming generation on spruce alternating with free-living generations on fir, larch, pine etc. They hibernate as nymphs and can accordingly be found any time of the year. Even if very small, the overwintering individuals are fairly easy to identify, with a good lupe even in the field.

The Lachninae, on the other hand, are all monoecious and have a one-year life cycle, hibernating as eggs on needles, in bark crevices, between cone scales and so on. Regardless of their often large size, some species, even common ones, are problematic and clearly in need of revision. *Cinara pini* (Macquart, 1819) and allied species, as well as the highly variable *C. pinea* (Mordvilko, 1895) (as here interpreted), deserve special attention.

Their wax and colour patterns are often conspicuous, so studies of fresh material are of utmost importance. Freeze-dried material is a very good complement. A couple of points need, however, to be taken into account when comparing fresh and dry material: freeze-dried specimens lack the transparency of live material; also, colouration due to body fluid will be opaque and much paler, wax pattern less obvious (although not lost), and sclerites will stand out very distinctly. Moreover, assessing the host relationships of many *Cinara* species is far from straight forward. Particularly with some large species (e.g., *Cinara (Cinara) piceae* (Panzer, 1801), *C. confinis* Koch, 1856, *C. nuda* Mordvilko, 1895) as adults are easily disturbed and tend to fall to the ground in windy weather, whereupon they climb up on anything vertical, and may be found on trees not serving as regular hosts. Binazzi & Scheurer (2009) gave an informative account on honeydew-producing conifer Lachnidae in Europe. The British species of conifer lachnids are extensively treated by Carter & Maslen (1982).

The eriosomatines feeding on conifers are a chapter of their own. They are all dioecious species with broad-leaved trees or shrubs as primary hosts, and feed on thin, usually mycorrhizal, roots of conifers. They can be found beneath the moss layer under conifers and are usually revealed by their white wax exudates, which is very helpful given their small size. Many of them (if not all) may hibernate here, and even stay here for many years. For more details, see Albrecht (2015).

Mindarinae is a small subfamily confined to conifers, whereas the large Aphidinae is represented by just a few species, predominantly polyphags occasionally found on conifers.

Material and methods

The host records and distribution data are according to Blackman & Eastop (1994, 2006, 2016), Heie (1980, 1986, 1992, 1994, 1995, 2004), Holman (2009) and the database of the Finnish Expert Group on Hemiptera (http://biolcoll.utu.fi/hemi/tyoryhma/tyoryhma_eng.htm), comprising most of the aphid data recorded from Finland, with additional records from adjacent countries. The photographs and drawings are original, unless otherwise stated. My own records of hosts and attendant ants are marked with asterisks (*) in the diagnoses and in the host and ant tables (Appendices 1 and 2), as are records by Osmo Heikinheimo and other Finnish collectors whenever it has been possible to confirm the relationships (e.g., from Heikinheimo's field notes). The plant nomenclature follows Karlsson & Agestam (2014). For the part of the attendant ants, I have not had the opportunity to scan the literature, so the ant lists are more or less completely relying on my own observations. My ant identifications and nomenclature are based on Douwes *et al*. (2012) and Czechowski *et al*. (2012). The aphid nomenclature and classification in this article follows Favret (2016) and Favret *et al*. (2015). Whenever available, live and freeze-dried material is used for the diagnoses, in conjunction with the literature. For geographical and phenological records from Finland, see Albrecht (2010).

The keys, instead of being dichotomous, mainly consist of multi-character diagnoses and synopses to entry points grouping the diagnoses into sections sharing one or a few easily observed characters. Together with the photographs and drawings the data given in the diagnoses should in most cases be enough to allow correct identifications, or when that is not the case, to give sufficient reason to doubt the results and seek additional information elsewhere in the literature.

Some terms and abbreviations used in this paper (for more, see e.g., Albrecht 2015; Blackman & Eastop 2016).

al.	=	alata, alate, winged
anholocycle	=	incomplete life cycle, asexual generations only
ant.	=	antenna
fundatrix	=	female hatched from a fertilized egg (often gall-inducer)
gallicola	=	female inhabiting or emanating from gall
holocycle	=	complete life cycle with alternating sexual and asexual generations
juv.	=	juvenile, nymph
neosistens	=	first larval instar of overwintering female on secondary host (sistens)
primary host	=	main host of host-alternating species, where the sexual reproduction takes place
pseudofundatrix	=	gall-inducer hatched from unfertilized egg (in some anholocyclic Adelgidae)
RIV	=	rostral segment 4
RV	=	rostral segment 5
RIV+V	=	rostral segments 4 and 5 combined
secondary host	=	intermediate host of host-alternating species where only asexual reproduction takes place
sexupara	=	female giving rise to sexually reproducing males and females
viv.	=	viviparous

The presence of the species in the Nordic countries is based on Heie (1980, 1986, 1992, 1994, 1995, 2004) and my own databases. The countries are denoted by letters as follows:

D = Denmark
F = Finland
Fa = Faroes
Gr = Greenland
I = Iceland
N = Norway
S = Sweden
Sv = Svalbard

Results

Phylum Arthropoda von Siebold, 1848
Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Sternorrhyncha Amyot & Serville, 1834

Infraorder **Aphidomorpha** Becker-Migdisova & Aizenberg, 1962

Synoptic key and diagnoses for aphids on conifers

*Key A. Aphids on spruce (***Picea***)*

Synopsis

A1 (A2) Dichotomous key to galls on *Picea* ..... p. 5

A2 (A1) Aphids on *Picea* A3

A3 (A15) On aerial parts of *Picea* A4

A4 (A11) Siphunculi absent; adults with sclerotised ovipositor. Apterae less than 1.2 mm, antennae at most 3-segmented ..... **Adelgidae** Annand, 1928 A5

A5 (A6) Abdomen (all morphs) with 4 pairs of evident spiracles (on abd. 2–5). Gall (when present) with interconnected chambers ..... ***Pineus*** Shimer, 1869: p. 6

A6 (A5) Abdomen (all morphs) with 5 pairs of evident spiracles (on abd. 2–6). Gall with separate chambers A7

A7 (A8) Wax glands of overwintering larvae with thin-walled facets secreting solid wax filaments; galls without protruding needles, hair or waxy bloom ....***Adelges (Aphrastasia)*** Börner, 1909 and ***A. (Dreyfusia)*** Börner, 1908) p. 8

A8 (A7) Wax glands of overwintering larvae with double-walled facets secreting glossy, stiff, straight or curved tubes of wax; galls usually with protruding needles and hairs or waxy bloom A9

A9 (A10) Overwintering larvae (where known): dorsal sclerites bearing single larger wax pores ringed by small glands of irregular shape. Al. gallicola: ant. IV and V often with broad, indistinct basal articulation ..... ***Adelges (Adelges)*** Vallot, 1836 p. 9

A10 (A9) Overwintering larvae: dorsal sclerites with groups of similar-sized ring-like wax pores. Al. gallicola with basal articulation of ant. IV and V narrower ....***Adelges*** (***Gilletteella*** Börner, 1930 and ***Sacciphantes*** Curtis, 1844) p. 11

A11 (A4) Siphunculi present; adults without sclerotised ovipositor. Apterae rarely less than 1.2 mm; antennae at least 4-segmented .....**Aphididae** Latreille, 1802 A12

A12 (A13 A14) Siphunculi elongate, tubular ..... ***Elatobium*** Mordvilko, 1914, ***Aulacorthum*** Mordvilko, 1914, ***Neomyzus*** van der Goot, 1915 and ***Aphis*** Linnaeus, 1758 p. 12

A13 (A12 A14) Siphunculi present as pores not raised from body surface ....***Mindarus*** Koch, 1857 p. 14

A14 (A12 A13) Siphunculi present as large pores elevated on obtuse cones ....***Cinara*** Curtis, 1835 p. 14

A15 (A3) Aphids on roots of *Picea* A16

A16 (A17) Apterae 2–6 mm, with brown, green or blackish colours; siphunculi present as pores elevated on cones. On thick roots, usually ant-attended ....***Cinara*** Curtis, 1835 p. 17

A17 (A16) Apterae 0.5–2 mm, whitish, pale green or yellowish, exuding abundant white wax wool; siphunculi absent. On thin mycorrhizal root ends, not attended by ants ....**Eriosomatinae** Kirkaldy, 1905 p. 17

A1 (A2) Dichotomous key to galls on *Picea*

1. Gall pineapple-shaped, 8–30 mm long 2
– Gall elongate, 10–80 mm long 9

2. Gall with conspicuous needle-bearing shoot apically, bright, often with red or purple scale margins; finely pubescent, without wax dusting 3
– Needle-bearing apical shoot inconspicuous or absent; thinly wax-dusted, not pubescent 4

3. Galls usually gregarious, often along with galls from preceding years, opening in August or early September ..... ***Adelges (Sacciphantes) abietis*** (Linnaeus, 1758) p. 11
– Galls usually solitary, opening in July or early August ..... ***Adelges (Sacciphantes) viridis*** (Ratzeburg, 1843) p. 12

4. On *Picea orientalis*. Gall globular, red or pink when young, later on greenish with red or purple at bases and tips of scales ..... ***Adelges (Dreyfusia) nordmannianae*** (Eckstein, 1890) p. 8
and ..... ***Adelges (Dreyfusia) merkeri*** (Eichhorn, 1957) p. 9
– Usually on *Picea abies* or *P. sitchensis*. Gall dull green, brownish or pale yellow, often with pinkish tinge 5

5. Gall compact, cone-like, without protruding needles, dull green as young, later on reddish-brown ..... ***Adelges (Aphrastasia) pectinatae*** (Cholodkovsky, 1888) p. 8
– Gall with protruding needles, pale yellow, often with pinkish tinge; at maturity turning purple 6

6. Galls solitary 7
– Galls usually gregarious, often along with galls from preceding years 8

7. Galls opening in June–July; gallicolae blackish, secreting only little wax ..... ***Adelges (Adelges) laricis*** Vallot, 1836 p. 9
– Galls opening late June–September; gallicolae secrete abundant wax ..... ***Adelges (Adelges) tardoides*** (Cholodkovsky, 1911) p. 10

8. Galls opening in June–July; gallicolae dark red, secreting only little wax ..... ***Adelges (Adelges) lapponicus*** (Cholodkovsky, 1889) p. 9
– Galls opening August–September; gallicolae blackish brown, secreting abundant wax ..... ***Adelges (Adelges) tardus*** (Dreyfus, 1888) p. 10

9. Usually on *Picea sitchensis*. Needles from scale-like widened bases strongly protruding. Chambers separate with green, pink or red openings ..... ***Adelges (Gilletteella) cooleyi*** (Gillette, 1907) p. 11
– Gall with interconnected chambers and more or less decumbent needles 10

10. Gall with needles much paler than the normal new growth ..... ***Pineus (Pineus) similis*** (Gillette, 1907) p. 6
– Needles in gall not paler than normal new growth 11

11. Gall usually bent and distorting shoot tip, with more protruding needles, often directed to one side; usually on *Picea abies* ..... ***Pineus (Pineus) cembrae*** (Cholodkovsky, 1888) p. 7
– Gall short and more or less straight with decumbent needles evenly distributed to all sides, usually on *Picea orientalis* ..... ***Pineus (Pineus) orientalis*** (Dreyfus, 1889) p. 7

A2 (A1) Aphids on *Picea* A3
A3 (A15) On aerial parts of *Picea* A4
A4 (A11) Siphunculi absent; adults with sclerotised ovipositor. Apterae less than 1.2 mm, antennae at most 3-segmented..... **Adelgidae** Annand, 1928 A5

Superfamily Adelgoidea Annand, 1928

Family **Adelgidae** Annand, 1928

Diagnosis

Gall-inducing species belong here. Holocyclic species with 2-year life cycle (see Albrecht 2015; Blackman & Eastop 1994). The adelgids are not attended by ants.

A5 (A6) Abdomen (all morphs) with 4 pairs of evident spiracles (on abd. 2–5). Gall (when present) with interconnected chambers .....***Pineus*** Shimer, 1869

Genus *Pineus* Shimer, 1869
Subgenus *Pineus* Shimer, 1869

Pineus (Pineus) pineoides (Cholodkovsky, 1907)
Fig. 1

Diagnosis

Apterae (one morph only) 0.6–0.8 mm, yellowish-grey to red-brown, dorsoventrally flattened, wax-covered. Head and prothorax fused, strongly sclerotised. Alatae unknown. Anholocyclic on *Picea*. Free-living in bark crevices, under scales, etc. on shaded parts of trunk and branches; one summer and one winter generation per year.

Recorded hosts

Pinaceae: *Picea abies**, *omorika*.

Distribution

F.

Pineus (Pineus) similis (Gillette, 1907)

Diagnosis

In or near galls on shoots. Both apterous (uniquely) and al. gallicolae produced. Al. gallicolae 1–2 mm, dark reddish brown. Anholocyclic, monoecious on a wide range of *Picea* species. In North America *Picea abies*, *glauca*, *engelmanni*, *mariana*, *pungens*, *rubens*; in Britain colonising *P. sitchensis* (Carter 1976). Pseudofundatrices overwinter in the second or third instar under bud scales. In spring they cause rather loose galls 1–4 cm long, with the constituent needles much paler than the normal new growth. As the gall matures the shoot and needles become brown and twisted giving it a ragged appearance. Apterous gallicolae oviposit within the galls, but may also be found outside the galls, laying eggs in small tufts of

wax on the stem. Al. gallicolae, 1.0–2.1 mm, dark reddish-brown, fly in June–July to recolonise spruce needles, laying eggs in white wax wool. These apparently develop into the overwintering pseudofundatrix generation. Diagnosis based on Blackman & Eastop (2006).

Recorded hosts (in Britain)

Pinaceae: *Picea sitchensis.*

Distribution

North America, introduced to Europe (Britain).

Pineus (Pineus) cembrae (Cholodkovsky, 1888)
Fig. 2

Diagnosis

In or near galls on shoots. Abdomen of overwintering juv. fundatrix with spinal and pleural wax glands on all tergites. Adult fundatrix with spinopleural glands on terg. 1–3, 1–4 or 1–5, and well-developed marginal glands on terg. Al. gallicola 1.5–1.7 mm, dark red with abundant wax; primary rhinarium on ant. V not extending more than half-way around the segment. Gall 4–5 cm long, straight or bending the shoot tip and concentrating the protruding needles to one side. Holocyclic and dioecious, alternating between *Picea* and *Pinus* (see p. 30). Partly anholocyclic on *Pinus*.

Recorded primary hosts

Pinaceae: *Picea abies* (usually), *glehnii*, *jezoensis*, *koraiensis*, *orientalis*.

Distribution

F S.

Pineus (Pineus) orientalis (Dreyfus, 1889)
Figs 3–4

Diagnosis

In or near galls on shoots. Al. gallicola: 1.5–2.3 mm, primary rhinaria on ant. segment V extending more than half-way around the segment, usually not occupying more than half the length of the segment. Gall terminal, shorter (about 3 cm) and usually straighter than in *P. cembrae*, with needles more or less decumbent and distributed to all sides. Holocyclic and dioecious, alternating between *Picea* and *Pinus* (see also p. 30).

Recorded primary hosts

Pinaceae: *Picea jezoensis*, *orientalis**, *pungens*, *torano*, spp. (but not *abies*!).

Distribution

D F S.

Pineus (Pineus) strobi (Hartig, 1837)

Diagnosis

Anholocyclic on *Pinus strobus* (see p. 31). Al. sexuparae lay eggs on of *Picea mariana*, but no sexuales are produced (Blackman & Eastop 1994).

A6 (A5) Abdomen (all morphs) with 5 pairs of evident spiracles (on abd. 2–6). Gall with separate chambers A7

A7 (A8) Wax glands of overwintering larvae with thin-walled facets secreting solid wax filaments; galls without protruding needles, hair or waxy bloom .... ***Adelges*** (***Aphrastasia*** Börner, 1909 and ***Dreyfusia*** Börner, 1908)

Genus *Adelges* Vallot, 1836
Subgenus *Aphrastasia* Börner, 1909

Adelges (Aphrastasia) pectinatae (Cholodkovsky, 1888)
Fig. 5

Diagnosis

Fund. juv. with spinal, pleural and marginal wax pore plates. Al. gallicola reddish brown, wax glands on head and prothorax with many distinct facets; rhinaria on ant. III, IV and V occupying more than half segment length. Gall compact, cone-like, dull green as young, later reddish-brown, 10–17 mm. Holocyclic and dioecious, alternating between *Picea* and *Abies* (see also p. 20). In Finland *A. pectinatae* seems to be anholocyclic on *Abies*.

Recorded primary hosts

Pinaceae: *Picea abies*, *glauca*, *glehnii*, *jezoensis*, *koraiensis*, *sitchensis*.

Distribution

F N S.

Subgenus *Dreyfusia* Börner, 1908

Adelges (Dreyfusia) nordmannianae (Eckstein, 1890)
Fig. 6

Diagnosis

Fund. juv. only with spinal and marginal wax pore plates; wax pore plates on inner margins of meso- and metathoracic spinal sclerites with numerous small pits arranged in 2–4 areas of rather rounded shape. Al. gallicola: 1.1–2.3 mm, wax glands on head and prothorax of granular appearance, without or with a few indistinct facets. Galls 7–15 mm, terminal, globular, red when young (resembling strawberries), later greenish with red or purple at bases and tips of scales. Holocyclic and dioecious, alternating between *Picea orientalis* and *Abies* (see also p. 20).

Recorded primary hosts

Pinaceae: *Picea orientalis* (usually), *abies*, *omorika*.

Distribution

D N S.

Adelges (Dreyfusia) merkeri (Eichhorn, 1957)
Fig. 7

Diagnosis

Fund. juv. only with spinal and marginal wax pore plates; wax pore plates on inner margins of meso- and metathoracic spinal sclerites divided into 3–4 often angular areas with relatively large pits of irregular shape. Al. gallicola: wax glands on head and prothorax of granular appearance, without or with a few indistinct facets. Galls like those of *A. nordmannianae* but are usually larger (7–22 mm) and open in June–July. Holocyclic and dioecious, alternating between *Picea orientalis* and *Abies* (see also p. 21).

Recorded primary hosts

Pinaceae: *Picea orientalis*.

Distribution

S.

A8 (A7) Wax glands of overwintering larvae with double-walled facets secreting glossy, stiff, straight or curved tubes of wax; galls usually with protruding needles and hairs or waxy bloom A9

A9 (A10) Overwintering larvae (where known): dorsal sclerites bearing single larger wax pores ringed by small glands of irregular shape. Al. gallicola: ant. IV and V often with broad, indistinct basal articulation .....***Adelges (Adelges)*** Vallot, 1836

Subgenus *Adelges* Vallot, 1836

Adelges (Adelges) laricis Vallot, 1836
Figs 8–9

Diagnosis

Fundatrix about 2.5 mm, blue-green with long wax filaments. Al. gallicolae 1–2 mm, blackish, wax glands poorly developed, premarginal glands absent, wax wool sparsely produced; head with 4 separate wax gland plates; ant. III shorter than IV. Galls 5–15 mm, pale yellowish with a waxy texture, often with a slight pinkish tinge, widely dispersed, usually singly on their branch; terminal or with very restricted plant growth beyond the gall; chambers not completely closed: nymphs often seen on outer gall surface. Galls opening in June–July. Holocyclic and dioecious, alternating between *Picea* and *Larix* (see also p. 24). Mixed spruce forests, rarely in moist or shady positions, also on solitary trees.

Recorded primary hosts

Pinaceae: *Picea abies**, *glauca*, *koraiensis*, *mariana*, *orientalis*, *pungens*, *sitchensis*.

Distribution

D F N S.

Adelges (Adelges) lapponicus (Cholodkovsky, 1889)

Diagnosis

Similar to *A. laricis*. Al. gallicolae dark red, 1.5 mm, laying eggs hardly covered with wax. Anholocyclic on *Picea*. Mixed spruce forests. Usually flying only a short distance. Galls normally many together,

along with galls from preceding years, opening in June–July. Gallicolae dark red, secreting only little wax.

Recorded hosts

Pinaceae: *Picea abies**, *glauca**, *jezoensis*, *mariana*, *pungens*, *sitchensis*.

Distribution

F.

Adelges (Adelges) tardoides (Cholodkovsky, 1911)

Diagnosis

In most respects similar to *A. laricis*. Al. gallicolae: ant. III longer than IV; glands (including premarginal) developed, abundant wax wool produced. Holocyclic and dioecious, alternating between *Picea* and *Larix* (see also p. 25). Galls 5–15 mm, widely dispersed, usually singly on their branch, opening late June–September. Gallicolae emerge from late July to August; secreting abundant wax.

Recorded primary hosts

Pinaceae: *Picea abies*.

Distribution

Europe. Not yet in the Nordic countries.

Adelges (Adelges) tardus (Dreyfus, 1888)
Figs 10–14

Diagnosis

Overwintering pseudofundatrix nymphs 0.3–0.4 mm, blackish with sparse, glossy grey, stiff, almost straight wax filaments. Al. gallicolae: 1–2 mm; ant. III longer than IV; glands (including premarginal) developed, blackish with reddish brown abdomen exuding abundant fine wax wool. They remain in the vicinity or their gall, laying eggs covered with abundant wax. Galls as in *A. laricis*, but gregarious, along with galls from preceding years, opening in August–September. Gall chambers not completely closed: nymphs can frequently be seen on the outer surface. Gallicolae blackish, secreting abundant wax. Anholocyclic on *Picea*. Usually on trees in rather open position: clearings, forest margins, solitary spruces and spruce hedges. Galls frequently intermixed with galls of *Adelges abietis*. Overwintering pseudofundatrices seem to prefer the surface of buds, not their bases as in *A. abietis* (according to my own records from Finland).

Recorded hosts

Pinaceae: *Picea abies**, *glauca*, *pungens*, *sitchensis*.

Distribution

D F S.

A10 (A9) Overwintering larvae: Dorsal sclerites with groups of similar-sized ring-like wax pores. Al. gallicola with basal articulation of ant. IV and V narrower ....***Adelges*** (***Gilletteella*** Börner, 1930 and ***Sacciphantes*** Curtis, 1844)

Subgenus *Gilletteella* Börner, 1930

Adelges (Gilletteella) cooleyi (Gillette, 1907)
Figs 15–16

Diagnosis

Fund. juv: dorsal sclerites with groups of 8–30 ring-like wax pores. Al. gallicola: 1.7–2.5 mm, wax glands on head and prothorax of al. gallicola with large distinct facets; rhinaria on ant. III–V transverse, slit-like. Gall 25–80 mm, spindle-shaped, needles from widened bases strongly protruding. Chambers separate with green, pink or red openings. Holocyclic and dioecious, alternating between *Picea* and *Pseudotsuga* (p. 28).

Recorded primary hosts

Pinaceae: *Picea sitchensis* (usually), *engelmannii*, *glauca*, *jezoensis*, *mariana*, *pungens*.

Distribution

D F N S.

Subgenus *Sacciphantes* Curtis, 1844

Adelges (Sacciphantes) abietis (Linnaeus, 1758)
Figs 17–21

Diagnosis

First instar pseudofundatrix about 0.5 mm, greyish brown; prothoracic pleurospinal sclerites longer than broad; dorsal sclerites with groups of 2–7 ring-like wax pores. Second instar nymphs in winter about 0.6–0.8 mm. Wax filaments of overwintering nymphs numerous, long, glossy grey, stiff, curled in all directions. Adult pseudofundatrix greyish or yellowish brown, exuding abundant fine, white wax wool. Al. gallicola 1.8–2.3 mm, brown to brownish black with thin greyish wax dusting and transverse white wax markings; abdomen yellowish brown; wax wool production fairly weak. Wax glands on head and prothorax absent or indistinct, without clear facets; rhinaria on antennal segments III–V oval to circular. Eggs brownish yellow. Anholocyclic on *Picea*, occurring in many habitats, usually 1–2 m above ground. In open positions such as forest margins, clearings and solitary trees, the scale margins of the galls become bright red or purple, whereas galls in shaded positions are less strikingly coloured.

The pseudofundatrices hibernate at bud bases and in bud axils, in contrast to *A. tardus* which prefers the surface of the buds (my own records from Finland). Second instar pseudofundatrices can be found from late autumn onwards, but first instar nymphs may occur as late as in February (according to my own records from S. Finland). Galls 15–35 mm, usually gregarious, pineapple-shaped with needle-bearing shoot apically, bright green with purple, red, pink or brownish (rarely green) scale margins. Scales pubescent, particularly along margins. They often occur along with galls from preceding years and with galls of *Adelges tardus*; opening in August–early September. Gall chambers completely closed: no nymphs occur on outer surface.

Recorded hosts

Pinaceae: *Picea abies**, *engelmannii*, *glauca*, *jezoensis*, *orientalis*, *pungens*, *sitchensis*, spp.

Distribution

D F N S.

Adelges (Sacciphantes) viridis (Ratzeburg, 1843)
Figs 22–23

Diagnosis

Overwintering first instar fundatrix dark green; dorsal sclerites with groups of 2–7 ring-like wax pores; prothoracic pleurospinal sclerites almost square.

Al. gallicola about 2 mm, dark olive to blackish with thin greyish wax dusting and transverse white wax markings; abdomen greenish or olive brown; wax wool production weak. Wax glands on head and prothorax absent or indistinct, without clear facets; rhinaria on ant. III–V oval to circular. Eggs green. Galls solitary, otherwise as in *A. abietis*. Holocyclic and dioecious, alternating between *Picea* and *Larix*.

Recorded primary hosts

Pinaceae: *Picea abies**, *engelmannii*, *glauca**, *koraiensis*, *omorika*, *orientalis*, *pungens*, *sitchensis*, spp.

Distribution

F.

A11 (A4) Siphunculi present; adults without sclerotised ovipositor. Apterae rarely less than 1.2 mm; antennae at least 4-segmented ..... **Aphididae** Latreille, 1802 A12

Superfamily Aphidoidea Latreille, 1802

Family **Aphididae** Latreille, 1802

A12 (A13 A14) Siphunculi elongate, tubular ..... ***Elatobium*** Mordvilko, 1914, ***Aulacorthum*** Mordvilko, 1914, ***Neomyzus*** van der Goot, 1915 and ***Aphis*** Linnaeus, 1758

Subfamily Aphidinae Latreille, 1802
Tribe Macrosiphini Wilson, 1910
Genus *Elatobium* Mordvilko, 1914

Elatobium abietinum (Walker, 1849)
Fig. 24

Diagnosis

Aptera 1–2 mm, pale green to yellowish, without wax wool. Holocyclic, monoecious. In small groups on needles of *Picea* (rarely other genera), causing discoloration and loss of older needles. Not attended by ants.

Recorded coniferous hosts

Pinaceae: *Picea abies**, *engelmanni*, *glauca*, *glehnii*, *jezoensis*, *mariana*, *omorika*, *orientalis*, *pungens**, *sitchensis*, *tianschanica*; *Abies cephalonica*, *homolepis*, *lasiocarpa*, *nordmanniana*, spp.; *Pseudotsuga menziesii*; *Pinus sibirica*.

Distribution

D F Fa I N S.

Genus *Aulacorthum* Mordvilko, 1914
Subgenus *Aulacorthum* Mordvilko, 1914

Aulacorthum (Aulacorthum) solani (Kaltenbach, 1843)
Fig. 25

Diagnosis

Aptera 1.2–2.6 mm, green with dark green spots in front of siphunculi. Polyphagous, very rarely on conifers. Not ant-attended.

Recorded coniferous hosts

Pinaceae: *Picea abies*, *sitchensis*.

Distribution

D F I N S.

Genus *Neomyzus* van der Goot, 1915

Neomyzus circumflexus (Buckton, 1876)

Diagnosis

Whitish, yellow or green; resembling *Aulacorthum solani*, but abdomen with brown or black markings, usually including a horseshoe-shaped patch. Polyphagous, very rarely on conifers. Not ant-attended.

Recorded coniferous hosts

Pinaceae: *Picea sitchensis*.

Distribution

D F N S.

Tribe Aphidini Latreille, 1802
Subtribe Aphidina Latreille, 1802
Genus *Aphis* Linnaeus, 1758
Subgenus *Aphis* Linnaeus, 1758

Aphis (Aphis) fabae Scopoli, 1763
Fig. 26

Diagnosis

Aptera 1.5–3 mm, dull black; legs and antennae partly white; abdomen sometimes with white wax markings; usually ant-attended. Polyphagous species (or group of species). Holocyclic and dioecious, primary hosts are *Euonymus* (Celastraceae), *Philadelphus* (Hydrangeaceae) and *Viburnum* (Adoxaceae). Numerous plants, mostly herbs, serve as secondary hosts. Only occasionally on conifers. Often attended by ants, but none recorded from conifers.

Recorded coniferous hosts

Pinaceae: *Picea sitchensis*; *Larix decidua*, *kaempferi*; *Tsuga heterophylla*; *Pinus contorta*.

Distribution

D S N F I.

A13 (A12 A14) Siphunculi present as pores not raised from body surface .....***Mindarus*** Koch, 1857

Subfamily Mindarinae Tullgren, 1909
Genus *Mindarus* Koch, 1857

Mindarus obliquus (Cholodkovsky, 1896)
Fig. 27

Diagnosis

Aptera 1.0–1.9 mm, pale yellowish green, with wax dusting, fine wax wool and thick, irregularly bent wax filaments yellowish green, very similar to *M. abietis* on *Abies*.

Three generations per year: fundatrix, al. and apterous progeny of the fundatrix and dwarfish sexuales. Holocyclic, monoecious on *Picea*. Colonies between needles of young shoots, not causing deformation. Sometimes attended by ants.

Recorded hosts

Pinaceae *Picea engelmannii*, *glauca**, *mariana*, *omorika*, *sitchensis*, spp. (but not *abies*).

Recorded attendant ants

Formicinae: *Lasius niger**.

Distribution

D F N S.

A14 (A12 A13) Siphunculi present as large pores elevated on obtuse cones ..... ***Cinara*** Curtis, 1835

Subfamily Lachninae Herrich-Schaeffer, 1854
Tribe Eulachnini Baker, 1920
Genus *Cinara* Curtis, 1835
Subgenus *Cinara* Curtis, 1835

Cinara (Cinara) piceae (Panzer, 1801)
Figs 28–29

Diagnosis

Aptera 4.5–7 mm, black, semi-matt with glossy sclerites, legs and antennae partly brownish red. Holocyclic, monoecious on *Picea.* Spruce and mixed forests. In dense colonies on stem and underside of branches, often high up in the trees, particularly on twigs with developing cones. Often also on young solitary spruces. Usually ant-attended. Moves restlessly around when disturbed and often falls to the ground where it may move to exposed roots.

Recorded hosts

Pinaceae: *Picea abies**, *glauca*, *omorika*, *orientalis*, *pungens*, *sitchensis*, *tianschanica*, spp. (Due to the agility of *C. piceae* and the similarity between *C. piceae* and *C. curvipes*, I suggest that records from *Abies* and other genera should be confirmed.)

Recorded attendant ants

Formicinae: *Camponotus herculeanus**; *Formica polyctena**, *truncorum**; *Lasius niger**.

Distribution

D F N S.

Cinara (Cinara) pilicornis (Hartig, 1841)
Figs 30–31

Diagnosis

Aptera 2.1–4.7 mm, light red-brown, orange brown, olive or grey-green; abdominal dorsum usually with a conspicuous wax pattern The thickness of the wax cover varies considerably and wears easily off. Siphuncular cones small, brown or greenish black. Legs and antennae pale. Second segment of hind tarsus long and conspicuously curved. Hairs very long; on antennal segment 3, 2–3 times the diameter of the segment or even more. Alatae with abundant wax wool. Holocyclic, monoecious on *Picea*, also on *Tsuga.* Found in forest margins, clearings, often on solitary trees. Colonies on undersides of previous year's twigs, during summer colonising current year's shoots. Often ant-attended.

Recorded hosts

Pinaceae: *Picea abies**, *engelmannii*, *glauca**, *omorika**, *orientalis*, *pungens*, *sitchensis*, *tianschanica*, spp.; *Tsuga heterophylla*?

Recorded attendant ants

Formicinae: *Formica aquilonia**, *fusca**, *truncorum**; *Lasius niger**. Myrmicinae: *Myrmica rubra**.

Distribution

D F I N S.

Cinara (Cinara) costata (Zetterstedt, 1828)
Figs 32–33

Diagnosis

Apterae 2.5–3.5 mm, light brownish with olive green blackish pleural longitudinal bands forming a bottle-shaped pattern, and transverse bronzy stripes posteriorly; the dark parts with a characteristic metallic sheen. The wax cover is often heavy and obscures the underlying pattern, at least interrupting the longitudinal bands. Sometimes whole colonies may be covered in wax. Holocyclic, monoecious on *Picea*. Found in margins and clearings of spruce or mixed forests. In small, dense, wax-covered colonies on lignified twigs, usually on lower branches of tall trees. Normally not attended by ants.

Recorded hosts

Pinaceae: *Picea abies**, *engelmannii*, *glauca**, *omorika**, *orientalis*, *pungens**, *sitchensis*, *tianschanica*, spp.

Distribution

D F N S.

Cinara (Cinara) pruinosa (Hartig, 1841)
Figs 34–37

Diagnosis

Apterae 3–5.0 mm, olive or brown with dark green to black marking bands interrupted by transverse streaks and patches of wax dust. Often with metallic sheen. Adults with large black siphuncular cones. Holocyclic, monoecious on *Picea*. Colonies on branch undersides, shoots and trunks, later in summer also on roots. Usually ant-attended.

Recorded hosts

Pinaceae: *Picea abies**, *glauca*, *orientalis*, *pungens*, *sitchensis*, *tianschanica*, spp.

Recorded attendant ants

Formicinae: *Formica aquilonia**, *lugubris**, *polyctena**, *truncorum**; *Lasius niger**. Myrmicinae: *Myrmica rubra**, *ruginodis**.

Distribution

D F N S.

Cinara (Cinara) piceicola (Cholodkovsky, 1896)
Figs 38–39

Diagnosis

Apterae 2–4.2 mm, grey-green, olive or pale brown with darker head and thorax and two longitudinal darker stripes. Siphuncular cones small, inconspicuous. Holocyclic, monoecious on *Picea*. Colonies on lignified shoots and branches, on tall as well as small spruces, in summer also on subterraneous parts. Often at ground level on dwarfish spruces on sandy ground at roadsides and ditch margins. Usually ant-attended.

Recorded hosts

Pinaceae: *Picea abies**, *glauca*, *orientalis*, *pungens*, *sitchensis*, spp.

Recorded attendant ants

Formicinae: *Formica aquilonia**, *lugubris**, *pratensis**, *sanguinea**, *truncorum**; *Lasius fuliginosus**, *niger**. Myrmicinae: *Myrmica rubra**.

Distribution

D F N S.

A15 (A3) Aphids on roots of *Picea* A16
A16 (A17) Apterae 2–6 mm, with brown, green or blackish colours; siphunculi present as pores elevated on cones. On thick roots, usually ant-attended .... ***Cinara*** Curtis, 1835 go to entry point A14 (p. 14)
A17 (A16) Apterae 0.5–2 mm, whitish, pale green or yellowish, exuding abundant white wax wool; siphunculi absent. On thin mycorrhizal root ends, not attended by ants ....**Eriosomatinae** Kirkaldy, 1905

Subfamily **Eriosomatinae** Kirkaldy, 1905

For key and diagnoses, see Albrecht (2015: 8, key A).

Tribe Pemphigini Herrich-Schaeffer, 1854
Genus *Pachypappella* Baker, 1920

Pachypappella lactea (Tullgren, 1909)

Diagnosis

Holocyclic, dioecious, alternating between *Populus tremula* (Salicaceae) and *Picea*, and maintaining a continuous anholocyclic population on *Picea*.

Recorded secondary hosts

Pinaceae: *Picea abies**, *sitchensis*.

Distribution

D F S.

Genus *Pachypappa* Koch, 1856

Pachypappa populi (Linnaeus, 1758)

Diagnosis

Holocyclic, dioecious, alternating between *Populus tremula* and *Picea*. Anholocyclic hibernation on roots of *Picea* is common.

Recorded secondary hosts

Pinaceae: *Picea abies**.

Distribution

F N S.

Pachypappa tremulae (Linnaeus, 1761)

Diagnosis

Holocyclic, dioecious, alternating between *Populus tremula* (Salicaceae) and *Picea*. Anholocyclic hibernation on roots of *Picea* is common.

Recorded secondary hosts

Pinaceae: *Picea abies**, *orientalis*, *sitchensis*.

Distribution

D F N S.

Pachypappa vesicalis Koch, 1856

Diagnosis

Holocyclic, dioecious, alternating between *Populus alba* (Salicaceae) and Pinaceae: *Picea* and *Pseudotsuga*.

Recorded secondary hosts

Pinaceae: *Picea abies**, *glauca*, *sitchensis*; *Pseudotsuga menziesii*.

Distribution

F S.

Genus *Prociphilus* Tullgren, 1925
Subgenus *Stagona* Koch, 1857

Prociphilus (Stagona) xylostei (De Geer, 1773)

Diagnosis

Holocyclic and dioecious, alternating between *Lonicera* (Caprifoliaceae) and *Picea.* An anholocyclic population on *Picea* roots is upheld throughout the year. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Picea abies**, *glauca*, *sitchensis*; *Pseudotsuga menziesii*. According to Holman (2009) also on *Abies*.

Distribution

D F N S.

*Key B. Aphids on fir (*Abies*)*

Synopsis

B1 (B8) Body, at least in adults, covered with white wax wool, filaments or ribbons; siphunculi absent B2

B2 (B3) On roots, forming colonies embedded in wax wool ..... ***Prociphilus*** Koch, 1857 p. 19

B3 (B2) On aerial parts of the tree B4

B4 (B7) Antennae at most 3-segmented. Scattered on bark or needles B5

B5 (B6) On needles ..... ***Adelges (Aphrastasia)*** Börner, 1909 p. 20

B6 (B5) On bark of stems, branches and twigs ..... ***Adelges (Dreyfusia)*** Börner, 1908 p. 20

B7 (B4) Antennae 6-segmented. In colonies between needles of young shoots ..... ***Mindarus*** Koch, 1857 p. 21

B8 (B1) Wax, if present, in the form of dusting, siphunculi present B9

B9 (B10) Siphunculi present as pores raised on cones ..... ***Cinara*** Curtis, 1835 p. 22

B10 (B9) Siphunculi tubular ..... ***Elatobium*** Mordvilko, 1914 p. 23

B1 (B8) Body, at least in adults, covered with white wax wool, filaments or ribbons; siphunculi absent B2

B2 (B3) On roots, forming colonies embedded in wax wool .....***Prociphilus*** Koch, 1857

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802
Subfamily Eriosomatinae Kirkaldy, 1905
Tribe Pemphigini Herrich-Schaeffer, 1854
Genus *Prociphilus* Koch, 1857
Subgenus *Prociphilus* Koch, 1857

Prociphilus (Prociphilus) bumeliae (Schrank, 1801)
Fig. 40

Diagnosis

Apterae about 2.9 mm, covered with wax wool. Two pairs of wax gland plates on head, of which the posterior ones better developed than the anterior. A narrow pale subapical zone on RIV+V present. Diagnosis based on Heie (2004). Holocyclic and dioecious, alternating between ash *Fraxinus excelsior* (sometimes other Oleaceae such as *Ligustrum* and *Syringa*) and *Abies*, where it feeds in wax-covered colonies on the roots. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Abies alba*, *veitchii*, spp.

Distribution

D F S.

Prociphilus (Prociphilus) fraxini (Fabricius, 1777)

Diagnosis

Apterae 1.8–2.7 mm, pale, wax-covered. Very similar to *P. bumeliae*, but with posterior wax gland plates on head weakly developed, sometimes absent. Diagnosis based on Heie (2004). Holocyclic and dioecious, alternating between *Fraxinus excelsior* (Oleaceae) and roots of *Abies*, where wax-covered colonies are formed. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Abies alba*, *balsamea*, *nordmanniana*, *sibirica*, spp.

Distribution

D N S.

Remarks

Holman (2009) also lists *Prociphilus (Stagona) xylostei* from *Abies* roots. See under *Picea* (entry A17, p. 17).

B3 (B2) On aerial parts of the tree B4
B4 (B7) Antennae at most 3-segmented. Scattered on bark or needles B5
B5 (B6) On needles .....***Adelges (Aphrastasia)*** Börner, 1909

Superfamily Adelgoidea Annand, 1928
Family Adelgidae Annand, 1928
Genus *Adelges* Vallot, 1836
Subgenus *Aphrastia* Börner, 1909

Adelges (Aphrastasia) pectinatae (Cholodkovsky, 1888)
Figs 41–44

Diagnosis

Neosistens 0.3–0.4 mm, shiny black with a double spinal crest and a marginal rim of more or less curly wax ribbons, and a posterior tuft of wax wool. Older sistentes and progredientes dark grey, embedded in a tuft of thick, stiff, 'half-pipe' shaped wax filaments. Spinal and pleural sclerites fused on all segments, and spinopleural sclerites also fused to marginal sclerites of abdominal tergites 6–8. Older sistentes and progredientes dark grey to purplish grey, richly exuding thick, curly wax filaments. Holocyclic and dioecious, alternating between spruce (*Picea*, p. 8) and fir (*Abies*). Predominantly in parks and plantations, scattered on needles, both upper- and undersides, often in great number. Not ant-attended. Apparently predominantly anholocyclic on *Abies*. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Abies alba**, *amabilis**, *balsamea**, *concolor**, *fraseri**, *grandis**, *koreana**, *lasiocarpa**, *nordmanniana*, *procera*, *sibirica**, *veichtii*, spp.

Distribution

F N S.

B6 (B5) On bark of stems, branches and twigs .....***Adelges (Dreyfusia)*** Börner, 1908

Subgenus *Dreyfusia* Börner, 1908

Adelges (Dreyfusia) nordmannianae (Eckstein, 1890)
Figs 45–46

Diagnosis

Neosistens rather similar to those of *A. pectinatae* (see above), but wax ribbons thinner and more strongly curled, and spinal and pleural sclerites on mesothorax, metathorax and abdominal tergites 1–5 separate (although sometimes touching). Older sistentes and progredientes dark grey, embedded in fine, curly wax wool. Wax pore plates on inner margins of meso- and metathoracic spinal sclerites containing numerous small, mostly rounded, pits arranged in 2–4 areas of rather rounded shape, the most central area containing 7–12 pits. Found on bark, usually on young branches and twigs, single specimens occasionally on needles (my own record). Not ant-attended.

Recorded secondary hosts

Pinaceae: *Abies alba**, *balsamea*, *cephalonica*, *concolor*, *grandis*, *nordmanniana*, *procera*, *sibirica*, *veitchii*, spp.

Distribution

D N S.

Adelges (Dreyfusia) merkeri (Eichhorn, 1957)

Diagnosis

Similar to *A. nordmannianae.* Neosistens: wax pore plates on inner margins of meso- and metathoracic spinal sclerites divided into 3–4 rounded areas, each with 3–8 pits. Total number of pits on the 10 central areas 26–63 (usually more than 40) (Blackman & Eastop 1994, 2014). Holocyclic and dioecious, alternating between *Picea orientalis* (p. 9) and *Abies alba*. Scattered on trunk and older branches, on all parts of seedlings. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Abies alba*. Holman (2009) also lists *A. nordmanniana*.

Distribution

S.

Adelges (Dreyfusia) piceae (Ratzeburg, 1843)
Fig. 47

Diagnosis

Similar to *A. merkeri* but neosistens with central areas of wax pore plates on meso- and metathoracic spinal sclerites often more-or-less triangular, each with 3–6 pits. Total number of pits on 10 central areas 18–59, usually less than 40. The characters distinguishing *A. piceae* and *A. merkeri* are variable, and the identification requires several specimens (Blackman & Eastop 2006; Heie 2004). Monoecious, anholocyclic on *Abies*. Found on trunk and branches. Not ant-attended.

Recorded hosts

Pinaceae: *Abies alba*, *amabilis*, *balsamea*, *concolor*, *lasiocarpa*, *nordmanniana*, *sibirica*, spp.

Distribution

D.

B7 (B4) Antennae 6-segmented. In colonies between needles of young shoots.....
.....***Mindarus*** Koch, 1857

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802
Subfamily Mindarinae Tullgren, 1909
Genus *Mindarus* Koch, 1857

Mindarus abietinus (Koch, 1857)
Figs 48–49.

Diagnosis

Aptera 1.7–2.0 mm, pale green, with wax dusting, fine wax wool and thick, irregularly bent wax filaments. Alata pale green with transverse sclerites on abd. dorsum, body and appendages with short,

fine wax wool. Holocyclic, monoecious on *Abies*. In colonies between needles on young shoots. Only 3 generations per year. Sexuales dwarfish, in June–July. Not ant-attended.

Recorded hosts

Pinaceae: *Abies alba*, *balsamea*, *cephalonica*, *concolor*, *grandis*, *homolepis*, *lasiocarpa*, *nordmanniana*, *pindrow*, *procera*, *sibirica**; *Pseudotsuga menziesii.*

Distribution

D F N S.

B8 (B1) Wax, if present, in the form of dusting, siphunculi present B9
B9 (B10) Siphunculi present as pores raised on cones ..... ***Cinara*** Curtis, 1835

Subfamily Lachninae Herrich-Schaeffer, 1854
Tribe Eulachnini Baker, 1920
Genus *Cinara* Curtis, 1835
Subgenus *Cinara* Curtis, 1835

Cinara (Cinara) confinis Koch, 1856
Figs 50–52

Diagnosis

Siphunculi short and raised on cones. Aptera 3.8–7.5 mm, dark brown to brownish black with a bronzy sheen, legs predominantly black. Venter and segment borders thinly wax-dusted. Siphunculi short, raised on cones. Holocyclic and monoecious on *Abies*. Forming colonies, often dense, on young parts of trunks and underside of branches. Sometimes ant-attended.

Recorded hosts

Pinaceae: *Abies alba*, *balsamea*, *cephalonica*, *concolor*, *grandis*, *holophylla**, *lasiocarpa*, *nordmanniana*, *pindrow*, *procera*, *sibirica**, spp.

Recorded attendant ants

Formicinae: *Formica rufa**.

Distribution

D F N S.

Cinara (Cinara) curvipes (Patch, 1912)
Fig. 53

Diagnosis

Aptera 3.4–5.5 mm subshining black, legs orange to red-brown, tarsi and hind tibiae partly black. Juveniles and adults in summer with a thin but rather dense greyish wax cover. Siphunculi short, raised on cones. In appearance similar to *C. piceae* (see under *Picea*, entry A14, p. 14). Holocyclic and monoecious on *Abies* (and *Cedrus*). On trunk and branches. Sometimes attended by ants.

Recorded hosts

Pinaceae: *Abies balsamea*, *concolor*, *koreana*, *lasiocarpa*, spp.; *Cedrus deodara*.

Recorded attendant ants

Formica rufa (group?).

Distribution

Introduced from North America. Not yet in the Nordic countries, but widespread in Central and Western Europe.

Cinara (Cinara) pectinatae Nördlinger, 1880
Figs 54–55

Diagnosis

Aptera 2.8–5 mm, bright green. Abdomen dorsally with diffuse whitish longitudinal bands, juveniles often with an additional whitish spinal streak; legs infuscate; eyes red. Underside and segment borders on thorax thinly wax-dusted. Holocyclic, monoecious on *Abies*. In small groups or colonies on young trunks and underside of lignified branches, sometimes ant-attended.

Recorded attendant ants

Formicinae: *Formica polyctena**.

Recorded hosts

Pinaceae: *Abies alba** (usually), *balsamea*, *grandis*, *nordmanniana*, *sibirica* spp.

Distribution

D N S.

B10 (B9) Siphunculi tubular ..... ***Elatobium*** Mordvilko, 1914

Subfamily Aphidinae Latreille, 1802
Tribe Macrosiphini Wilson, 1910
Genus *Elatobium* Mordvilko, 1914

Elatobium abietinum Walker, 1849

Diagnosis

Aptera 1–2 mm, green to yellowish, without wax wool. On needles, rarely on *Abies*. See under *Picea* (entry A12, p. 12).

*Key C. Aphids on larch (*Larix*)*

Synopsis

C1 (C2) Siphunculi absent. Apterae: antennae with at most 3 segments. Body less than 2.5 mm, often covered with white wax wool or filaments ..... ***Adelges*** Vallot, 1836 p. 24

C2 (C1) Siphunculi present. Antennae with at least 4 segments. Body usually larger than 2.5 mm. Wax, if present, in the form of dusting or well-defined pattern C3

C3 (C4) Siphunculi present as pores raised on cones ..... ***Cinara*** Curtis, 1835 p. 26

C4 (C3) Siphunculi elongate, tubular ..... ***Aphis*** Linnaeus, 1758 p. 27

C1 (C2) Siphunculi absent. Apterae: antennae with at most 3 segments. Body less than 2.5 mm, often covered with white wax wool or filaments ..... ***Adelges*** Vallot, 1836

Superfamily Adelgoidea Annand, 1928
Family Adelgidae Annand, 1928
Genus *Adelges* Vallot, 1836
Subgenus *Sacciphantes* Curtis, 1844

Adelges (Sacciphantes) viridis (Ratzeburg, 1843)
Figs 56–57

Diagnosis

Neosistens: 0.5–0.8 mm, dull green with small, roundish wax gland plates on head, thorax and abdomen. Wax glands with double-walled facets secreting hollow tubes of wax. Sexuparae on *Larix* in spring pale greenish with sparse wax secretion. Aptera in summer covered with fine wax wool. Alatae 1.3–1.7 mm. Holocyclic and dioecious, alternating between *Picea* and *Larix*. On *Larix* overwintering at bud bases or in bark crevices on twigs and branches. In spring and summer on needles. Not ant-attended.

Recorded secondary hosts

Pinaceae: *L. decidua**, *decidua x kaempferi*, *kaempferi*, *sibirica**, spp.

Distribution

F.

Subgenus *Adelges* Vallot, 1836

Adelges (Adelges) laricis Vallot, 1836
Figs 58–61

Diagnosis

Neosistens: About 0.3 mm, brownish black, without wax secretion. Dorsal plates of head and thorax fused. Dorsum heavily sclerotised and somewhat wrinkled. Adult aptera oval or sub-circular, blackish or dark grey, about 1 mm., usually with wax wool. Alata 1.0–1.5 mm, head with anterior and posterior wax gland areas, if present, usually separate. Al. gallicola (migrating from *Picea*) with poorly developed wax secretion. Holocyclic and dioecious, alternating between *Picea* (p. 9) and *Larix*. On *Larix* overwintering at bud bases or in bark crevices on twigs and branches. In spring and summer on needles. Not ant-attended.

Recorded secondary hosts

Pinaceae: *Larix decidua**, *decidua x kaempferi*, *gmelinii*, *kaempferi**, *laricina**, *lyallii**, *sibirica**, spp.

Distribution

D F N S.

Adelges (Adelges) tardoides (Cholodkovsky, 1911)

Diagnosis

In most respects similar to *A. laricis*. The al. gallicolae secrete abundant wax. Holocyclic and dioecious, alternating between *Picea* (p. 10) and *Larix*.

Recorded secondary hosts

Pinaceae: *Larix sibirica.*

Distribution

Europe. Not recorded in the Nordic countries.

Subgenus *Cholodkovskya* Börner, 1909

Adelges (Cholodkovskya) viridanus (Cholodkovsky, 1896)
Fig. 62

Diagnosis

Neosistens: 0.6–0.7 mm, yellow or yellow-green; dorsal plates of head and thorax separate; head with 5 pairs of small wax gland fields; dorsum membranous. Adult sistens pyriform, yellowish green, with wax wool, 1.8–2.5 mm. Eggs yellow. Alatae 2.0–2.6 mm, greenish grey, head with anterior and posterior wax gland areas united. Anholocyclic on *Larix*. On needles in summer, overwintering in bark crevices. Not ant-attended.

Recorded hosts

Pinaceae: *Larix decidua x kaempferi*, *gmelini*, *kaempferi*, *sibirica*, spp.

Distribution

S.

Adelges (Cholodkovskya) viridulus (Cholodkovsky, 1911)

Diagnosis

Very similar to *A. viridanus*. Neosistens with fewer wax pores on posterior abdominal segments than *A. viridanus* (Blackman & Eastop 2016). Anholocyclic on *Larix*.

Recorded hosts

Pinaceae: *Larix sibirica*.

Distribution

Northern Russia.

C2 (C1) Siphunculi present. Antennae with at least 4 segments. Body usually larger than 2.5 mm. Wax, if present, in the form of dusting or well-defined pattern C3

C3 (C4) Siphunculi present as pores raised on cones ..... ***Cinara*** Curtis, 1835

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802
Subfamily Lachninae Herrich-Schaeffer, 1854
Tribe Eulachnini Baker, 1920
Genus *Cinara* Curtis, 1835
Subgenus *Cinara* Curtis, 1835

Cinara (Cinara) laricis (Hartig, 1839)
Figs 63–65

Diagnosis

Aptera 3–5 mm, subshining brown with numerous small black hair-bearing sclerites and usually with a greyish wax bloom pattern rendering a conspicuous chequered appearance. Holocyclic, monoecious on *Larix*. Found in forest margins, meadows, parks, plantations etc. In small colonies or scattered along 1–3 year-old twigs of tall trees, on young shoots and cones, and trunks of young trees. Sometimes ant-attended.

Recorded hosts

Pinaceae: *Larix decidua**, *decidua x kaempferi*, *gmelinii*, *leptolepis*, *sibirica**.

Recorded attendant ants

Formicinae: *Formica rufa**; *Lasius niger**.

Distribution

D F S B.

Cinara (Cinara) cuneomaculata (del Guercio, 1909)
Figs 66–68

Diagnosis

Aptera 2.3–4.5 mm, olive brown to dark purplish brown, subshining with a thin greyish wax bloom ventrally and also as a transverse pattern on dorsum, much like the pattern of *C. laricis*. Small, hair-bearing sclerites absent. Holocyclic, monoecious on *Larix*. Found in forest margins, meadowland etc. In small colonies or scattered along young twigs (usually 0–2 years old). Often ant-attended.

Recorded hosts

Pinaceae: *Larix decidua**, *kaempferi**, *laricina*, *sibirica**, spp.

Recorded attendant ants

Formicinae: *Formica rufa**.

Distribution

D F S.

Cinara (Cinara) kochiana (Börner, 1939)
Fig. 69

Diagnosis

Aptera 4–6 mm, brown to greyish-brown, slightly wax-powdered on dorsum. Monoecious, holocyclic on *Larix*. In colonies in bark crevices on lower part of trunk or bases of older branches, also on more or less exposed roots. Usually ant-attended. Diagnosis based on Heie (2004).

Recorded hosts

Pinaceae: *Larix decidua*, *gmelinii*, *kaempferi*, *sibirica.*

Recorded attendant ants

Formicinae: *Formica lugubris.*

Distribution

D S.

C4 (C3) Siphunculi elongate, tubular ..... ***Aphis*** Linnaeus, 1758

Subfamily Aphidinae Latreille, 1802
Tribe Aphidini Latreille, 1802
Subtribe Aphidina Latreille, 1802
Genus *Aphis* Linnaeus, 1758
Subgenus *Aphis* Linnaeus, 1758

Aphis (Aphis) fabae Scopoli, 1763

Diagnosis

Aptera 1.5–3 mm, dull black; legs and antennae partly white; abdomen sometimes with white wax markings. See under *Picea* (entry A12, p. 12).

*Key D. Aphids on hemlock and Douglas fir (*Tsuga *and* Pseudotsuga*)*

Synopsis

D1 (D4) On young shoots or needles D2

D2 (D3) Siphunculi absent ..... ***Adelges*** Vallot, 1836 and ***Mindarus*** Koch, 1857 p. 28

D3 (D2) Siphunculi present, tubular..... ***Aphis*** Linnaeus, 1758 p. 29

D4 (D1) On thin mycorrhizal roots ..... **Eriosomatinae** Kirkaldy, 1905 p.29

D1 (D4) On young shoots or needles D2
D2 (D3) Siphunculi absent ..... ***Adelges*** Vallot, 1836 and ***Mindarus*** Koch, 1857

Superfamily Adelgoidea Annand, 1928
Family Adelgidae Annand, 1928
Genus *Adelges* Vallot, 1836
Subgenus *Gilletteella* Börner, 1930

Adelges (Gilletteella) cooleyi (Gillette, 1907)
Figs 70–71

Diagnosis (see also p. 11)

Apterae brownish black, covered with wax wool. Neosistens 0.3–0.4 mm, black. Dorsum with rounded wax gland plates exuding sparsely white wax. Marginally with glands exuding broad and fairly short wax ribbons, and posteriorly with a tuft of long narrow ribbons. Al. sexuparae 1.2–1.7 mm; abdomen with normal spinal and pleural wax gland plates on all segments; rhinaria at most reaching half-way around the segments. Holocyclic and dioecious, alternating between *Picea* (p. 11) and *Pseudotsuga*.

Recorded secondary hosts

Pinaceae: *Pseudotsuga menziesii**.

Distribution

D F N S.

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802
Subfamily Mindarinae Tullgren, 1909
Genus *Mindarus* Koch, 1857

Mindarus abietinus (Koch, 1857)

Diagnosis

Aptera 1.7–2.0 mm, pale green, with wax dusting, fine wax wool and thick, irregularly bent wax filaments. See under *Abies* (entry B7, p. 21).

Subfamily Aphidinae Latreille, 1802
Tribe Macrosiphini Wilson, 1910
Genus *Elatobium* Mordvilko, 1914

Elatobium abietinum (Walker, 1849)

Diagnosis

Aptera 1–2 mm, pale green to yellowish, without wax wool. See under *Picea* (entry A12, p. 12).

D3 (D2) Siphunculi present, tubular..... ***Aphis*** Linnaeus, 1758

Tribe Aphidini Latreille, 1802
Genus *Aphis* Linnaeus, 1758
Subgenus *Aphis* Linnaeus, 1758

Aphis (Aphis) fabae Scopoli, 1763

Diagnosis

Aptera 1.5–3 mm, dull black; legs and antennae partly white; abdomen sometimes with white wax markings. See under *Picea* (entry A12, p. 12).

D4 (D1) On thin mycorrhizal roots .....**Eriosomatinae** Kirkaldy, 1905

Eriosomatinae Kirkaldy, 1905

If pinkish, see under *Pinus* (entry E13, p. 39), otherwise see under *Picea* (entry A17 p. 17). For key and diagnoses, see Albrecht (2015: 8, key A).

*Key E. Aphids on pine (***Pinus***, Pinaceae)*

Synopsis

E1 (E11) Aphids on aerial parts of *Pinus* E2

E2 (E3) Siphunculi absent; adults with sclerotised ovipositor. Apterae less than 1.2 mm; antennae at most 3-segmented .....***Pineus*** Shimer, 1869 p. 30

E3 (E2) Siphunculi present at least as pores; adults without sclerotised ovipositor. Apterae rarely less than 1.2 mm; antennae at least 4-segmented E4

E4 (E10) Siphunculi present as pores E5

E5 (E6 E7) Body slender, at least twice as long as wide, with or without wax bloom ....***Eulachnus*** del Guercio, 1909 p. 31

E6 (E5 E7) Body oval; dark greyish brown with abundant wax wool; apical segment of rostrum short, hardly twice as long as wide ..... ***Schizolachnus*** Mordvilko, 1909 p. 33

E7 (E5 E6) Body oval, grey, brown or blackish, wax, if present, as a distinct pattern or thin wax dusting; apical segment of rostrum long and narrow, 3 times as long as wide or more..... .....***Cinara*** Curtis, 1835 E8

E8 (E9) Segment 1 of hind tarsus short; its dorsal side about half the length of the ventral .....***Cinara (Cinara)*** Curtis, 1835 p. 34

E9 (E8) Hind tarsus 1 long; its dorsal side ⅔ the length of the ventral or more ....***Cinara (Cinara)*** Curtis, 1835 p. 36

E10 (E4) Siphunculi elongate, tubular ....***Elatobium*** Mordvilko, 1914, ***Aphis*** Linnaeus, 1758 p. 39

E11 (E1) Aphids on roots of *Pinus*..... E12

E12 (E13) Apterae 2–6 mm, with brown, grey or blackish colours; siphunculi present as pores elevated on cones. Usually on thick exposed roots ..... ***Cinara*** Curtis, 1835 p. 39

E13 (E12) Apterae 0.5–2 mm, pale pinkish, exuding abundant white wax wool; siphunculi absent. On thin roots .....***Prociphilus*** Tullgren, 1925 p. 39

E1 (E11) Aphids on aerial parts of *Pinus* E2
E2 (E3) Siphunculi absent; adults with sclerotised ovipositor. Apterae less than 1.2 mm; antennae at most 3-segmented .....***Pineus*** Shimer, 1869

Superfamily Adelgoidea Annand, 1928
Family Adelgidae Annand, 1928
Genus *Pineus* Shimer, 1869
Subgenus *Pineus* Shimer, 1869

Pineus (Pineus) pini (Macquart, 1819)
Figs 72–75

Diagnosis

Apterae 0.8–1.1 mm, broadly drop-shaped in outline, dark red-brown, embedded in dense, fine wax wool. Wax glands on anterior part of cephaloprothoracic shield (between the eyes) mainly comprising groups of 2–10 facets that are loosely grouped, round in outline. Alatae 1.0–1.2 mm, reddish black with woolly wax. *P. pini* prefers open habitats: pine forests, forest clearings and margins, meadows, roadsides etc. Anholocyclic on *Pinus*. One overwintering generation on thin trunks or twigs and two or more overlapping generations on young shoots. See also *P. orientalis* below.

Recorded hosts

Pinaceae: *Pinus banksiana*, *mugo**, *nigra*, *pinaster*?, *ponderosa*, *rigida*, *sylvestris**.

Distribution

D F I N S.

Pineus (Pineus) orientalis (Dreyfus, 1889)
Fig. 76

Diagnosis

Apterae indistinguishable from *P. pini*. Gallicolae similar to apterae of *P. pini* but larger (1.5–2.3 mm); marginal wax gland plates smaller, their facets smaller than the largest on head; anteriorly on abdomen the plates are as far or further apart than the width of the plates; the spinal plates on abdomen fused with the other plates on their segment. Sexupara indistinguishable from the alata of *P. pini*. Holocyclic, dioecious, alternating between *Picea* (see p. 7) and *Pinus*.

Scattered on twigs and shoots. Diagnosis mainly after Heie (2004).

Recorded secondary hosts

Pinaceae: *Pinus mugo*, *sylvestris*, spp.

Distribution

D F S.

Pineus (Pineus) cembrae (Cholodkovsky, 1888)
Figs 77–80

Diagnosis

Apterae 0.5–0.8 mm, red-brown with blackish sclerites, covered in wax wool. Wax glands on cephaloprothoracic shield with closely packed, more or less polygonal facets; groups closest to ocelli usually with more than 40 facets. Holocyclic, dioecious, alternating between *Picea* (see p. 7) and *Pinus*. At least in Finland also anholocyclic on *Pinus*. Parks, forests, street plantations. Scattered on young shoots, twigs and cones, overwintering in bark crevices and under scales.

Recorded secondary hosts

Pinaceae: *Pinus cembra**, *koraiensis*, *pumila*, *sibirica**.

Distribution

F S.

Pineus (Pineus) strobi (Hartig, 1837)
Fig. 81

Diagnosis

Apterae 0.7–0.9 mm, similar to *P. cembrae*. Wax glands on cephaloprothoracic shield between eyes usually with less than 30 facets per group. Anholocyclic on *Pinus*. Found on shaded parts of trunk and branches. Alatae (sexuparae) fly to *Picea mariana* and lay eggs, but the sexual phase is abortive. Diagnosis based on Heie (2004) and Blackman & Eastop (1994).

Recorded hosts

Pinaceae: *Pinus peuce*, *sibirica*, *strobus*.

Distribution

D N S (North America, introduced to Europe).

E3 (E2) Siphunculi present at least as pores; adults without sclerotised ovipositor. Apterae rarely less than 1.2 mm; antennae at least 4-segmented E4
E4 (E10) Siphunculi present as pores E5
E5 (E6 E7) Body slender, at least twice as long as wide, with or without wax bloom ..... ***Eulachnus*** del Guercio, 1909

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802
Subfamily Lachninae Herrich-Schaeffer, 1854
Tribe Eulachnini Baker, 1920
Genus *Eulachnus* del Guercio, 1909

Eulachnus agilis (Kaltenbach, 1843)
Fig. 82

Diagnosis

Apterae 1.5–2.2 mm, elongate, green, thinly wax-powdered, with numerous dark green or brown hair-bearing sclerites. Dorsal hairs 1.5–2 times as long as the diameter of their sclerite. Holocyclic,

monoecious on *Pinus*. Scattered on needles, rarely on twigs. *E. agilis* seems to prefer older trees and needles injured by *Schizolachnus* species. Not ant-attended.

Recorded hosts

Pinaceae: *Pinus banksiana**, *cembra*, *mugo**, *nigra*, *sibirica*, *sylvestris**, spp.

Distribution

D F N S.

Eulachnus brevipilosus Börner, 1940

Diagnosis

Similar to *E. agilis* but dorsal hairs much shorter, about half the diameter of their sclerites. First segment of hind tarsus with 6 ventral hairs. Hairs on antennal segment III capitate. Holocyclic, monoecious on *Pinus*. Biology as in *E. agilis*. Diagnosis based on Heie (2004) and Blackman & Eastop (1994).

Recorded hosts

Pinaceae: *Pinus mugo*, *nigra*, *sylvestris**, spp.

Distribution

D F N S.

Eulachnus nigricola (Pasek, 1953)

Diagnosis

Similar to *E. brevipilosus*, but first segment of hind tarsus with 8 ventral hairs, and hairs on antennal segment III not capitate. Holocyclic, monoecious on *Pinus nigra*. Biology as in *E. agilis*. Diagnosis based on Heie (2004) and Blackman & Eastop (1994).

Recorded hosts

Pinaceae: *Pinus nigra*, *sylvestris.*

Distribution

D.

Eulachnus cembrae Börner, 1950

Diagnosis

Apterae 2.2–3 mm, elongate, bright green or yellowish green, wax-powdered. Dorsal hairs on abdominal segments 1–6 not arising from sclerites. Holocyclic, monoecious on *Pinus*. Not ant-attended. Diagnosis based on Heie (2004) and Blackman & Eastop (1994).

Recorded hosts

Pinaceae: *Pinus cembra*, *peuce*, *strobus.*

Distribution

Montane Europe. Not recorded in the Nordic countries.

Eulachnus rileyi (Williams, 1911)
Fig. 83

Diagnosis

Apterae 2–2.8 mm, elongate, grey, brown, orange or olive, with grey, often coarse, wax dusting, often forming transverse fasciae. Body hairs long, dorsal hairs on abdomen more than twice the diameter of their sclerites. Holocyclic, monoecious on *Pinus*, at least in Finland clearly preferring *P. mugo*. Adults on twigs and branches. Juveniles in rows on needles, frequently causing yellowing. Not ant-attended.

Recorded hosts

Pinaceae: *Pinus austriaca*, *banksiana*, *cembra*, *mugo**, *nigra*, *peuce*, *sylvestris*, spp.

Distribution

D F N S.

E6 (E5 E7) Body oval; dark greyish brown with abundant wax wool; apical segment of rostrum short, hardly twice as long as wide ..... ***Schizolachnus*** Mordvilko, 1909

Genus *Schizolachnus* Mordvilko, 1909

Schizolachnus pineti (Fabricius, 1781)
Figs 84–85

Diagnosis

Apterae 1.2–1.5 mm, grey, grey-brown or brown, covered with greyish wax. The ultimate part of rostrum, the so-called segment V, as long as its basal width. Hind tibia pale or dark, very densely hairy. Holocyclic, monoecious on many *Pinus* species, preferably *sylvestris* and *mugo*, forming dense rows along upper sides of last year's needles, on young as well as old trees. Not ant-attended.

Recorded hosts

Pinaceae: *Pinus cembra*, *contorta*, *nigra*, *pinaster*, *pinea*, *banksiana**, *mugo**, *sylvestris**, spp.

Distribution

D F N S.

Schizolachnus obscurus Börner, 1940
Fig. 86

Diagnosis

Apterae 1.9–2.7 mm, brownish, covered with greyish white wax. The ultimate part of rostrum about 1.5 × as long as it basal width. Hind tibia dark, less densely hairy than in *S. pineti*. Holocyclic, monoecious. Forming rows on needles of *Pinus nigra* (sometimes on other *Pinus* species). Not ant-attended. Diagnosis based on Heie (2004).

Recorded hosts

Pinaceae: *Pinus nigra*, rarely *mugo*, *pinaster*, *pinea*, *sylvestris.*

Distribution

D.

E7 (E5 E6) Body oval, grey, brown or blackish, wax, if present, as a distinct pattern or thin wax dusting; apical segment of rostrum long and narrow, 3 times as long as wide or more .... ***Cinara*** Curtis, 1835 E8

Genus *Cinara* Curtis, 1835

Subgenus ***Cinara*** Curtis, 1835

E8 (E9) E8 (E9) ..... Segment 1 of hind tarsus short; its dorsal side about half the length of the ventral ..... ***Cinara (Cinara)*** Curtis, 1835

Cinara (Cinara) pini (Linnaeus, 1758)
Figs 88–89

Diagnosis

Apterae 2–3.5 mm, greyish brown, brown or olive brown, with a bronze sheen and thin but distinct wax markings along mid-line and at segment borders; ventrally more or less completely wax-dusted. Body dorsoventrally flattened, widest anterior to the siphunculi, evenly tapering towards head. Dorsal hairs on abdomen sparse and very short, mostly 0.01–0.04 mm, usually less than 10 hairs between the siphuncular sclerites. See also *C. acutirostris* (on *Pinus nigra* and *P. pinea*) and *C. cembrae* (on *P. cembra*). Ovipara (if correctly interpreted) with a large dull black transverse sclerite across segments 5 and 6, encompassing the siphunculi, but not extending forwards as in *C. nigritergi*. Holocyclic, monoecious on *Pinus*. Open forests, meadow margins, sea shores etc. Forming small colonies on young shoots, twigs and branches, viviparous colonies almost invariably attended by ants.

Recorded hosts

Pinaceae: *Pinus mugo**, *sylvestris**. Records from *Pinus banksiana*, *cembra*, *contorta*, *nigra*, *pinaster*, *pinea*, *sibirica*, *strobus* etc. are to be confirmed. According to Eastop (1972) and Blackman & Eastop (2015), records from hosts other than *P. sylvestris* are likely to be mis-identifications or misapplications of the name *pini.*

Recorded attendant ants

Formicinae: *Camponotus herculeanus**; *Formica aquilonia**, *cinerea**, *fusca**, *lemani**, *polyctena**, *pratensis**, *rufa**, *sanguinea**, *truncorum**; *Lasius niger*.*

Distribution

D F N S.

Cinara (Cinara) acutirostris Hille Ris Lambers, 1956
Fig. 90

Diagnosis

Aptera 2.5–3.5 mm, similar to *C. pini* (on *Pinus sylvestris* and *P. mugo*), but hairs on abdomen longer, there are several rather long hairs up to 0.1 mm long between the siphuncular cones. Further, the length of RIV+V is 1.2–1.5 times the length of the second tarsal segment (in *C. pini* less than 1.2). The diagnosis is based on Dransfield & Brightwell (2015–2016). Holocyclic, monoecious on *Pinus*.

Recorded hosts

Pinaceae: *Pinus nigra*, *pinea.*

Recorded attendant ants

Formicinae: *Formica rufa* group.

Distribution

Western, central and southern Europe. Not yet recorded from the Nordic countries.

Cinara (Cinara) cembrae (Seitner, 1936)
Fig. 91

Diagnosis

Apterae 3.3–4.8 mm, shiny brown, resembling *C. pini*. Hairs on abdominal tergite 5 short (maximally 0.004–0.04 mm). RIV 0.21–0.29 mm, longer than 2 × RV (in *C. pini* 0.14–0.22 mm, about 2 × RV). Hairs on basal part of antennal segment VI maximally about 2 × basal diameter of the segment. The diagnosis is based on Pintera (1966) and Blackman & Eastop (1994). Holocyclic and monoecious on *Pinus cembra*, forming colonies on bark of two-year-old or older branches. Attended by ants. Records from *Pinus peuce*, *pumila* and *sibirica* refer to other species (Szelegiewicz 1976).

Recorded hosts

Pinaceae: *Pinus cembra.*

Recorded attendant ants

Formicinae: *Formica rufa* (group?).

Distribution

Central and eastern Europe, including St. Petersburg area in Russia.

Cinara (Cinara) nigritergi Mamontova-Solukha, 2002
Figs 92–93

Diagnosis

Apterae 2.5–4 mm, dark brown to black with grey wax markings and a large dull or subshining sclerite encompassing the siphunculi, anteriorly extending to a variable extent, often reaching the thoracal sclerites. Hairs short and sparse, as in *C. pini* (see above), and in contrast to *C. pinihabitans*. Open forests on sand or rock, meadow margins, pine plantations, sea shores etc. Holocyclic (ovipara described by Stekolshchikov 2011), monoecious on *Pinus*, forming colonies on young shoots and 1–2 years old twigs on trees of all ages; usually attended by ants. Ovipara with a preanal wax ring.

Recorded hosts

Pinaceae: *Pinus sylvestris**.

Recorded attendant ants

Formicinae: *Lasius fuliginosus**, *niger**.

Distribution

F S [SWE: Hall., Varberg, Träslövsläge, N57 02.8 E12 17.3, Sea shore dune. *Pinus sylvestris*. Dense colony on 1–2 year-old branch, attended by *Lasius fuliginosus*. A06-1162. A. Albrecht].

Cinara (Cinara) pinihabitans (Mordvilko, 1895)
Figs 94–95

Diagnosis

Apterae 3–4.5 mm, fairly similar to *C. pini* but much denser and longer pubescent. Hairs on abdomen 0.1–0.2 mm, 40–50 present between the siphuncular sclerites. A transverse dull brown to black sclerite between the siphuncular cones and extending forwards along the spinal and pleural areas present, at least (always?) in the ovipara. Compare the short-haired *C. nigritergi* below. Holocyclic, monoecious on *Pinus*, forming colonies on old branches. Probably attended by ants.

Recorded hosts

Pinaceae: *Pionus mugo*, *sylvestris**.

Distribution

F S.

Cinara (Cinara) nuda Mordvilko, 1895
Figs 96–97

Diagnosis

Apterae 3–4 mm, shiny brown with a bronze sheen and two longitudinal patches or streaks, hardly wax-dusted at all. Dorsal hairs short, strong, erect. Found at forest margins, sea shores, sand dunes, pine plantations etc. Holocyclic, monoecious on *Pinus sylvestris*, forming large colonies on 2–8 year-old parts of trunks and basal branches, usually on young trees. Almost always attended by ants.

Recorded hosts

Pinaceae: *Pinus mugo*, *nigra*, *sylvestris**.

Recorded attendant ants

Formicinae: *Formica aquilonia**, *cinerea**, *fusca**, *polyctena**, *truncorum**; *Lasius niger**, *platythorax**.

Distribution

F S.

E9 (E8) Hind tarsus 1 long; its dorsal side ⅔ the length of the ventral or more .....
..... ***Cinara (Cinara)*** Curtis, 1835

Cinara (Cinara) brauni Börner, 1940
Fig. 98

Diagnosis

Apterae 2.5–3.8 mm, golden brown covered with a dense, greyish wax powder, except for posterior part of dorsum which is shiny black. Holocyclic, monoecious on *Pinus*, sometimes anholocyclic (Binazzi & Roversi 1987). On 0–1 year-old twigs, usually attended by ants. Diagnosis based on Heie (1995), Blackman & Eastop (1994) and Dransfield & Brightwell (2015).

Recorded hosts

Pinaceae: *Pinus nigra*, rarely *sibirica*, *sylvestris*.

Recorded attendant ants

Formicinae: *Formica rufa* group.

Distribution

S.

Cinara (Cinara) pilosa (Zetterstedt, 1840)
Figs 99–100

Diagnosis

Apterae 3–5 mm, yellowish to reddish brown, sometimes with two longitudinal olive-green streaks dorsally. Wax pattern fairly weak but conspicuous. Hairs very long, on dorsum mostly standing in roundish sclerites. Hairs on femora and tibiae originating from small dark spots. Holocyclic, monoecious on *Pinus*. Found in open forests on sand or rock, forest margins etc., clearly preferring old pine trees. Usually singly or adults surrounded by a few young on twigs, buds, flower and cone axils etc. Sometimes attended by ants.

Recorded hosts

Pinaceae: *Pinus mugo**, *nigra*, *sylvestris**.

Recorded attendant ants

Formicinae: *Lasius niger**; Myrmicinae: *Myrmica rubra**.

Distribution

F N S [NOR: Fn, Alta, Hjemmeluft, 69°55' N 23°6' E, Aug. 3. 1992, open pine forest, *Pinus sylvestris*, 1 al. viv. on needle, A. Albrecht leg. (A92-835)]. (See also Stekolshchikov & Kozlov 2012).

Cinara (Cinara) pinea (Mordvilko, 1895)
Figs 101–103, 87B

Diagnosis

Apterae 3–5 mm, orange-brown, red-brown, dark brown to almost black with conspicuous wax pattern and numerous brown or blackish, roundish, hair-bearing sclerites. Legs with at least knees and hind tarsi fuscous. Hairs long and thin, also on abdominal dorsum, those on legs more or less upright, on tibiae as long as or longer than width of tibia. Holocyclic, monoecious on *Pinus*.

A very variable species, and probably there are more than one species involved (as also suggested by Blackman & Eastop (2015)). Mostly in open habitats: forest margins, clearings, dunes, rocks, dry meadows etc. On young shoots, terminal twigs, cone and flower bases. In spring often in dense colonies, later on usually in small groups. Almost invariably attended by ants.

Recorded hosts

Pinaceae: *Pinus banksiana**, *mugo**, *nigra*, *pinea*, *ponderosa*, *sibirica*, *sylvestris**, spp.

Recorded attendant ants

Formicinae: *Camponotus herculeanus**, *ligniperda**; *Formica aquilonia**, *cinerea**, *fusca**, *lemani**, *pressilabris**, *polyctena**, *rufa**, *truncorum**; *Lasius niger**, *platythorax**. Myrmicinae: *Myrmica rubra**, *ruginodis**.

Distribution

D F N S.

Cinara (Cinara) piniphila (Ratzeburg, 1844)
Figs 104–105

Diagnosis

Aptera 2.5–4 mm. Similar to *C. pinea* but hairs much shorter, particularly on abdominal dorsum (not longer than 0.1 mm), those on femora and tibiae oblique, about half as long as width of tibia. Dorsal hair-bearing sclerites fewer than in *C. pinea*. Holocyclic, monoecious on *Pinus*. In Finland found on young pines in costal dunes, attended by *Formica cinerea*. Feeding among needles on young shoots and 1–2 year-old twigs.

Recorded hosts

Pinaceae: *Pinus sylvestris**.

Recorded attendant ants

Formicinae: *Formica cinerea*.*

Distribution

F.

Cinara (Cinara) schimitscheki Börner, 1940
Fig. 106

Diagnosis

Apterae 4–4.7 mm, broadly oval and flattened, dark brown, covered with wax powder. Dorsal sclerites rounded, their diameter up to 30 µm. Dorsal hairs blunt, up to 85 µm. Antennal hairs fairly short, on segment 3 mostly shorter than the diameter of the segment. Holocyclic, monoecious on *Pinus*, usually *P. nigra*. Diagnosis based on Pintera (1966) and Scheurer (1976). In spring at twig apices among previous year's needles, later on underside of older branches under bark flakes.

Recorded hosts

Pinaceae: *Pinus mugo*, *nigra* (usually), *pinea*.

Recorded attendant ants

Formicinae: *Formica sanguinea*; *Lasius niger*, *alienus* (Scheurer 1976).

Distribution

Throughout Europe except in the north. Asia.

Cinara (Cinara) hyperophila (Koch, 1855)
Figs 107–109

Diagnosis

Apterae 2.5–3.5 mm, shiny dark brown to black with a metallic lustre, which especially in juveniles can be very conspicuous. Head, thorax and venter with a fairly thick grey wax dusting. A spinal wax streak, spreading along the segment borders is usually present, and adult apterae often with rounded presiphuncular wax patches. Legs and antennae predominantly dark brown to black. Abdominal hairs long, erect, most of them not originating from sclerites. Hairs on femora rather short, erect or semi-erect, those on tibiae short, oblique. Holocyclic, monoecious on *Pinus*. Found in forest margins, pine plantations, sea shore dunes etc. Forming small colonies on current year's shoots, rarely on older. Usually on small pines. Often ant-attended.

Recorded hosts

Pinaceae: *Pinus mugo*, *pinaster*, *sylvestris**.

Recorded attendant ants

Formicinae: *Formica cinerea**, *fusca**, *polyctena**, *rufa**, *sanguinea**, *truncorum**; *Lasius niger**, *platythorax**.

Distribution

D F S.

E10 (E4) Siphunculi elongate, tubular ..... ***Elatobium*** Mordvilko, 1914, ***Aphis*** Linnaeus, 1758

Subfamily Aphidinae Latreille, 1802
Tribe Macrosiphini Wilson, 1910
Genus *Elatobium* Mordvilko, 1914

Elatobium abietinum (Walker, 1849)

Diagnosis

Aptera 1–2 mm, pale green to yellowish. See under *Picea* (entry A12, p. 12).

Tribe Aphidini Latreille, 1802
Genus *Aphis* Linnaeus, 1758
Subgenus *Aphis* Linnaeus, 1758

Aphis (Aphis) fabae Scopoli, 1763

Diagnosis

Aptera 1.5–3 mm, dull black. See under *Picea* (entry A12, p. 12).

E11 (E1) Aphids on roots of *Pinus* E12
E12 (E13) Apterae 2–6 mm, with brown, grey or blackish colours; siphunculi present as pores elevated on cones. Usually on thick exposed roots ..... ***Cinara*** Curtis, 1835 go to entry point E7 above (p. 34)
E13 (E12) Apterae 0.5–2 mm, pale pinkish, exuding abundant white wax wool; siphunculi absent. On thin roots ..... ***Prociphilus*** Tullgren, 1925

Subfamily Eriosomatinae Kirkaldy, 1905
Tribe Eriosomatini Kirkaldy, 1905
Genus *Prociphilus* Tullgren, 1925
Subgenus *Stagona* Koch, 1857

Prociphilus (Stagona) pini (Burmeister, 1835)
Fig. 110

Diagnosis

Aptera 1–2 mm, cream or pale pinkish, covered by dense wax wool. Holocyclic, dioecious. Alternating between *Crataegus* (Rosaceae) and thin roots of *Pinus*. *P. pini* prefers habitats on well-drained soil, e.g., pine forests on rock and sandy ground, under moss cover and stones, sometimes in nests of *Lasius flavus* and attended by the ants. See also Albrecht (2015).

Recorded secondary hosts

Pinaceae: *Pinus contorta*, *sylvestris**; *Pseudotsuga*; *Tsuga canadensis*.

Recorded attendant ants

Formicinae: *Lasius flavus**.

Distribution

D F N S.

Key F. Aphids on Cupressaceae

Synopsis

F1 (F7) On aerial parts of the plant F2

F2 (F5, F6) Siphunculi as pores elevated on low cones (wider than high) ..... ***Cinara*** Curtis, 1835 F3

F3 (F4) Hind tibiae uniformly dark, at most slightly lighter in the basal half ..... ***Cinara (Cupressobium)*** Börner, 1940 p.40

F4 (F3) Hind tibiae pale or with a pale zone between the dark knee and apex ..... ***Cinara (Cupressobium)*** Börner, 1940 p. 42

F5 (F2 F6) Siphunculi conical, 1.5–2 times as long as wide ..... ***Brachycaudus*** van der Goot, 1913 p. 43

F6 (F2 F5) Siphunculi parallel-sided, more than 4 times as long as wide ..... ***Myzus*** Passerini, 1860 p. 44

F7 (F1) On thin roots, embedded in wax wool ..... ***Gootiella*** Tullgren, 1925 p. 44

F1 (F7) On aerial parts of the plant F2

F2 (F5 F6) Siphunculi as pores elevated on low cones (wider than high) ..... ***Cinara*** Curtis, 1835 F3

Superfamily Aphidoidea Latreille, 1802
Family Aphididae Latreille, 1802

Subfamily **Lachninae** Herrich-Schaeffer, 1854

F3 (F4) Hind tibiae uniformly dark, at most slightly lighter in the basal half ..... ***Cinara (Cupressobium)*** Börner, 1940 p.40

Tribe Eulachnini Baker, 1920
Genus *Cinara* Curtis, 1835
Subgenus *Cupressobium* Börner, 1940

Cinara (Cupressobium) smolandiae Danielsson & Carter, 1993
Figs 111–112

Diagnosis

Apterae 3–4 mm, olive with a weak bronzy sheen and an evenly distributed thin grey wax dusting. Hairs on tibiae fairly short, on hind tibia not longer than 1.5 × width of tibia at middle. Hind tibia longer than 2.2 mm. Juveniles pinkish or olive brown with thinner wax coating and paler legs. Holocyclic, monoecious on *Juniperus communis*, forming colonies in bark crevices and old wounds caused by the rust fungus *Gymnosporangium.* Attended by ants.

Recorded hosts

Cupressaceae: *Juniperus communis**.

Recorded attendant ants

Formicinae: *Camponotus* sp.; *Formica polyctena**, sp.

Distribution

F S.

Cinara (Cupressobium) juniperi (De Geer, 1773)
Figs 113–115

Diagnosis

Apterae 2–2.5 mm, rather light reddish brown, rarely olive, with a wax coating of variable thickness and extent, typically leaving two longitudinal stripes bare or with thinner wax. Hairs on tibiae longer than in *C. smolandiae*, on the outer side of hind tibia longer than 1.5 × width of tibia. Spinopleural sclerites present on meso- and metanotum and abdominal tergites 1–2 (–5). Juveniles with paler legs and usually thinner wax coating. Holocyclic, monoecious on *Juniperus* and *Thuja*. Found in open woodland, forest margins and dry meadows, sea shores, rocky habitats; in small colonies on thin twigs, only rarely on thicker branches. Usually ant-attended.

Recorded hosts

Cupressaceae: *Juniperus chinensis*, *communis**, *sabina*, *squamata*, *virginiana*; *Thuja occidentalis.*

Recorded attendant ants

Formicinae: *Formica cinerea**, *clara**, *fusca**, *polyctena**, *rufa**; *Lasius fuliginosus**, *niger**. Myrmicinae: *Myrmica rubra**.

Distribution

D F G N S.

Cinara (Cupressobium) mordvilkoi (Pasek, 1954)
Fig. 116

Diagnosis

Similar to *C. juniperi* and sometimes difficult to distinguish. Aptera 2.7–3.2 mm. *C. mordvilkoi* is slightly larger and its wax dusting is thinner and more evenly distributed, posterior part of abdomen often more or less shiny. Colour in both adults and juveniles – at least in Finnish material – greyish olive without reddish tinge. Spinopleural sclerites present on thorax but absent or strongly reduced on abdomen.

Durak (2011) made a DNA study combined with morphological analyses of the two species, confirmed their distinctness, and found some statistically significant distinguishing characters (all apparently related to size): see Table 1.

Holocyclic, monoecious on *Juniperus communis*. In spring on thin twigs, in summer moving to roots and stems at ground level. Recorded hosts

Recorded hosts

Cupressaceae: *Juniperus communis**.

Distribution

F.

Table 1. Morphological features of the apterous viviparous females *C. juniperi* (n = 30) and *C. mordvilkoi* (n = 30). Minimum–maximum (mean). Statistical significance: * = P < 0.05; ** = P < 0.01. Length unit = mm. Data from Durak (2011).

Characters	*C. juniperi*	*C. mordvilkoi*	
body length	2.1–2.45 (2.33)	2.75–3.12 (2.94)	**
tibia length	0.9–1.12 (1.04)	1.45–1.55 (1.5)	**
antennae segment III	0.22–0.35 (0.28)	0.32–0.4 (0.37)	**
antennae segment IV	0.12–0.15 (0.128)	0.15–0.17 (0.162)	*
antennae segment V	0.15–0.21 (0.18)	0.2–0.25 (0.21)	*
antennae segment VI	0.22–0.26 (0.23)	0.25–0.27 (0.26)	*
antennae length	0.82–1.1 (0.96)	1.17–1.22 (1.19)	**
rostrum length	0.85–1.0 (0.9)	1.32–1.72 (1.43)	**

F4 (F3) Hind tibiae pale or with a pale zone between the dark knee and apex .... ***Cinara (Cupressobium)*** Börner, 1940

Cinara (Cupressobium) cupressi (Buckton, 1881)
Fig. 117

Diagnosis

Apterae 1.5–3.5 mm, olive black with a bronzy sheen. Wax cover thin, anteriorly leaving two diverging bands free; area between siphunculi shiny, with more or less well developed transverse wax stipes. Legs dark; tibiae pale at middle. Basal part of antennal segment VI with 4–6 hairs. Juveniles with paler legs. Holocyclic, partially anholocyclic, monoecious on various Cupressaceae. Parks, hedge rows, forest margins. Forming colonies on foliated branches, often causing damage to the plant. Attended by ants.

Recorded hosts

Cupressaceae: *Chamaecyparis lawsoniana*; *Cupressus* spp; *Juniperus chinensis*, *communis*, *sabina*, *scopulorum*, *virginiana*, spp.; *Thuja occidentalis**, *plicata**.

Recorded attendant ants

Formicinae: *Lasius niger**.

Distribution

D F S.

Cinara (Cupressobium) fresai (Blanchard, 1939)

Diagnosis

Similar to *C. cupressi*, best distinguished by having 7–12 hairs on the basal part of antennal segment VI (4–6 in *C. cupressi*). See also Carter & Maslen (1982). Found in unheated glasshouses, apparently anholocyclic. Diagnoses based on Blackman & Eastop 2015 and Carter & Maslen 1982.

Recorded hosts

Cryptomeria japonica; *Cupressus*; *Juniperus chinensis*, *sabina*, *squamata*, *virginiana*.

Distribution

Britain. Not recorded in the Nordic countries.

Cinara (Cupressobium) tujafilina (Del Guercio, 1909)
Fig. 118

Diagnosis

Apterae 1.5–3.2 mm, reddish-brown with a whitish dorsal wax coating, leaving two longitudinal stripes and parts of the area around siphunculi bare and shining. Mostly anholocyclic (Blackman & Eastop 1994) on various Cupressaceae. Tibiae dark only at apices. On foliated and bare branches, wounds, roots. Attended by ants.

Recorded hosts

Cupressaceae: *Chamaecyparis lawsoniana*; *Cupressus* sp.; *Juniperus*, *chinensis*, *communis*, *procumbens*, *virginiana*, spp.; *Thuja occidentalis*; *Thujopsis dolabrata.*

Recorded attendant ants

Formicinae: *Lasius niger.*

Distribution

Almost cosmopolitan. Not yet recorded from North Europe.

F5 (F2 F6) Siphunculi conical, 1.5–2 times as long as wide.....***Brachycaudus*** van der Goot, 1913

Subfamily Aphidinae Latreille, 1802
Tribe Macrosiphini Wilson, 1910
Genus *Brachycaudus* van der Goot, 1913
Subgenus *Brachycaudus* van der Goot, 1913

Brachycaudus (Brachycaudus) helichrysi (Kaltenbach, 1843)

Diagnosis

Aptera 1–1.8 mm, pale green, yellow or yellowish white, ovoid, slightly dorsoventrally flattened. Appendages apically darkened. Siphunculi conical, 1–1.5 times as long as wide. Holocyclic, dioecious, alternating between *Prunus* (Rosaceae) and Asteraceae and Boraginaceae. *Cryptomeria* is hardly a true host. Often attended by ants, but no record from conifers.

Recorded coniferous hosts

Cupressaceae: *Cryptomeria japonica*?

Distribution

D F I N S.

F6 (F2 F5) Siphunculi parallel-sided, more than 4 times as long as wide ..... ***Myzus*** Passerini, 1860

Genus *Myzus* Passerini, 1860
Subgenus *Nectarosiphon* Schouteden, 1901

Myzus (Nectarosiphon) persicae (Sulzer, 1776)

Diagnosis

Aptera 1.2–2.2 mm, almond-shaped, pale yellow to dirty yellow, olive, green, brownish, purple or reddish. For image, see e.g., Albrecht (2015). Siphunculi twice as long as cauda or more, slightly swollen beyond middle. Dioecious, alternating between peach (*Prunus persica*) and plants of more than 40 families. Anholocyclic in the north and in the tropics. Usually in urban environments, also a common indoor pest. *Thuja* is hardly a true host.

Recorded coniferous hosts

Cupressaceae: *Thuja plicata*?

Distribution

D F N S.

F7 (F1) On thin roots, embedded in wax wool ..... ***Gootiella*** Tullgren, 1925

Subfamily Eriosomatinae Kirkaldy, 1905
Tribe Pemphigini Herrich-Schaeffer, 1854
Genus *Gootiella* Tullgren, 1925

Gootiella tremulae Tullgren, 1925

For key and diagnosis, see Albrecht (2015): 8, key A.

Recorded hosts

Holocyclic, dioecious, alternating between *Populus tremula* (Salicaceae) and *Juniperus* (Cupressaceae), where the aphids live in wax nests similar to those of *P. lactea*, and commonly over winter there (Danielsson 1990).

Recorded secondary hosts

Cupressaceae: *Juniperus communis*, *sabina.*

Distribution

D F S.

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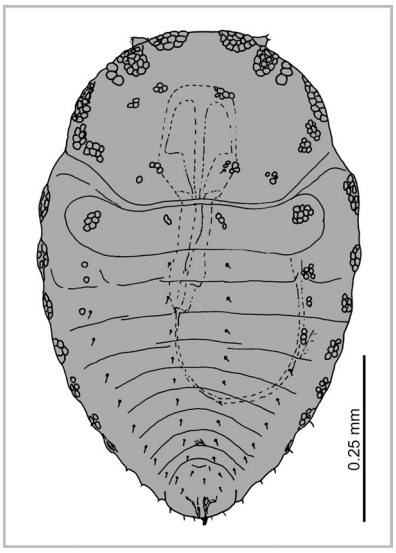

Fig. 1. *Pineus (Pineus) pineoides* (Cholodkovsky, 1907). Adult aptera (after Schneider-Orelli 1940, modified).

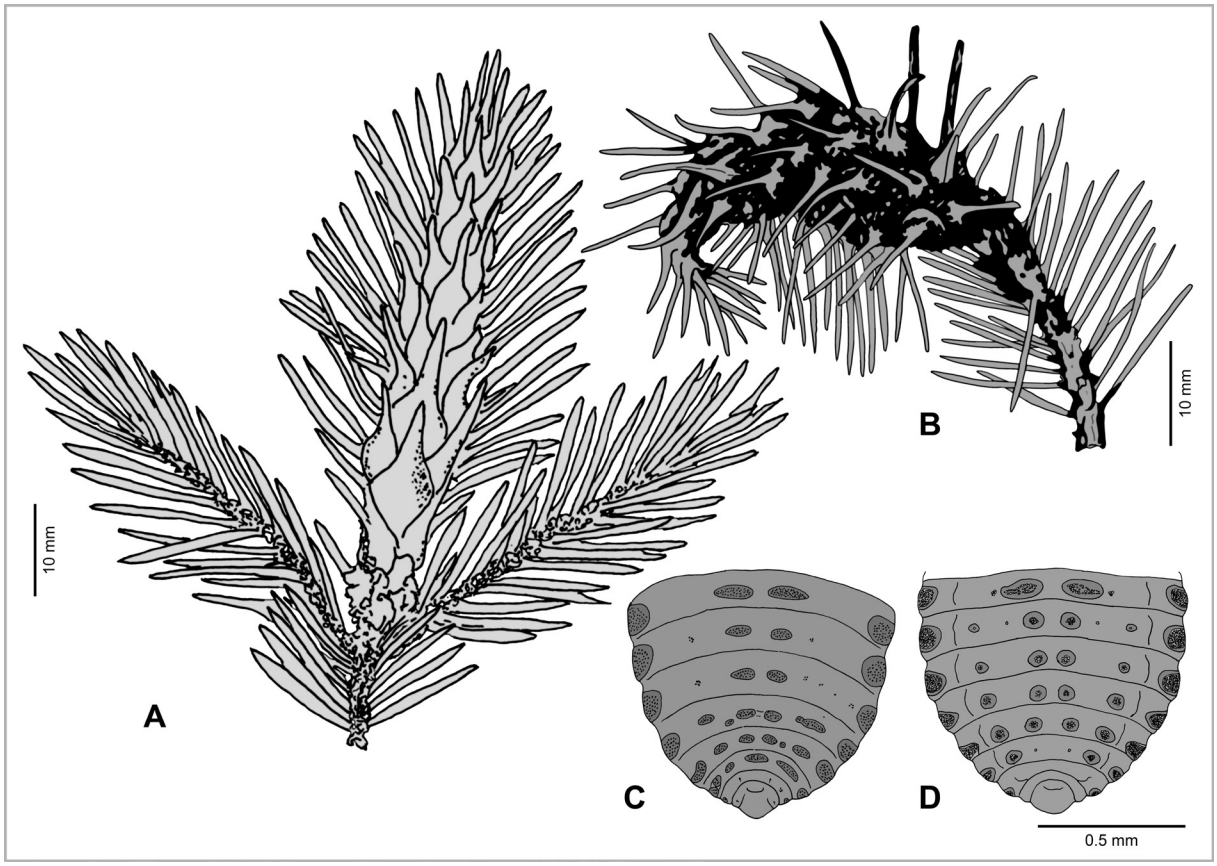

Fig. 2. *Pineus (Pineus) cembrae* (Cholodkovsky, 1888). **A–B**. Galls on *Picea abies* (A after Francke-Grosmann 1938, redrawn; B after Shaposnikov, modified from Heie 2004). **C–D**. Gallicola (C) and sexupara (D), abdomen showing wax gland plates (after Börner 1908, modified from Heie 2004).

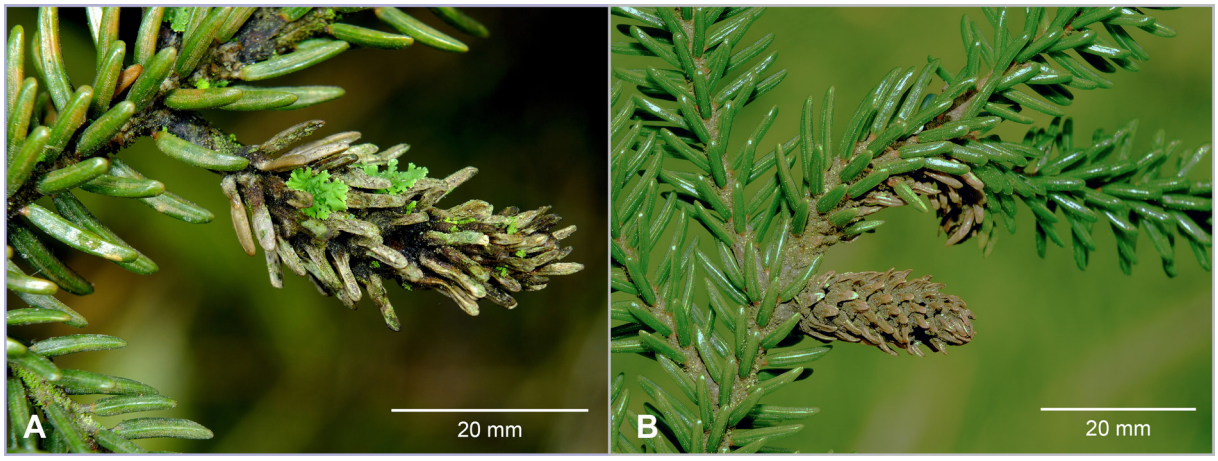

Fig. 3. *Pineus (Pineus) orientalis* (Dreyfus, 1889), old galls on *Picea orientalis*.

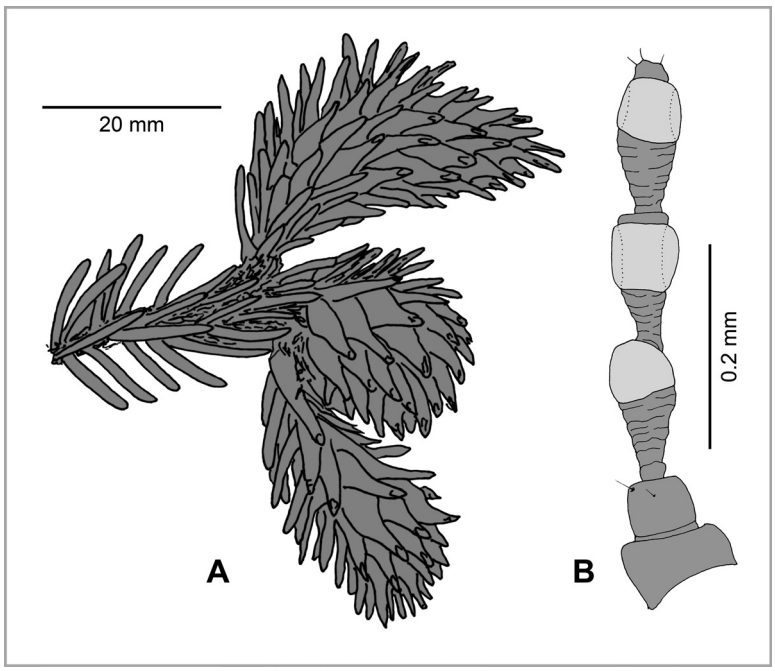

Fig. 4. *Pineus (Pineus) orientalis* (Dreyfus, 1889). **A**. Gall on *Picea orientalis* (after Carter 1976, redrawn). **B**. Antenna of gallicola (after Annand 1928, modified).

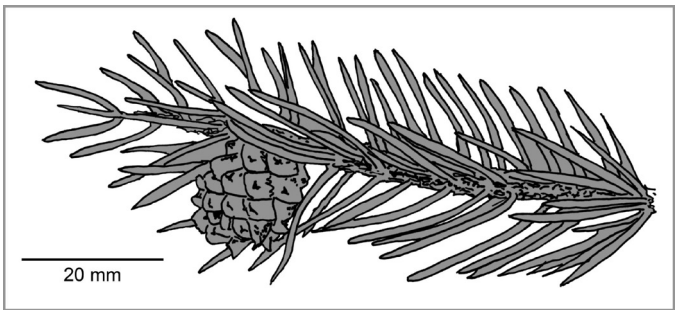

Fig. 5. *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888). Gall on *Picea abies* (after Cholodkovsky, redrawn and modified from Shaposhnikov 1964).

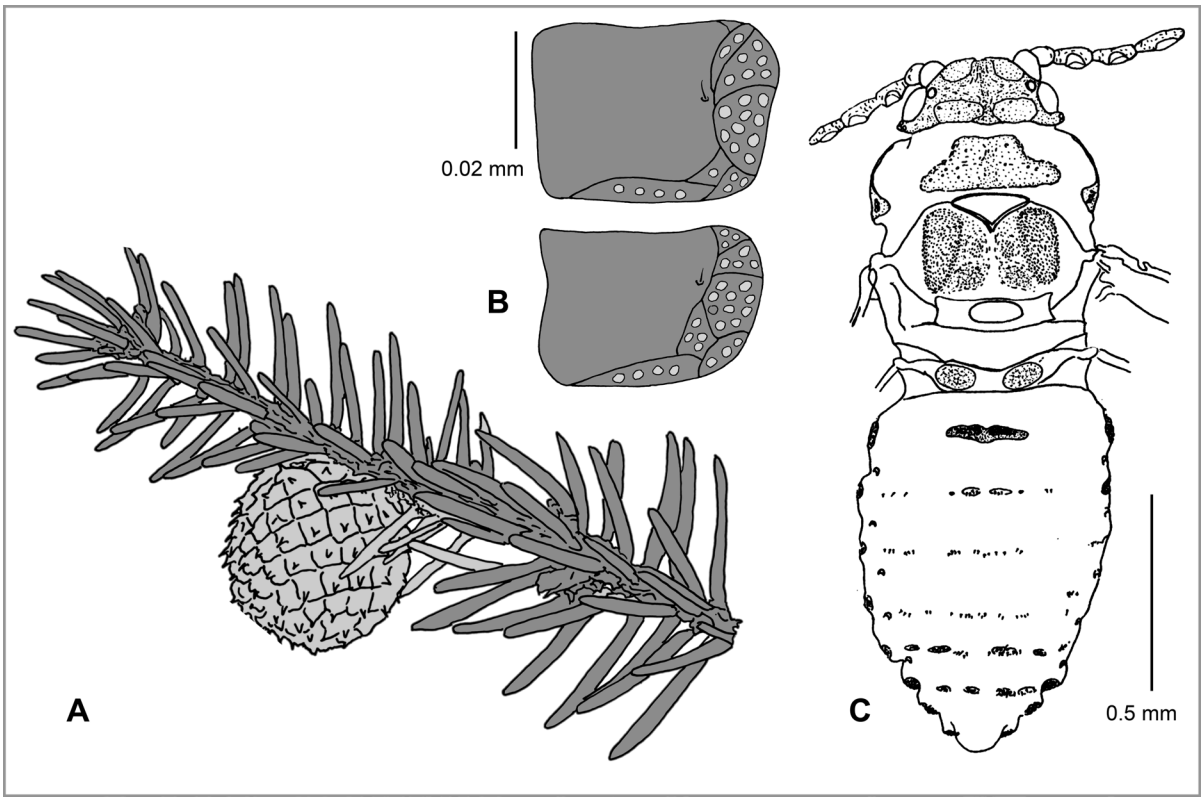

Fig. 6. *Adelges (Dreyfusia) nordmannianae* (Eckstein, 1890). **A**. Gall on *Picea orientalis* (orig.). **B**. First instar hibernating fundatrix, spinal plates on meso- and metathorax (left side), showing arangement of wax gland pits (after Eichhorn 1956). **C**. Gallicola (after Carter 1971, redrawn and slightly modified from Heie 2004).

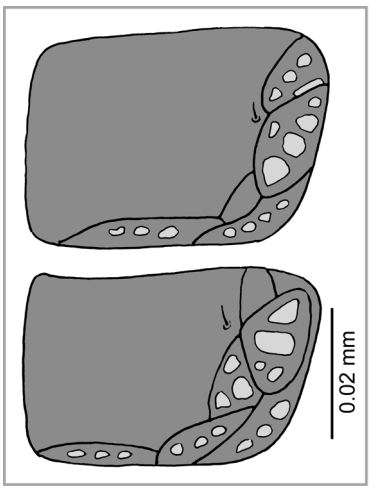

Fig. 7. *Adelges (Dreyfusia) merkeri* (Eichhorn, 1957). First instar hibernating fundatrix, spinal plates on meso- and metathorax (left side), showing arangement of wax gland pits (after Eichhorn 1956, modified).

Fig. 8. *Adelges (Adelges) laricis* Vallot, 1836. Galls on *Picea abies*. **A**, **D**. Almost mature. **B**. Young. **C**. Half-grown. **E**. Abandoned gall (in winter).

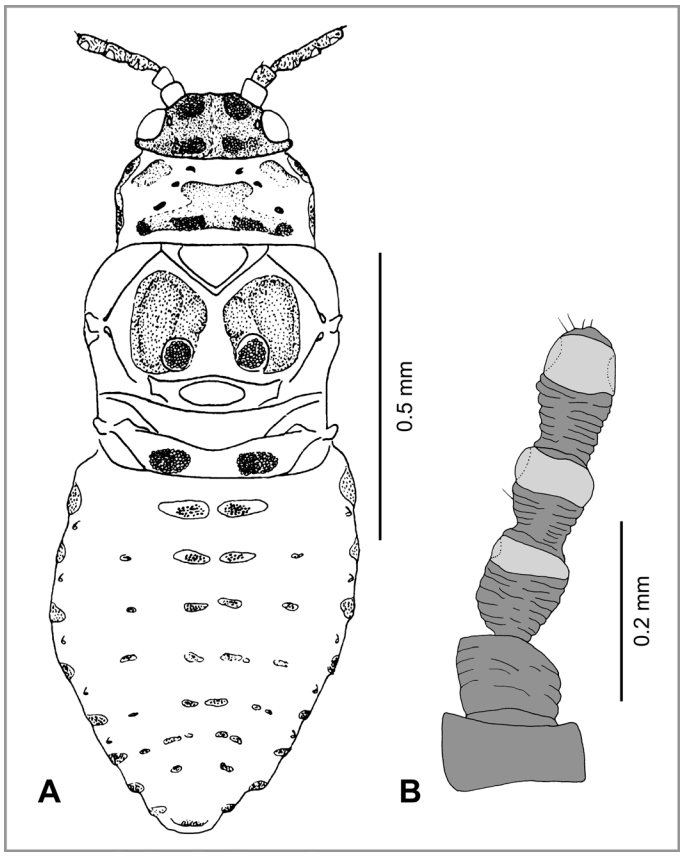

Fig. 9. *Adelges (Adelges) laricis* Vallot, 1836. **A**. Sexupara (after Carter 1971, modified and redrawn from Heie 2004). **B**. Antenna of gallicola (after Annand 1928, modified).

Fig. 10. *Adelges (Adelges) tardus* (Dreyfus, 1888). Galls on *Picea abies*. **A–B**. Almost full-grown. **C**. Almost mature. **D–E**. Mature, first gallicolae have emerged. **F–G**. Fully opened galls. Scale bars: 10 mm.

Fig. 11. *Adelges (Adelges) tardus* (Dreyfus, 1888) on *Picea abies*. **A**. Mature, opened gall with alate gallicolae on surface. **B–I**. Gallicolae laying eggs on needles in vicinity of their mother gall. **J–K**. Gallicolae *in vitro*. Scale bars for E–K: 1 mm.

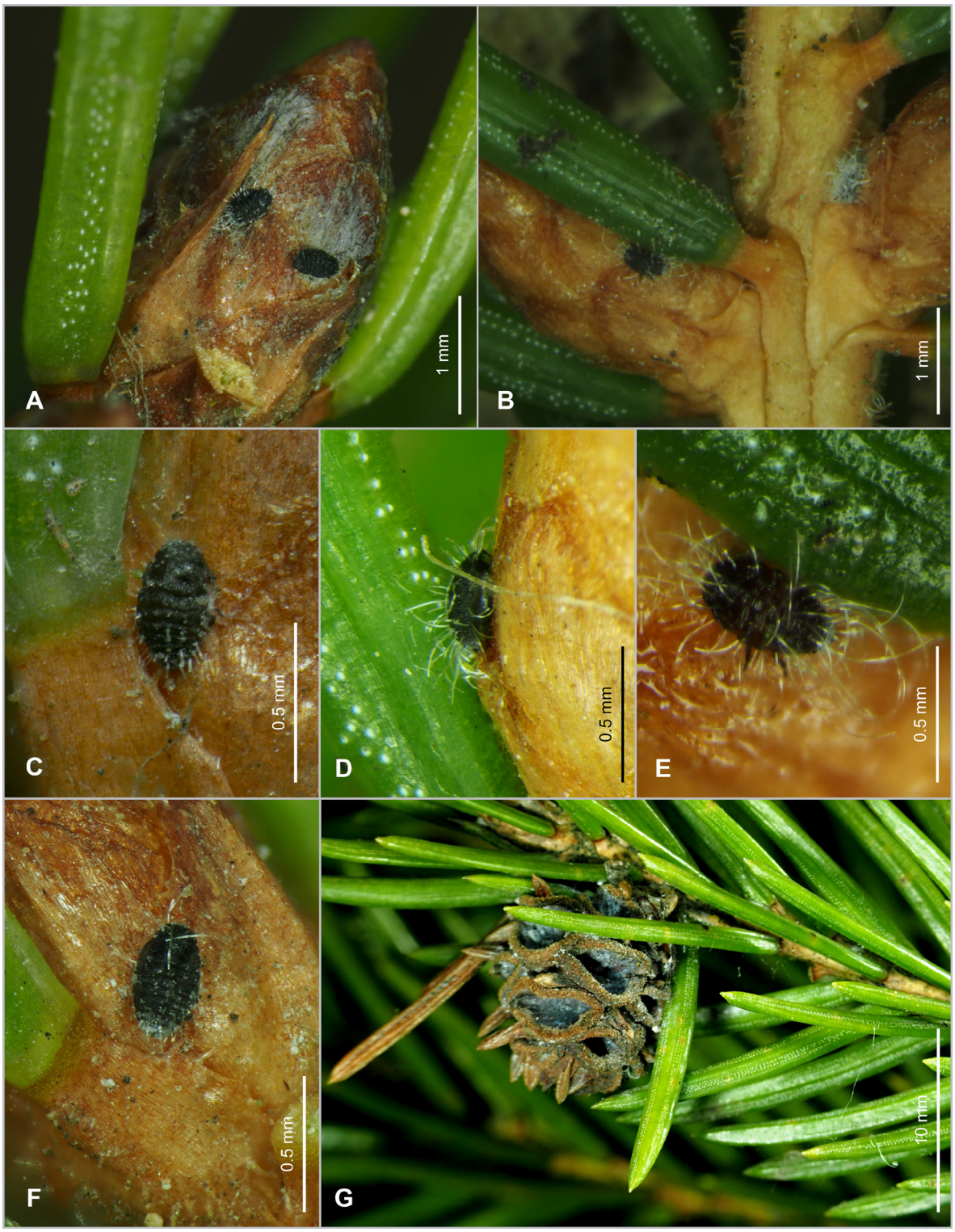

Fig. 12. *Adelges (Adelges) tardus* (Dreyfus, 1888). **A–F**. Hibernating pseudofundatrix nymphs on buds of *Picea abies*. Note the sparse, long, more or less straight wax filaments (most of them worn off, except in D–E). Often together with nymphs of *A. (Sacciphantes) abietis* (Linnaeus, 1758), whose wax filaments are dense, flattened and strongly curled (the specimen to the right in B). The nymphs usually hibernate on the surface of the bud, whereas those of *A. abietis* prefer bud bases and axils. **G**. Hibernating nymphs, which are easiest to find in the vicinity of the previous summer's galls.

Fig. 13. A–C. *Adelges (Adelges) tardus* (Dreyfus, 1888). Wax-covered pseudofundatrices at bases of developing galls on *Picea abies*. **D**. As A–C, but with the wax wool brushed off to expose the pseudofundatrix and her eggs.

Fig. 14. A–B. Developing galls of *Adelges (Adelges) tardus* (Dreyfus, 1888) on *Picea abies*, close to galls of *A. (Sacciphantes) abietis* (Linnaeus, 1758). **C**. Half-grown galls of *A. tardus* and *A. abietis* on the same twig. Note the tufts of protruding needles on the *A. tardus* galls, apparently due to interference from *A. abietis*. Scale bars: 10 mm.

Fig. 15. *Adelges (Gilletteella) cooleyi* (Gillette, 1907). Galls on *Picea pungens*. Photo Whitney Cranshaw, Colorado State University, Bugwood.org (CC BY 3.0 US, https://creativecommons.org/licenses/by/3.0/us/, downloaded via http://www.forestpests.org/vd/images/5422254-SMPT.jpg).

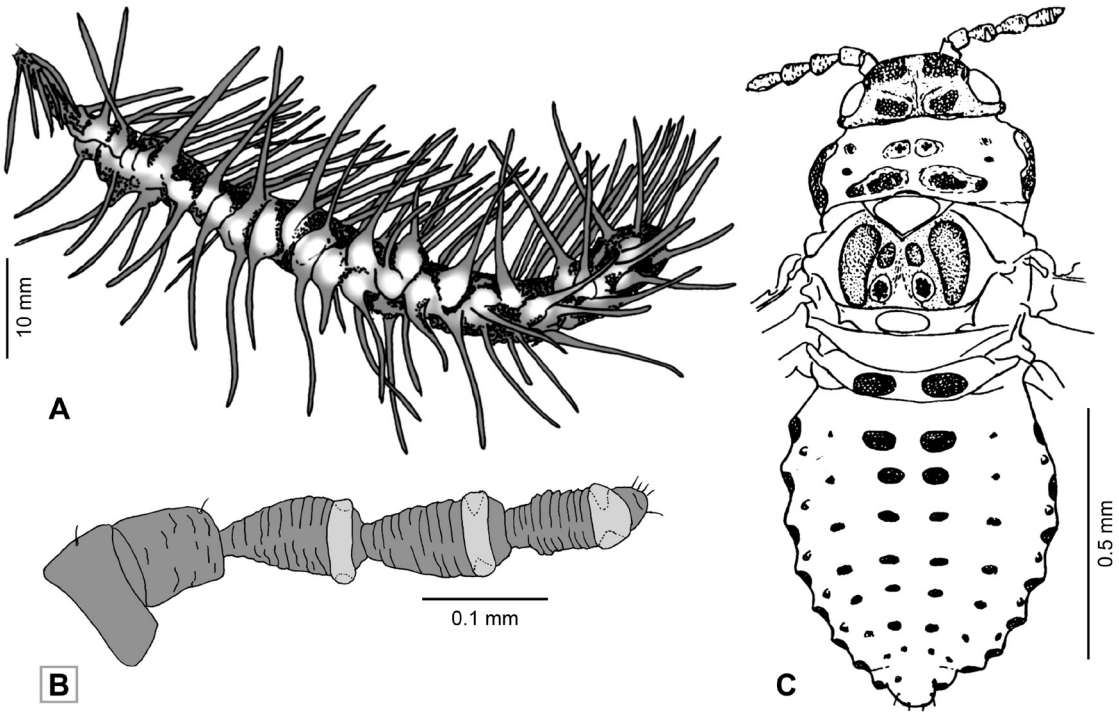

Fig. 16. *Adelges (Gilletteella) cooleyi* (Gillette, 1907). **A**. Gall on *Picea* (after Carter 1976). **B**. Antenna of gallicola (modified from Annand 1928). **C**. Sexupara (after Carter 1971, redrawn and modified from Heie 2004).

Fig. 17. *Adelges (Sacciphantes) abietis* (Linnaeus, 1758), galls on *Picea abies*. **A**–**B**. Almost full-grown. **C**. Half-grown. Colouration typical for galls growing in open sites. Scale bars: 10 mm.

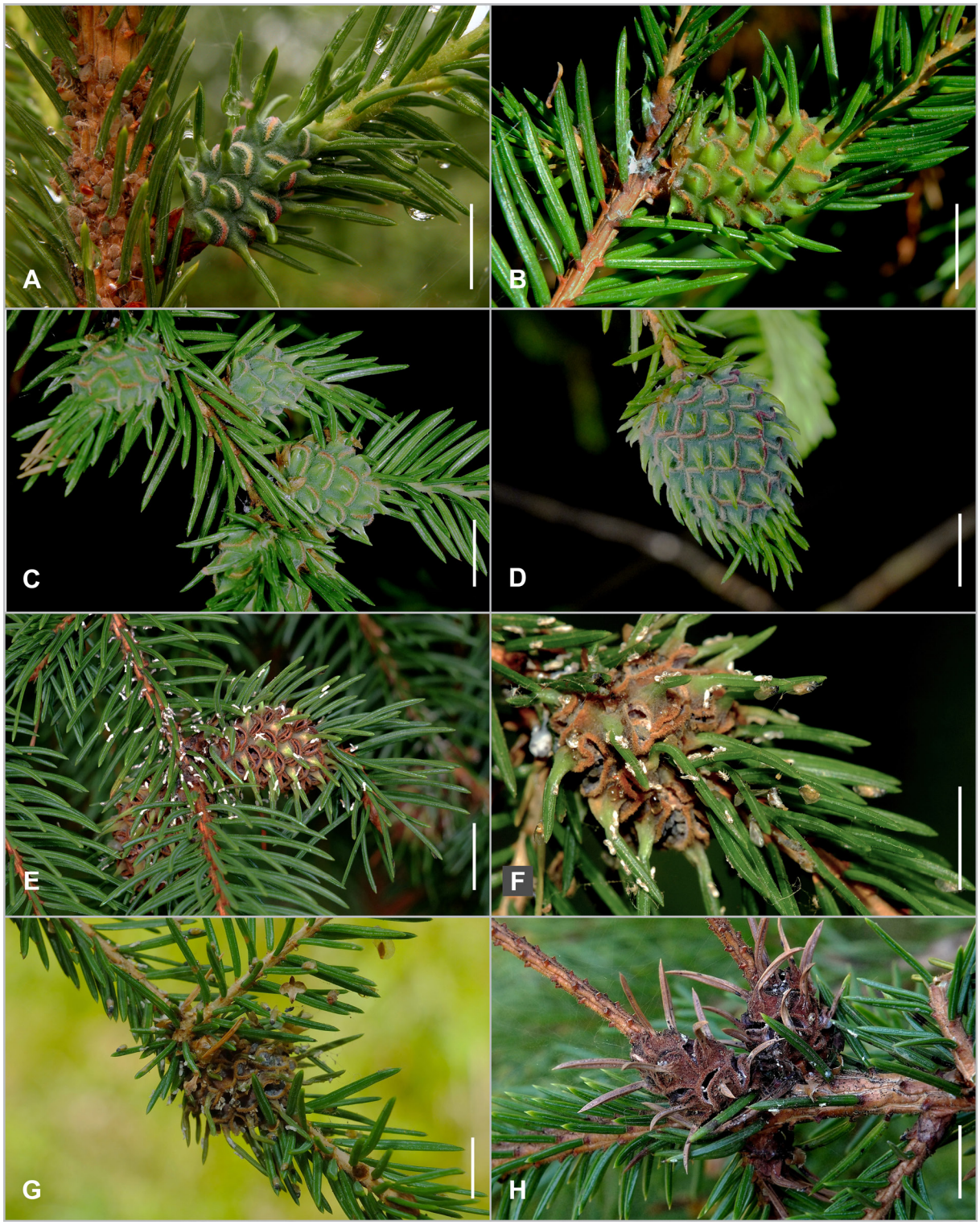

Fig. 18. *Adelges (Sacciphantes) abietis* (Linnaeus, 1758), galls on *Picea abies*. **A–D**. Galls from different sites showing variation in colouration. **A**. From a semi-open site. **B**. In semi-shade. **C–D**. In deep shade. **E–F**. Newly opened galls with exuviae and alate gallicolae around. **G–H**. Galls from previous summer. Note the colony of *Cinara pilicornis* (Hartig, 1841) on the stem in A. Scale bars: 10 mm.

Fig. 19. *Adelges (Sacciphantes) abietis* (Linnaeus, 1758) on *Picea abies*. The gallicolae fly only a very short distance from their mother gall (**A–B**), where they lay their eggs (**C–E**). A majority of the eggs remain on the mother's dorsum, sheltered by her wings. Newly hatched alatae are red-brown (**F–G**), head and thorax darkening with age (**I**).

Fig. 20. *Adelges (Sacciphantes) abietis* (Linnaeus, 1758) on *Picea abies* in winter. **A**. First instar exuvium and second instar nymphs. **B**. First instar exuvium. **C–D**. Second instar nymphs, in D with wax filaments worn off.

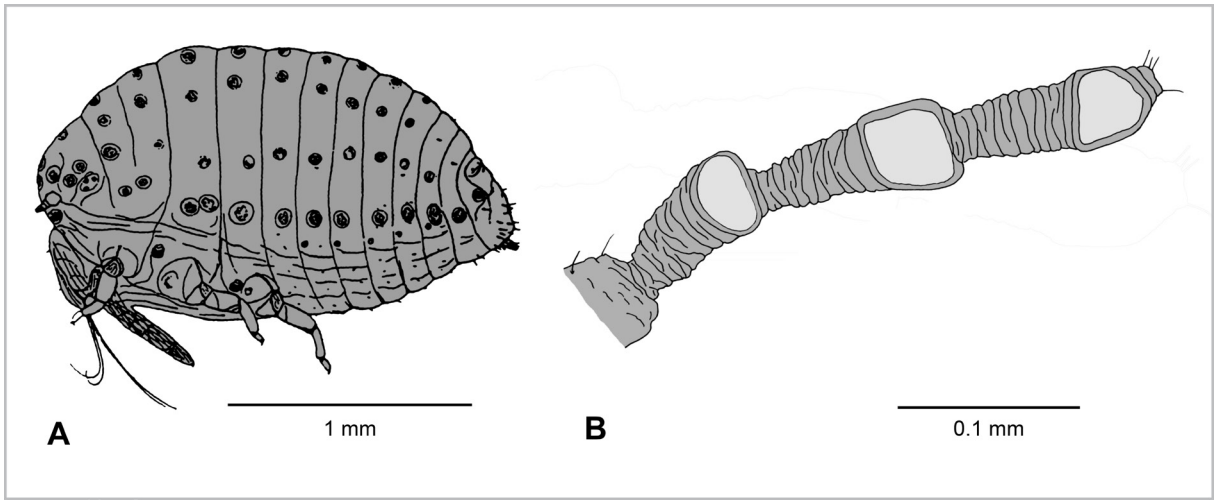

Fig. 21. *Adelges (Sacciphantes) abietis* (Linnaeus, 1758). **A**. Adult pseudofundatrix. **B**. Antenna of alate gallicola. (After Börner 1908, redrawn and modified.)

Fig. 22. *Adelges (Sacciphantes) viridis* (Ratzeburg, 1843). **A–B**. Abandoned galls on *Picea abies*. **C**. Alate gallicola (on *Larix decidua*).

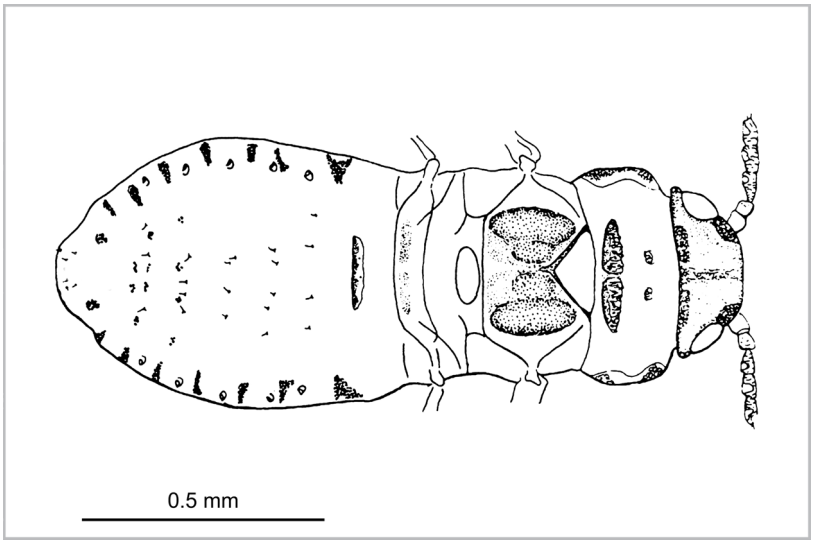

Fig. 23. *Adelges (Sacciphantes) viridis* (Ratzeburg, 1843), sexupara (after Carter 1971, redrawn and modified from Heie 2004).

Fig. 24. *Elatobium abietinum* (Walker, 1849). Colony on needles of *Picea pungens*.

Fig. 25. *Aulacorthum (Aulacorthum) solani* (Kaltenbach, 1843). Aptera on *Aquilegia vulgaris* L. (Ranunculaceae).

Fig. 26. *Aphis (Aphis) fabae* Scopoli, 1763. Colony on *Philadelphus coronarius* L. (Hydrangeaceae).

Fig. 27. *Mindarus obliquus* (Cholodkovsky, 1896), small colonies on *Picea glauca.* Apterae and young alatae (with wing pads). The ant in B is *Lasius niger* (Linnaeus, 1758). Scale bars: 1 mm.

Fig. 28. *Cinara (Cinara) piceae* (Panzer, 1801) on *Picea abies*. Colonies on upper part of trunk of young tree. **A**. Apterae with small nymphs, attended by *Lasius niger* (Linnaeus, 1758). **B–C**. Half-grown and full-grown young alatae, and a few apterae.

Fig. 29. *Cinara (Cinara) piceae* (Panzer, 1801) on *Picea abies*. Alatae with young nymphs, attended by *Camponotus herculeanus* (Linnaeus, 1758).

Fig. 30. *Cinara (Cinara) pilicornis* (Hartig, 1841) on *Picea abies*. Typical mid-summer colonies on branch undersides.

Fig. 31. *Cinara (Cinara) pilicornis* (Hartig, 1841). Newly founded colonies on young shoots of *Picea abies*. Wax cover intact and pattern very distinct. Note the thick wax wool on the alatae (A, D).

Fig. 32. *Cinara (Cinara) costata* (Zetterstedt, 1828). Colony on underside of a 1–2 year-old twig of *Picea abies*.

Fig. 33. *Cinara (Cinara) costata* (Zetterstedt, 1828) on *Picea abies*, showing different stages of development and deterioration of wax pattern.

Fig. 34. *Cinara (Cinara) pruinosa* (Hartig, 1841). Colony on underside of branch of *Picea abies*, attended by *Formica aquilonia* Yarrow, 1955. Adult and juvenile apterae.

Fig. 35. *Cinara (Cinara) pruinosa* (Hartig, 1841). Colony on underside of branch of *Picea abies*, attended by *Formica aquilonia* Yarrow, 1955 (D). Adult apterae, juvenile apterae and alatae.

Fig. 36. *Cinara (Cinara) pruinosa* (Hartig, 1841) on *Picea abies*. **A**. Branch with colony and attendant *Formica aquilonia* Yarrow, 1955 on underside. **B–C**. Adult and juvenile apterae. The dark individuals are parasitized. **D**. Adult aptera. **E**. Full-grown juvenile aptera.

Fig. 37. *Cinara (Cinara) pruinosa* (Hartig, 1841) on *Picea abies*. **A**. Adult and juvenile apterae, including teneral adults. **B**. Fundatrix with juvenile apterae. **C**. Juvenile and adult fundatrix, attended by *Formica aquilonia* Yarrow, 1955. **D–E**. Alatae with newly founded colonies.

Fig. 38. *Cinara (Cinara) piceicola* (Cholodkovsky, 1896). Apterae and juveniles on branches of *Picea abies*, attended by *Formica aquilonia* Yarrow, 1955.

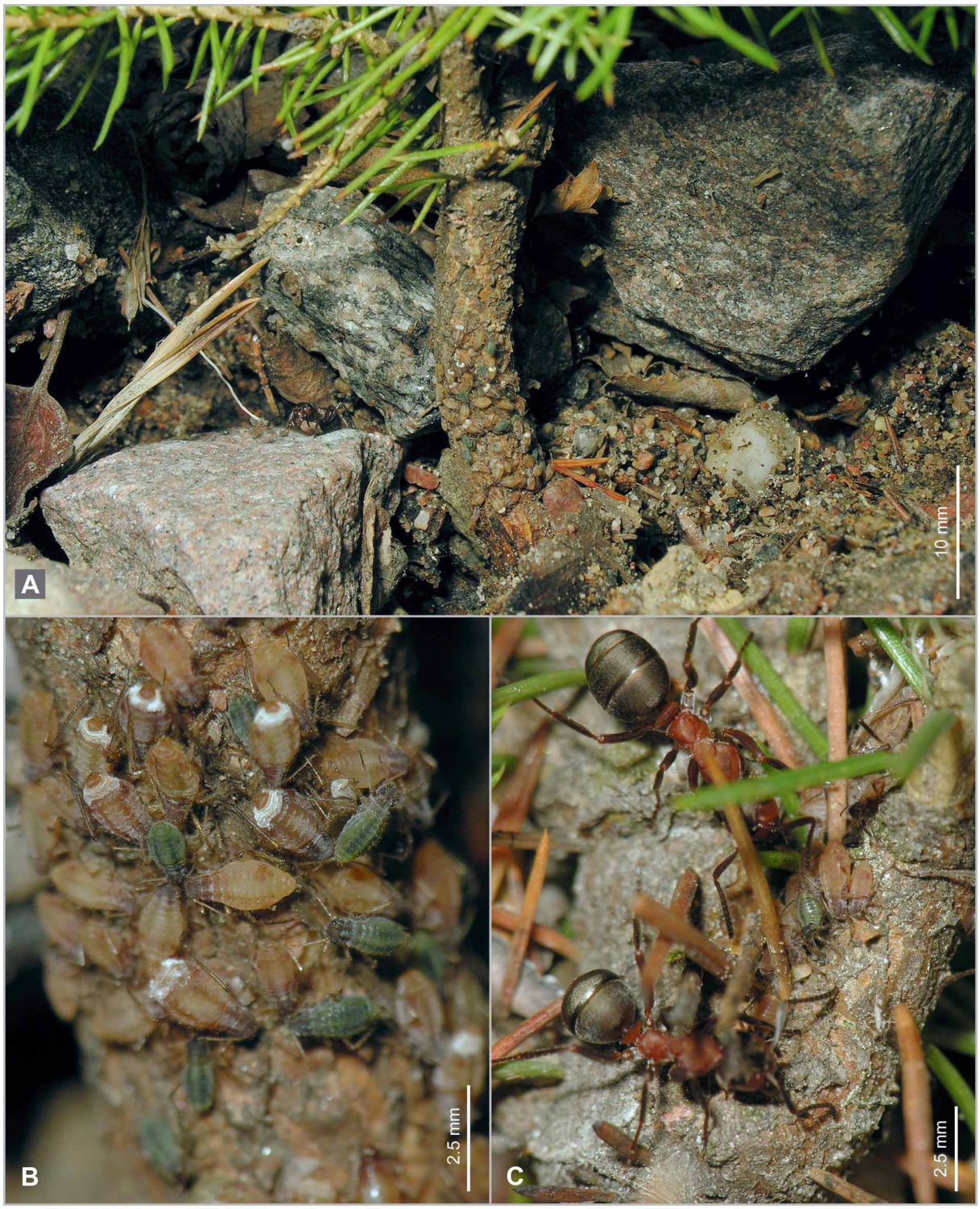

Fig. 39. *Cinara (Cinara) piceicola* (Cholodkovsky, 1896) on dwarfish *Picea abies*. **A–B**. Colony of apterae and oviparae among gravel at ground level. **C**. Apterae on stem, attended by *Formica lugubris* Zetterstedt, 1838.

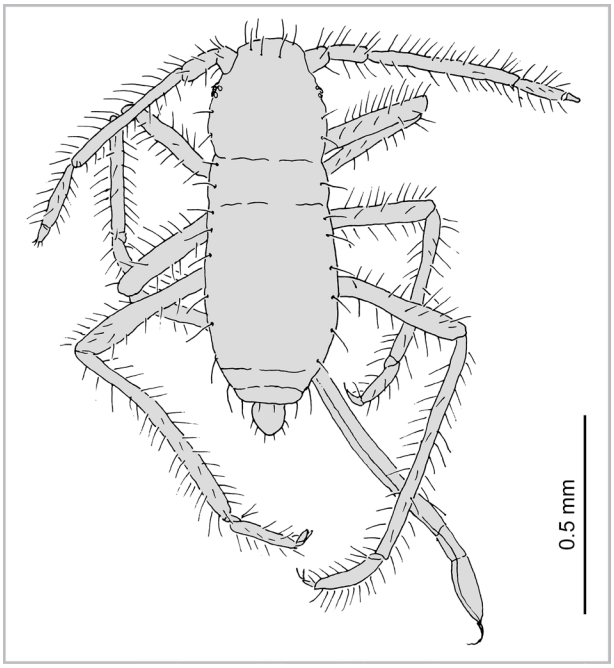

Fig. 40. *Prociphilus (Prociphilus) bumeliae* (Schrank, 1801). Young aptera from *Abies* root (after Heie 2004, redrawn).

Fig. 41. *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888). Apterous progredientes on undersides of needles of *Abies koreana*. Note the conspicuous coarse wax filaments.

Fig. 42. *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888). **A**. Apterae (and neosistentes) on *Abies concolor*. **B–C**. Apterae with eggs on *A. alba* and *Abies* sp. **D**. Adult and juvenile apterae on *A. koreana* (freeze-dried sample). **E**. Juvenile alata on *A. sibirica*.

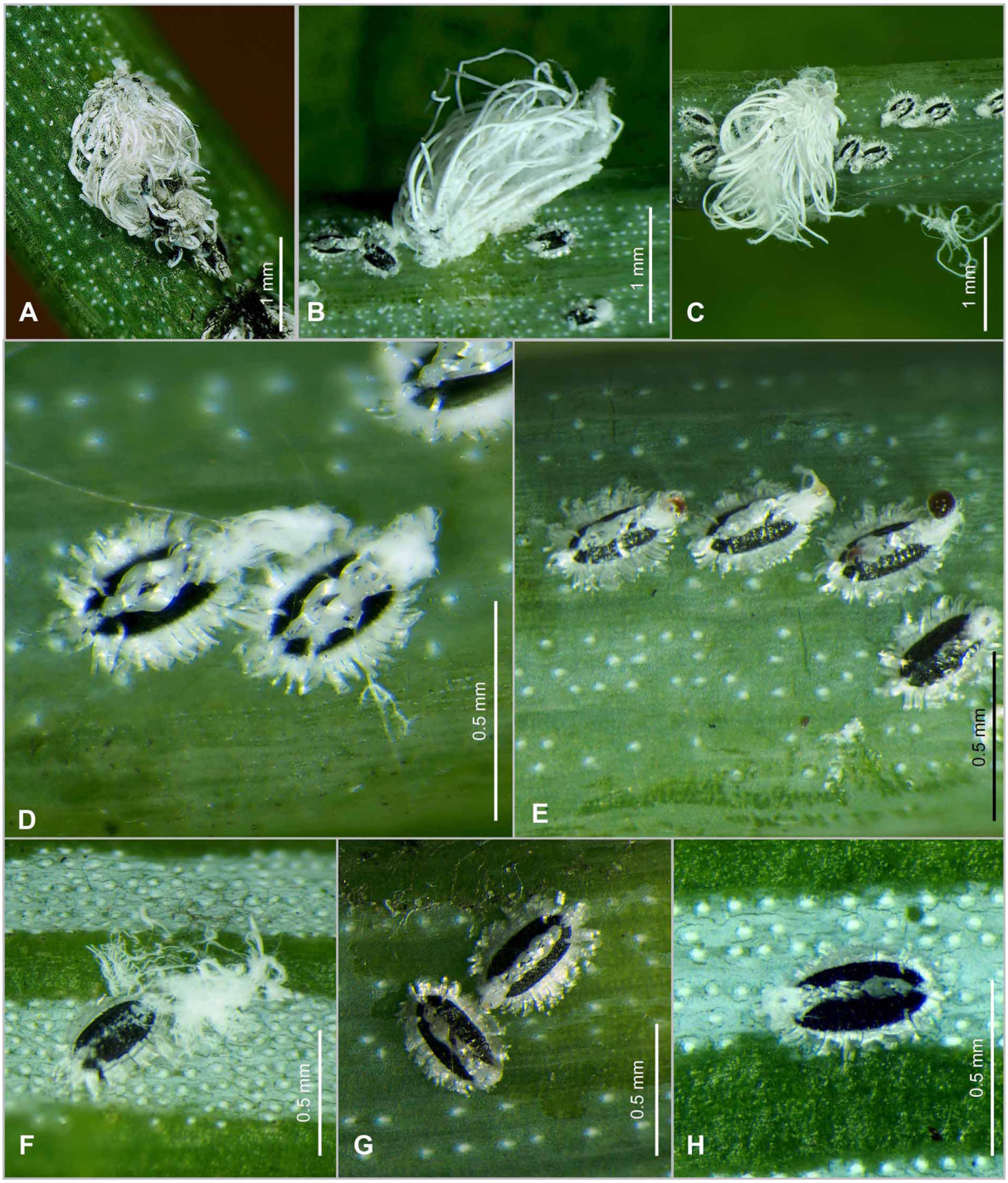

Fig. 43. *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888) on needles of *Abies concolor*. **A–C**. Apterae with first instar hibernating nymphs (neosistens). **D–H**. Neosistens.

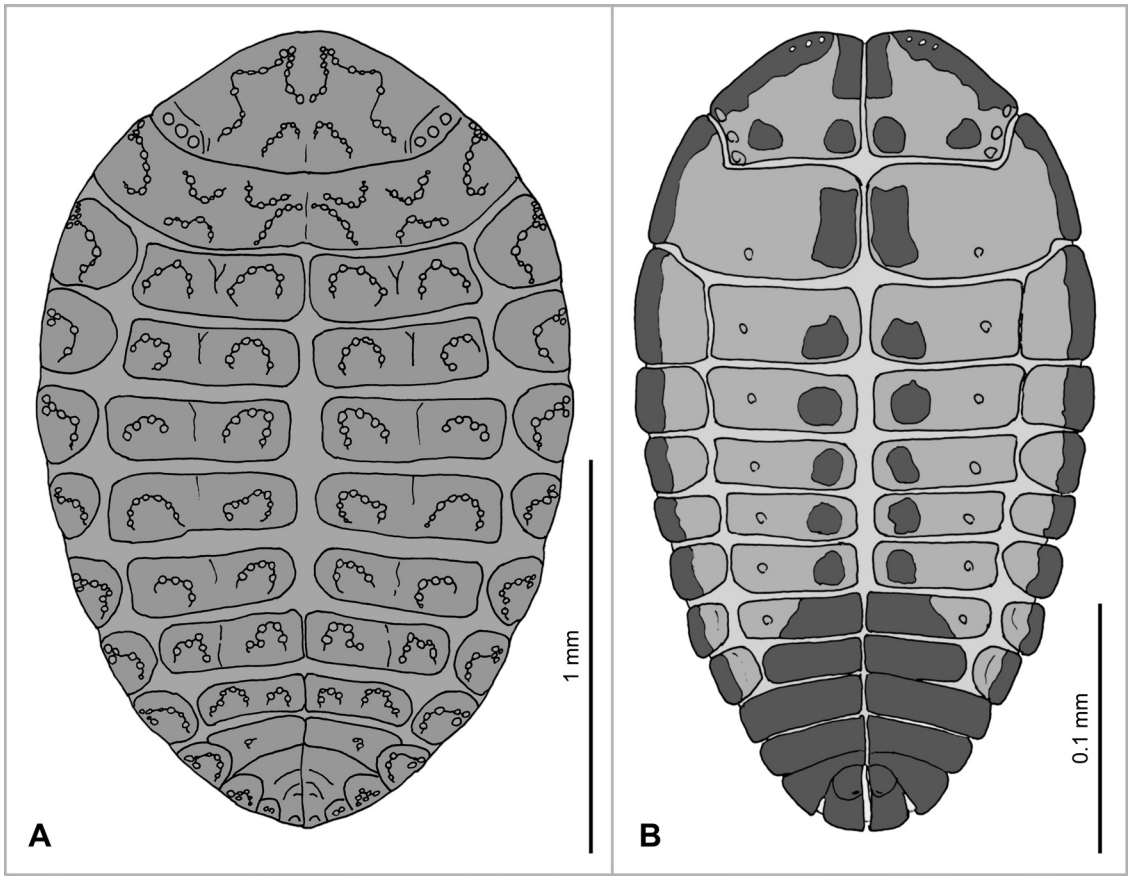

Fig. 44. *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888). **A**. Adult progrediens, showing arrangement of plates and wax gland pits (after Inouye 1953, modified). Note the wax gland pattern, giving rise to 'half-pipe'-shaped wax filaments. **B**. Hibernating first instar nymph (neosistens), with wax-exuding areas shaded (after Inouye 1953, modified and redrawn from Pashchenko 1988).

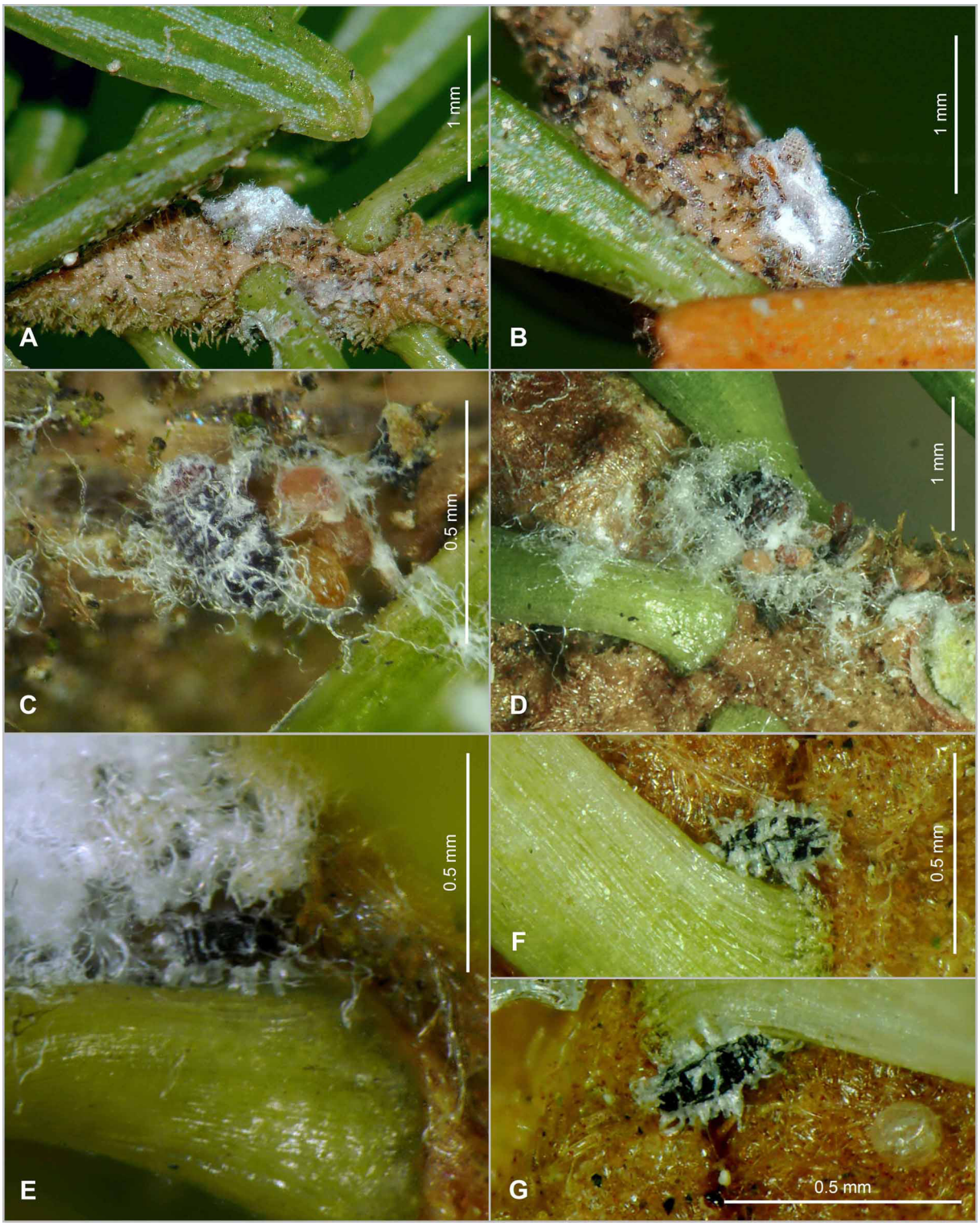

Fig. 45. *Adelges (Dreyfusia) nordmannianae* (Eckstein, 1890) on *Abies alba*. **A–D**. Apterous progredientes with eggs. Note the thin, woolly wax filaments. **E–G**. First instar hibernating nymphs (neosistens).

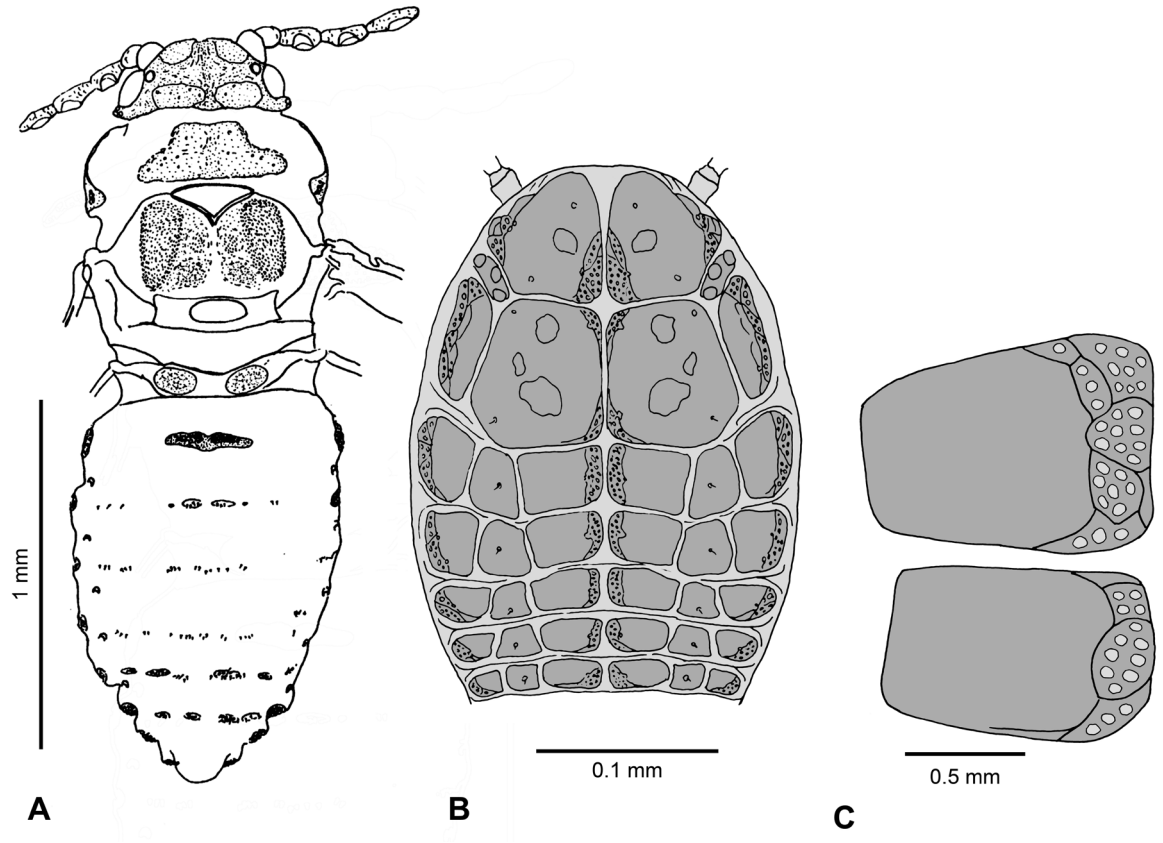

Fig. 46. *Adelges (Dreyfusia) nordmannianae* (Eckstein, 1890). **A**. Gallicola (after Carter 1971, redrawn from Heie 2004). **B–C**. Hibernating first instar nymph (neosistens). **B**. Habitus, showing arrangement of sclerites plates and wax gland pits (after Schneider-Orelli 1947, modified and redrawn from Börner & Heinze 1957). **C**. Spinal sclerites of meso- and metathorax, left side (after Pschorn-Walcher & Zwölfer 1958, modified and redrawn).

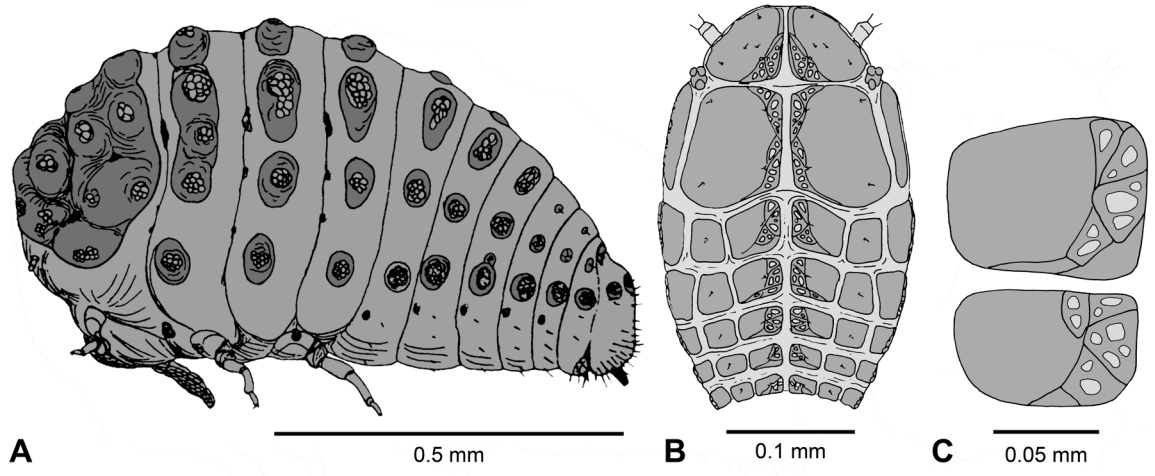

Fig. 47. *Adelges (Dreyfusia) piceae* (Ratzeburg, 1843). **A**. Adult sistens (after Börner 1908, redrawn and modified). **B–C**. Hibernating first instar nymph (neosistens). **B**. Habitus, showing arrangement of sclerites and wax gland pits (after Schneider-Orelli 1947, modified and redrawn). **C**. Spinal sclerites of meso- and metathorax, left side (after Pschorn-Walcher & Zwölfer 1958, modified and redrawn).

Fig. 48. *Mindarus abietinus* (Koch, 1857) on *Abies sibirica.* Colony on young shoot, mostly juvenile alatae.

Fig. 49. *Mindarus abietinus* (Koch, 1857). Adult alatae and young oviparae on needles of *Abies sibirica.*

Fig. 50. *Cinara (Cinara) confinis* Koch, 1856. Colony on underside of branch of *Abies sibirica*.

Fig. 51. *Cinara (Cinara) confinis* Koch, 1856. Colony on branch of *Abies sibirica*. Needles strongly infested by *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888).

Fig. 52. *Cinara (Cinara) confinis* Koch, 1856 on young *Abies sibirica*. Colonies on 1–2 year-old parts of main shoot, attended by *Formica rufa* Linnaeus, 1761. **B–C**. Needles with brown spots and overwintered nymphs from the previous year's infestation of *Adelges (Aphrastasia) pectinatae* (Cholodkovsky, 1888)

Fig. 53. *Cinara (Cinara) curvipes* (Patch, 1912), juvenile alata on *Abies* sp. (from Dransfield & Brightwell 2015, licensed under Creative Commons Attribution 3.0, downloaded 15 Sept. 2015).

Fig. 54. *Cinara (Cinara) pectinatae* Nördlinger, 1880. Colonies (ad. and juv.) on trunk and branches of young *Abies alba*, attended by *Formica polyctena* Förster, 1850.

Fig. 55. *Cinara (Cinara) pectinatae* Nördlinger, 1880. Colonies (mostly juv.) on trunk and branches of young *Abies alba*.

Fig. 56. *Adelges (Sacciphantes) viridis* (Ratzeburg, 1843) on *Larix sibirica*. **A–B**. Dead gallicolae on upper side of needle, with eggs and newly hatched neosistens under the wings. **C–D**. Neosistens on needle. **E**. Neosistens on bark of twig.

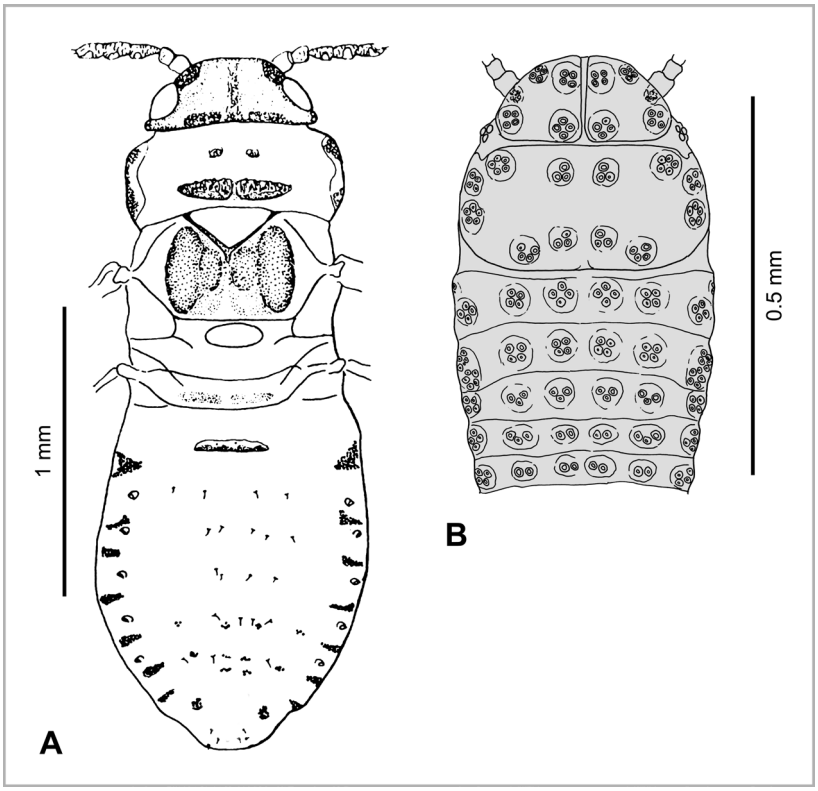

Fig. 57. *Adelges (Sacciphantes) viridis* (Ratzeburg, 1843). **A**. Sexupara. Note wax glands on prothorax (absent in gallicola) (after Carter 1971, redrawn from Heie 2004). **B**. Neosistens (after Schneider-Orelli 1947, modified).

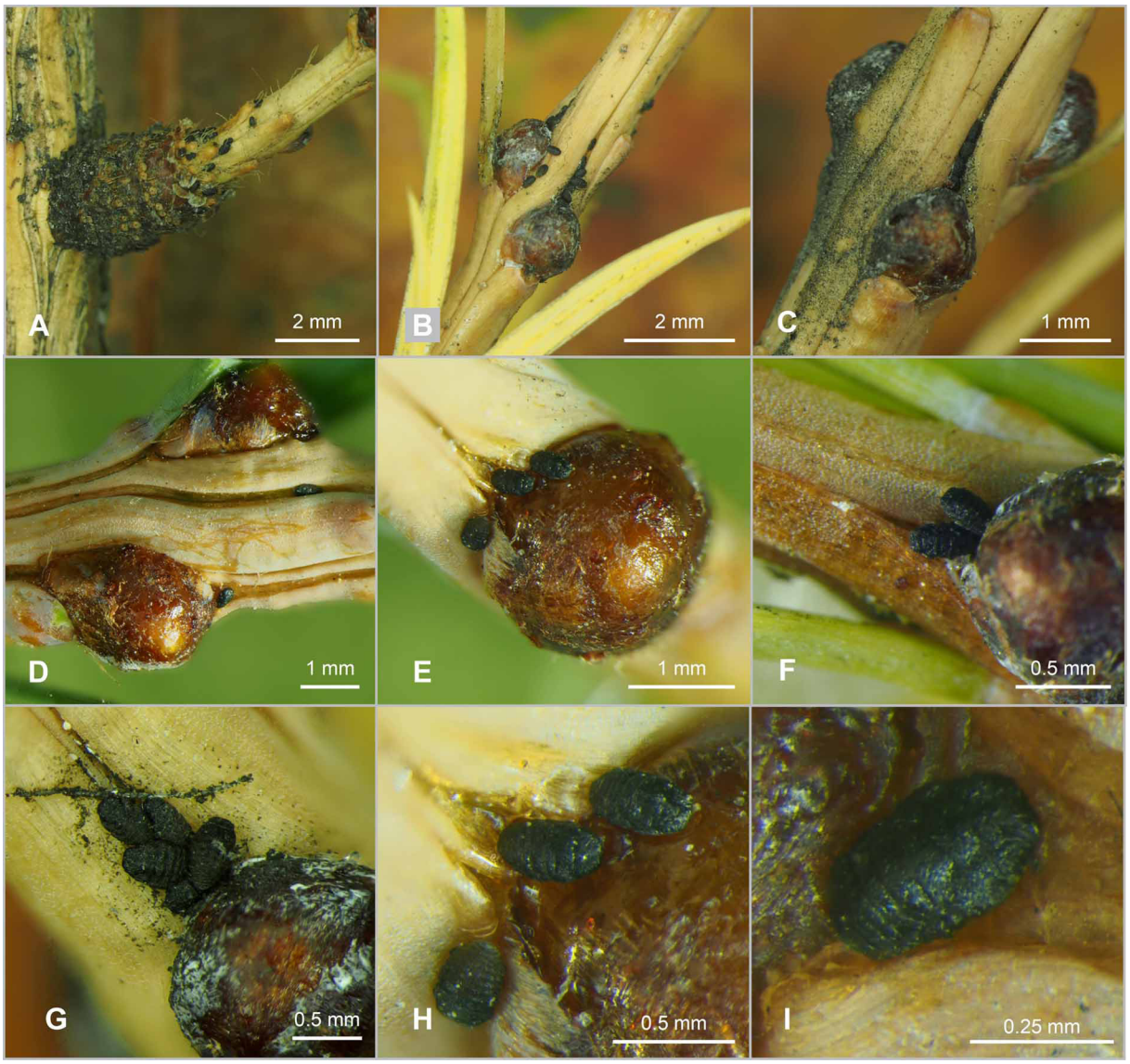

Fig. 58. *Adelges (Adelges) laricis* Vallot, 1836. Neosistentes in winter on twigs of *Larix sibirica*.

Fig. 59. *Adelges (Adelges) laricis* Vallot, 1836. Apterous and alate progredientes on *Larix sibirica*.

Fig. 60. *Adelges (Adelges) laricis* Vallot, 1836. Adult apterous progredientes with eggs and honeydew droplets on *Larix sibirica*. (**A–D**) and *Larix kaempferi* (**E–F**). Scale bars: about 2.5 mm.

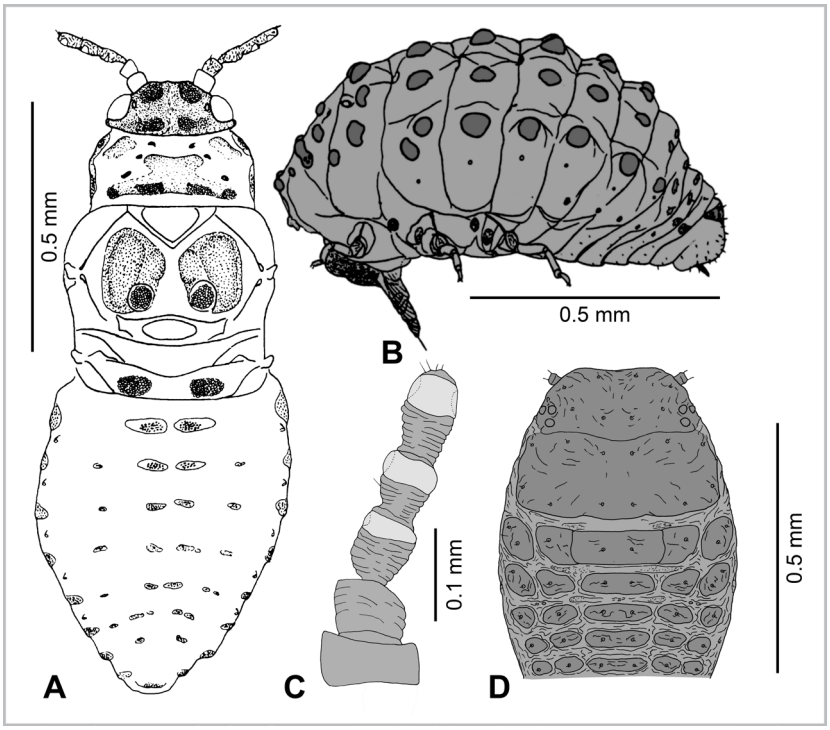

Fig. 61. *Adelges (Adelges) laricis* Vallot, 1836. **A**. Sexupara (after Carter 1971, redrawn from Heie 2004). **B**. Adult apterous progrediens (after Börner 1908, redrawn from Heie 2004). **C**. Antenna of gallicola (after Annand 1928, modified). **D**. Neosistens (after Schneider-Orelli 1947, modified).

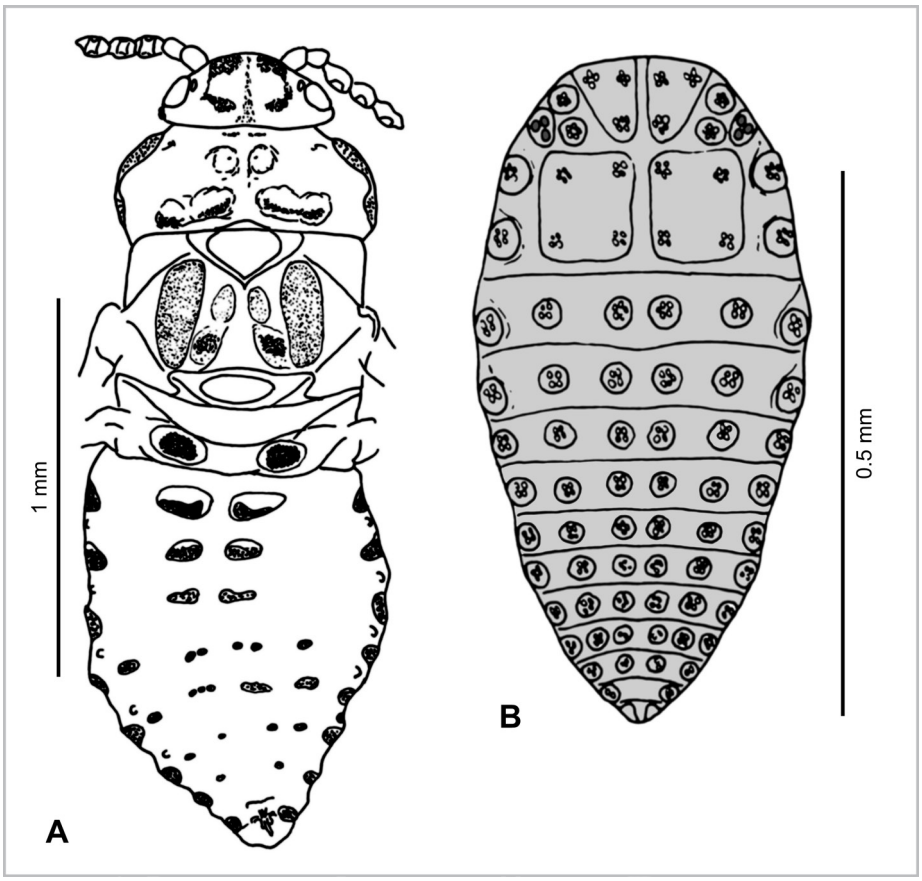

Fig. 62. *Adelges (Cholodkovskya) viridanus* (Cholodkovsky, 1896). **A**. Alata (after Carter 1971, redrawn from Heie 2004). **B**. Neosistens (after Inouye 1953).

Fig. 63. *Cinara (Cinara) laricis* (Hartig, 1839). Adult apterae with juvenile apterae and alatae. **A–D**. On *Larix decidua*. **E**. On *L. sibirica*.

Fig. 64. *Cinara (Cinara) laricis* (Hartig, 1839). Alatae and apterae with nymphs on young cones of *Larix decidua*. Note the wax-powdered venter (in C).

Fig. 65. *Cinara (Cinara) laricis* (Hartig, 1839) on *Larix decidua* in late autumn. **A**. Ovipara on twig. **B**. Eggs between scales of previous year's cone. Preanal wax ring absent in the ovipara, hence the eggs without wax cover.

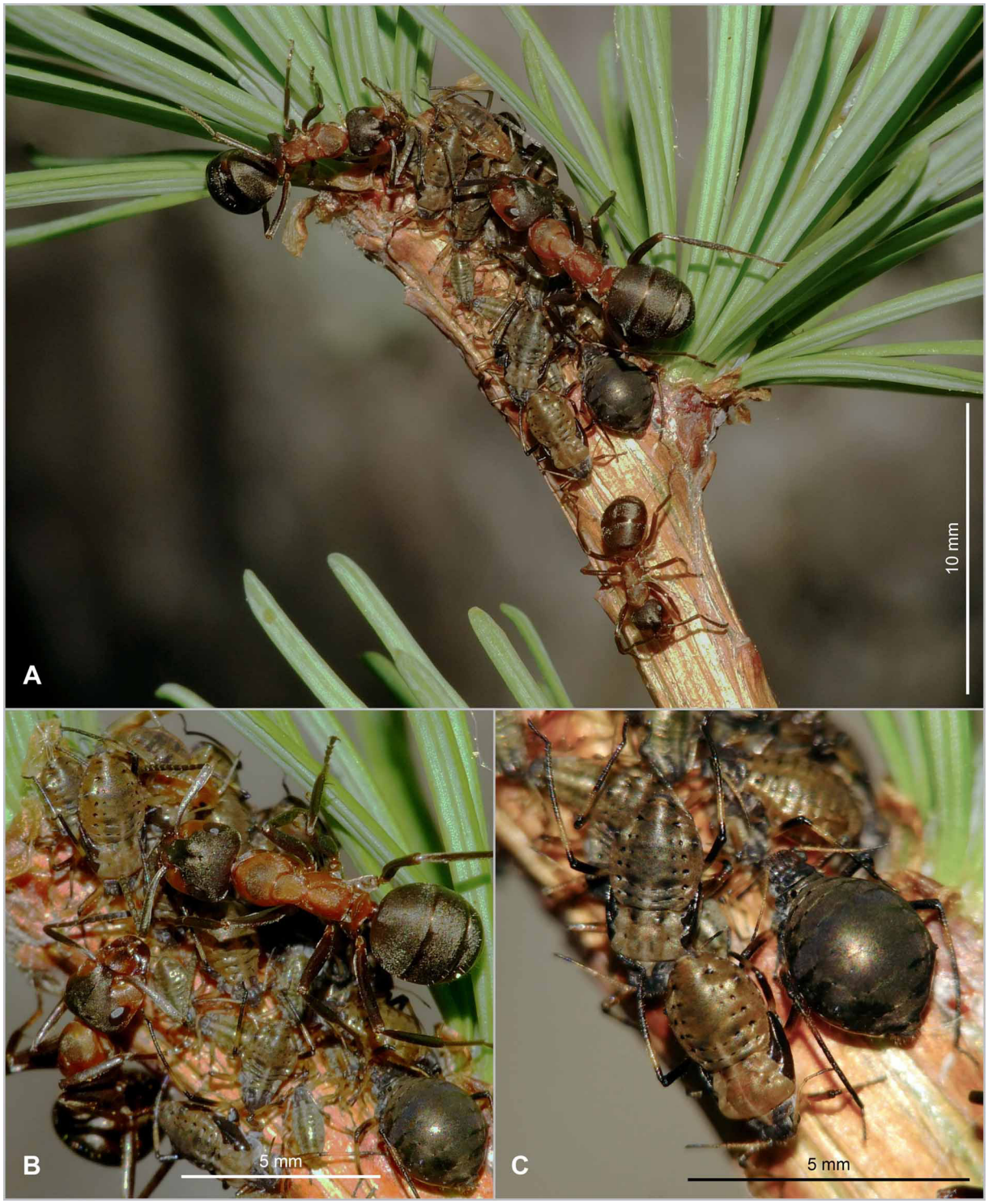

Fig. 66. *Cinara (Cinara) cuneomaculata* (del Guercio, 1909). Fundatrix with young (mostly alatae) on twig of *Larix kaempferi*, attended by *Formica rufa* Linnaeus, 1761.

Fig. 67. *Cinara (Cinara) cuneomaculata* (del Guercio, 1909). **A–D, F**. Among needles of *Larix sibirica*. **E**. Among needles of *L. kaempferi*. Note the variation in the wax pattern.

Fig. 68. *Cinara (Cinara) cuneomaculata* (del Guercio, 1909) on *Larix decidua* in late autumn. **A–B**. Oviparae on old twigs and cones. **C**. Eggs between scales of old cone. Note the preanal wax ring of the oviparae and the wax powder on the eggs.

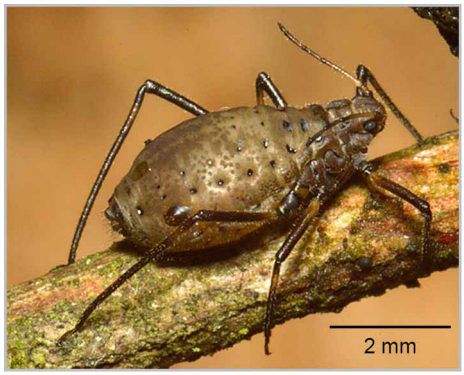

Fig. 69. *Cinara (Cinara) kochiana* (Börner, 1939). Aptera (from Dransfield & Brightwell 2015, licensed under CC BY 3.0 US, https://creativecommons.org/licenses/by/3.0/us/legalcode, downloaded 27 Oct. 2015).

Fig. 70. *Adelges (Gilletteella) cooleyi* (Gillette, 1907). Apterae and neosistentes on needles of *Pseudotsuga menziesii*.

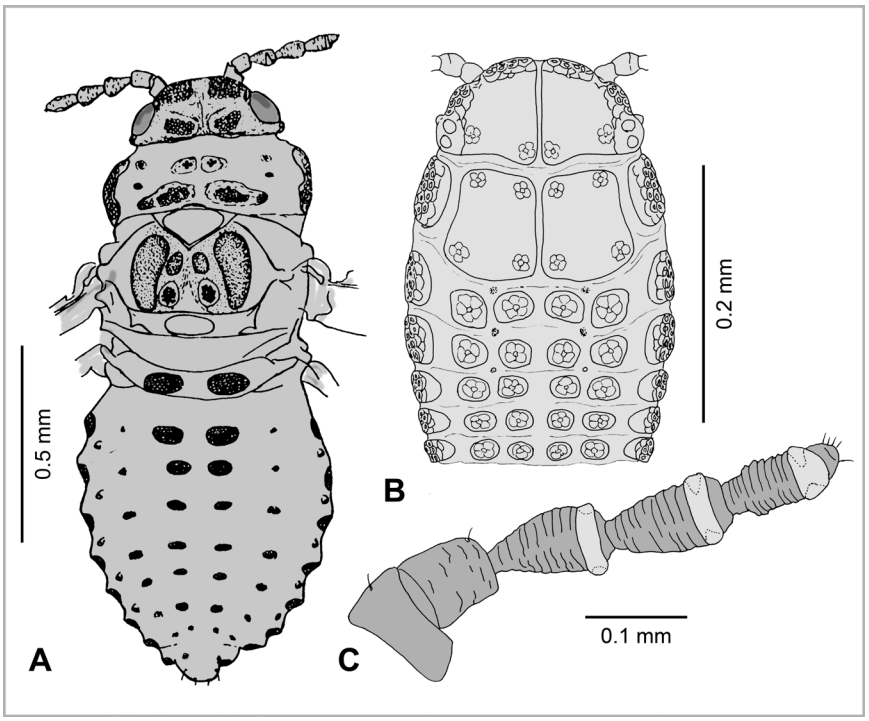

Fig. 71. *Adelges (Gilletteella) cooleyi* (Gillette, 1907). **A**. Gallicola (after Carter 1971, redrawn from Heie 2004). **B**. Neosistens (after Schneider-Orelli 1947). **C**. Antenna of gallicola (after Annand 1928, modified).

Fig. 72. *Pineus (Pineus) pini* (Macquart, 1819) on *Pinus sylvestris*. **A**. Old colony on dwarfish pine. **B**–**C**. Apterae on trunk of young tree.

Fig. 73. *Pineus (Pineus) pini* (Macquart, 1819) on young growth of *Pinus sylvestris*. **A**. Apterae. **B–D**. Apterae and juvenile alatae. **E–H**. Alatae. **I**. Apterae with wax wool removed.

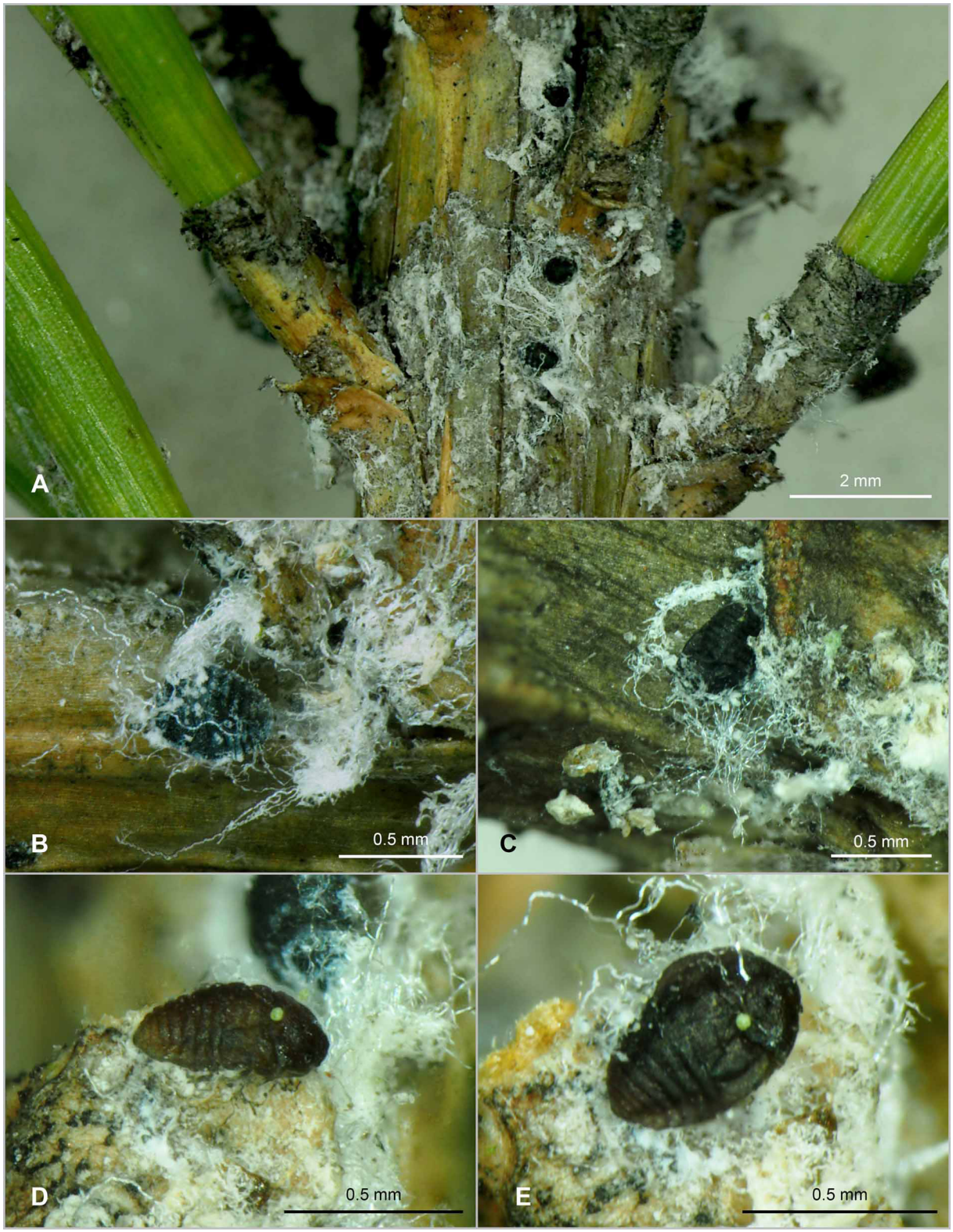

Fig. 74. *Pineus (Pineus) pini* (Macquart, 1819) on *Pinus sylvestris* in winter. **A**. Colony in top of dwarfish plant growing on exposed rock. **B**. Juvenile aptera. **C–E**. Juvenile alatae, excess wax wool and covering bark flakes removed.

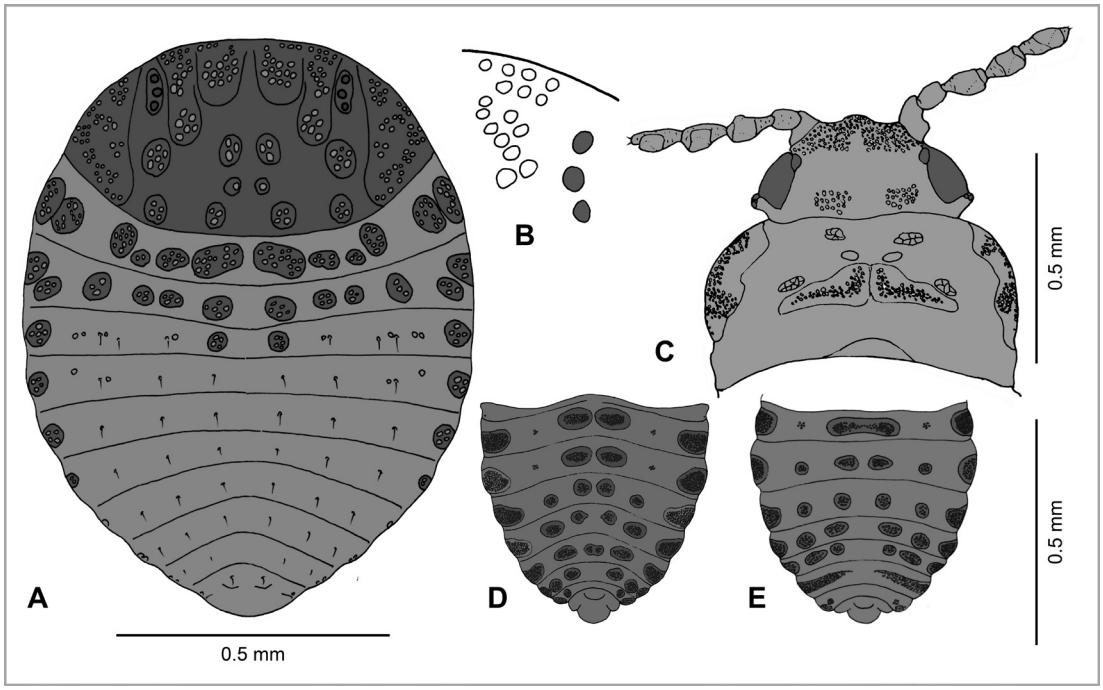

Fig. 75. *Pineus (Pineus) pini* (Macquart, 1819). **A**. Adult aptera (after Inouye 1953, modified from Pashchenko 1988). **B**. As A, showing outer intraocular group of wax gland pits. **C**. Adult alata, head and prothorax, showing arrangement of wax glands (after Carter 1971, modified from Heie 2004). **D–E**. Adult alata, abdomen (after Börner, modified from Heie 2004).

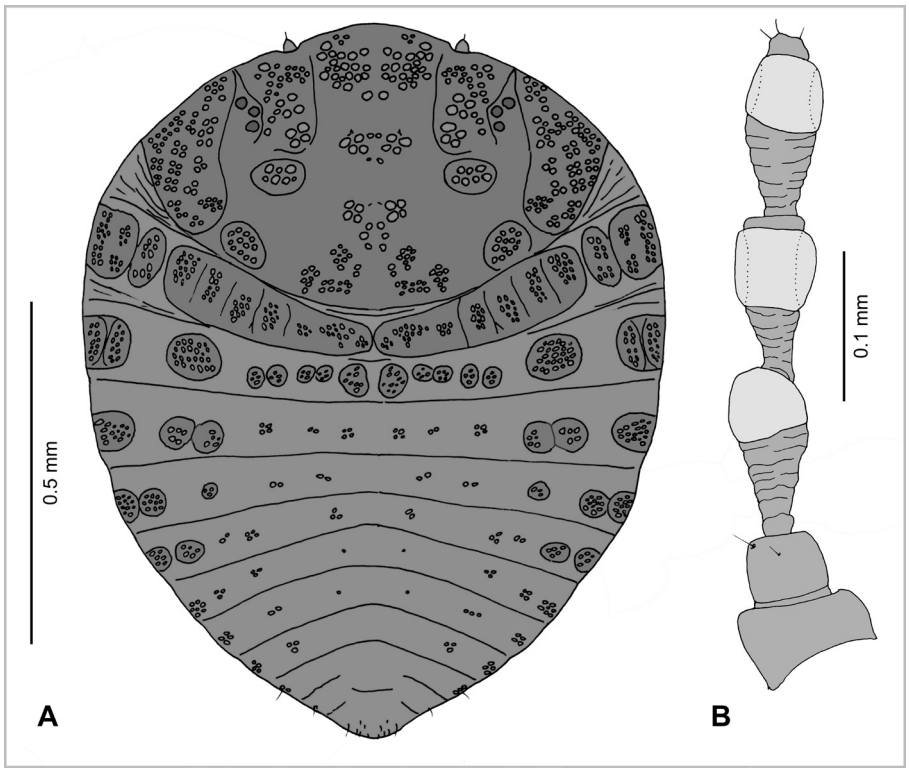

Fig. 76. *Pineus (Pineus) orientalis* (Dreyfus, 1889). **A**. Aptera (after Inouye 1953, modified from Pashchenko 1988). **B**. Antenna of gallicola (after Annand 1928, modified).

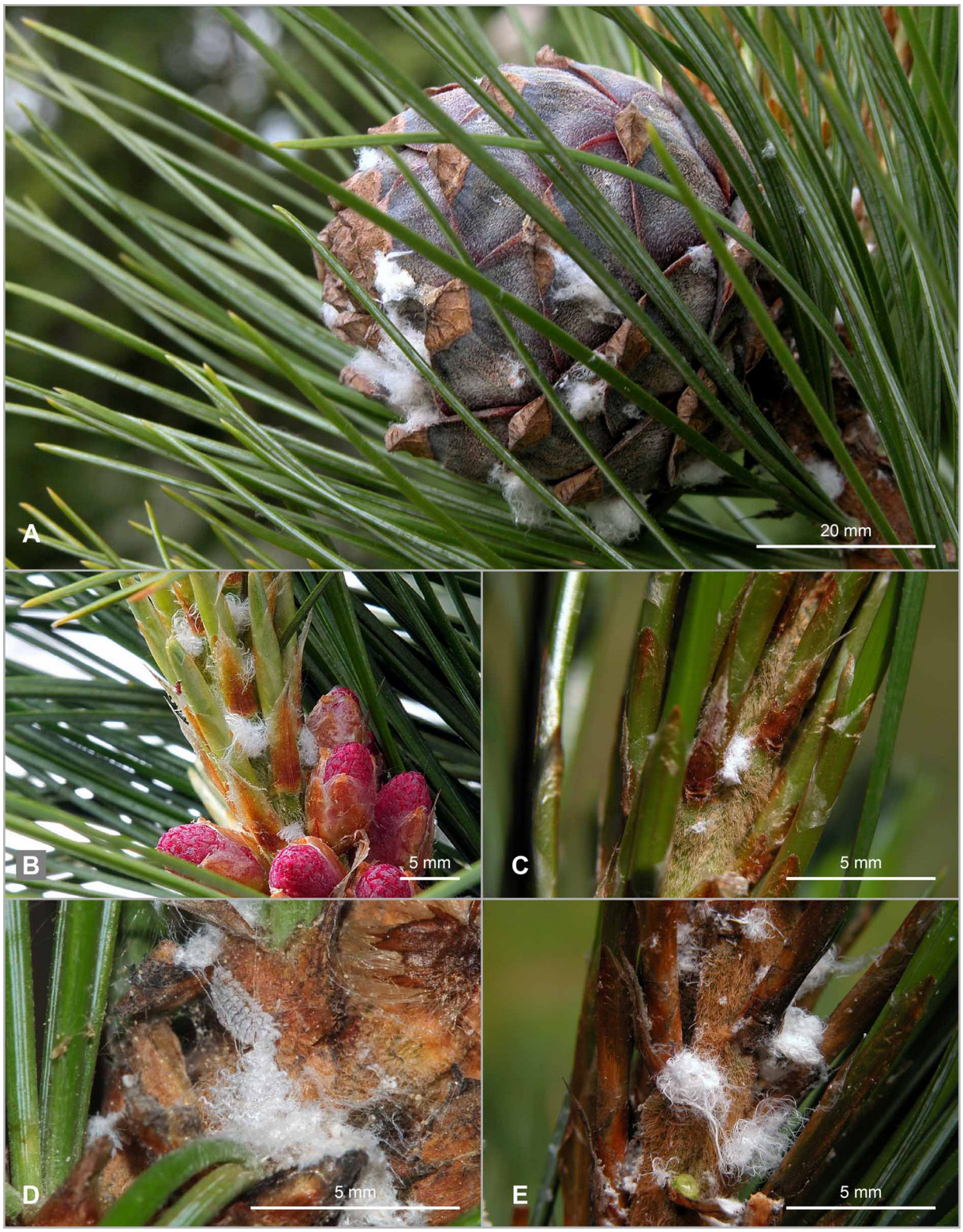

Fig. 77. *Pineus (Pineus) cembrae* (Cholodkovsky, 1888). Apterae on young growth of *Pinus cembra*. In D, also a scymnine ladybird larva (Coleoptera, Coccinellidae).

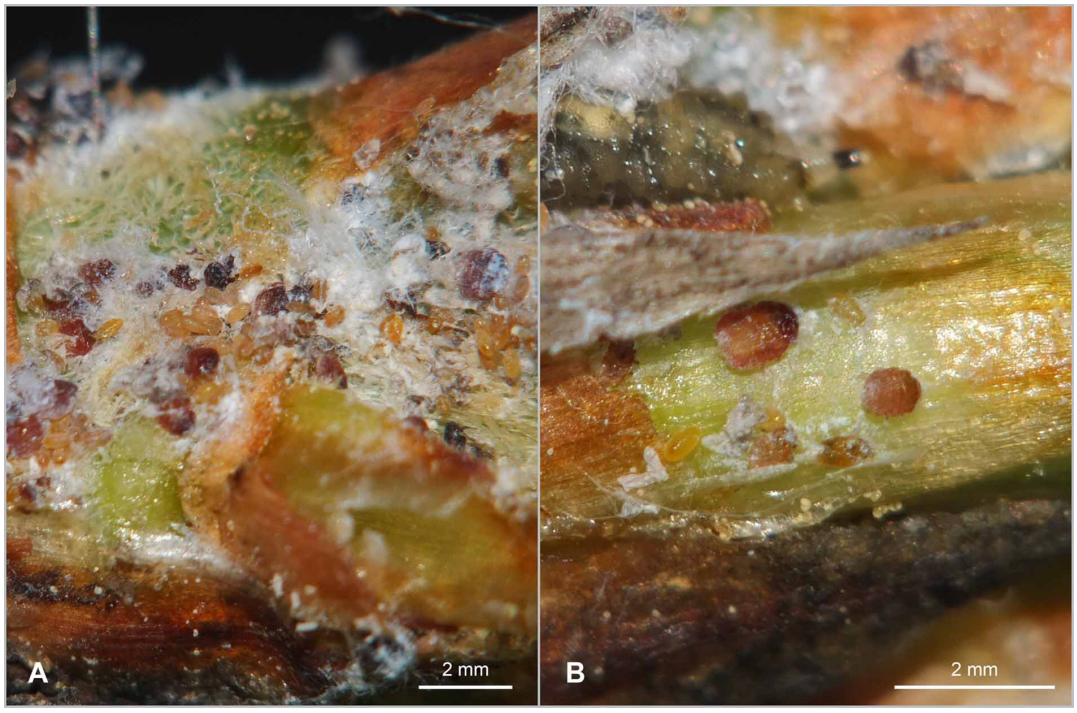

Fig. 78. *Pineus (Pineus) cembrae* (Cholodkovsky, 1888). Apterae with eggs and juveniles on young growth of *Pinus cembra*. (wax wool removed). In B, also a syrphid (Diptera, Syrphidae) larva.

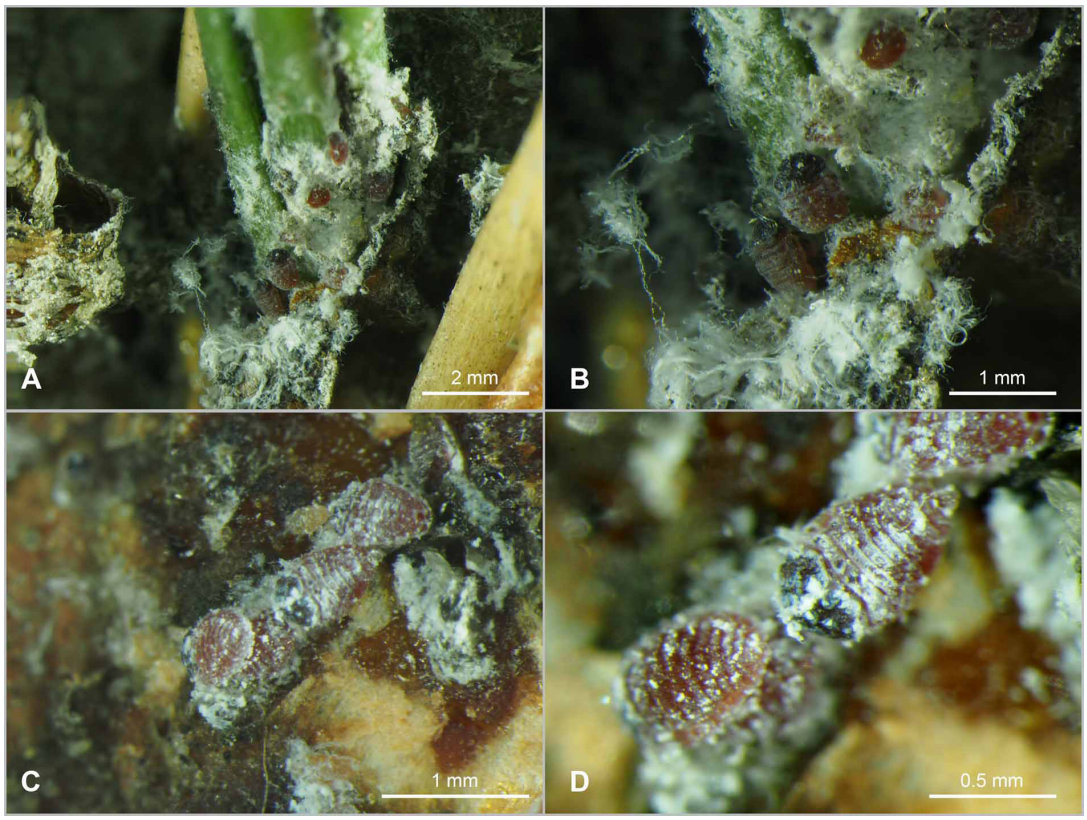

Fig. 79. *Pineus (Pineus) cembrae* (Cholodkovsky, 1888). Overwintering apterae on twig of *Pinus cembra*. Bud scales and wax wool removed.

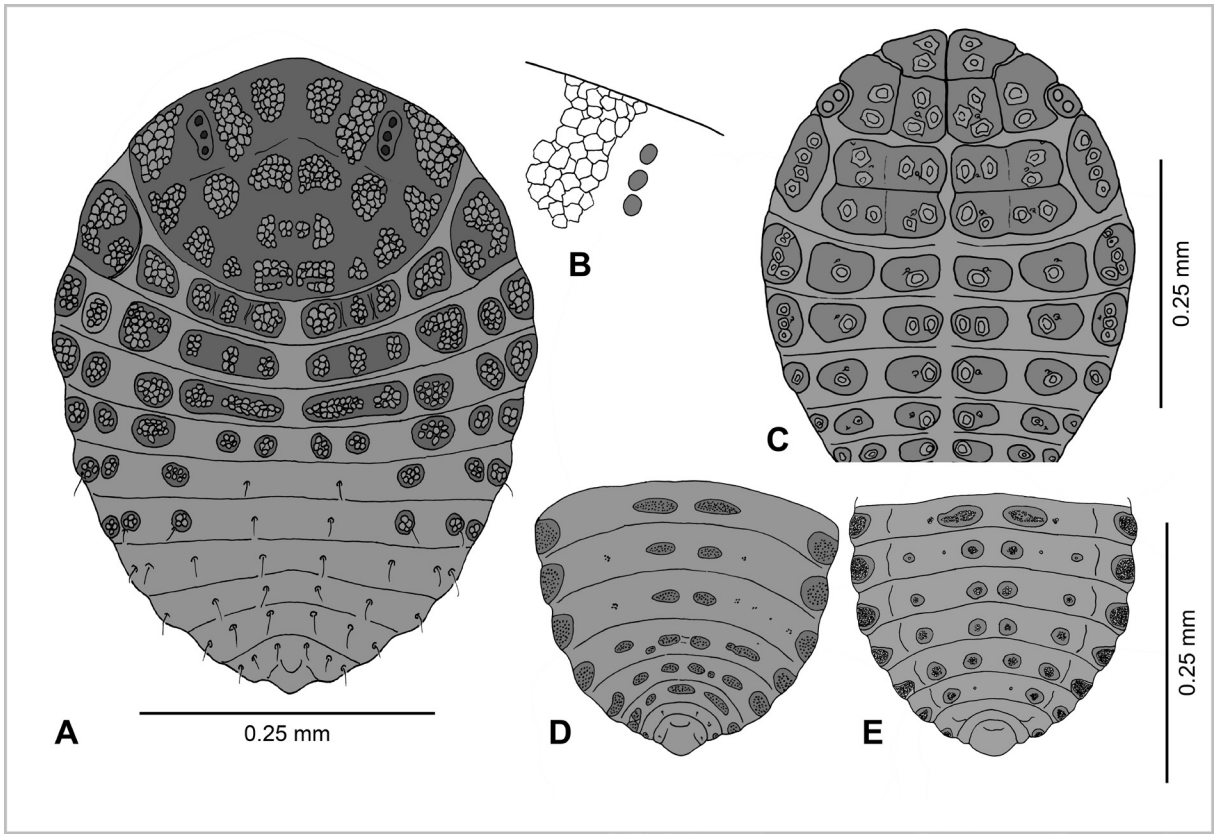

Fig. 80. *Pineus (Pineus) cembrae* (Cholodkovsky, 1888). **A–B**. Adult aptera; in B showing outer intraocular group of wax gland pits (after Inouye 1953, modified.). **C**. Hibernating nymph (after Inouye 1953, modified from Pashchenko 1988). **D–E**. Abdomen of gallicola (D) and sexupara (E) (after Börner, modified from Heie 2004).

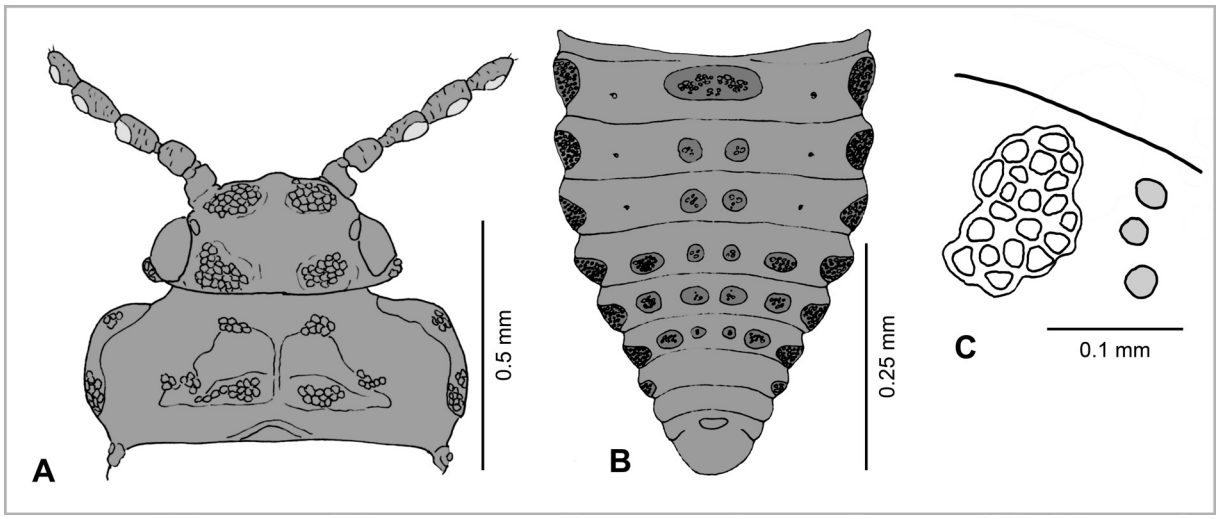

Fig. 81. *Pineus (Pineus) strobi* (Hartig, 1837). **A**. Alata, head and prothorax (after Carter 1971, modified from Heie 2004). **B**. Alata, abdomen (after Börner, modified from Heie 2004). **C**. Aptera, outer intraocular group of wax gland pits (freely after Blackman & Eastop 1994).

Fig. 82. *Eulachnus agilis* (Kaltenbach, 1843) on needles of *Pinus sylvestris*. **A–E**. Apterae. **F–G**. Alatae.

Fig. 83. *Eulachnus rileyi* (Williams, 1911) on *Pinus mugo*. Apterae, juveniles, and one alata (J). Scale bars: 2 mm.

Fig. 84. *Schizolachnus pineti* (Fabricius, 1781) on *Pinus sylvestris*. The black individuals are newly molted, still without wax cover.

Fig. 85. *Schizolachnus pineti* (Fabricius, 1781). Aptera, alata, and eggs (in B) on needles of *Pinus sylvestris*.

Fig. 86. *Schizolachnus obscurus* Börner, 1940. Aptera on *Pinus nigra* (from Dransfield & Brightwell 2015, licensed under Creative Commons Attribution 3.0, downloaded 2 Mar. 2016).

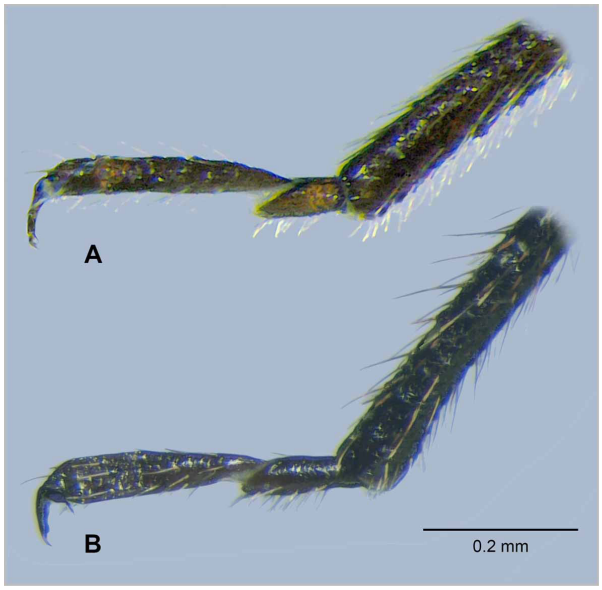

Fig. 87. Hind tarsus, showing length and form of second segment. **A**. *Cinara (Cinara) nuda* Mordvilko, 1895 **B**. *C. pinea* (Mordvilko, 1895).

Fig. 88. *Cinara (Cinara) pini* (Linnaeus, 1758) on *Pinus sylvestris*. **A**. Colony on previous year's terminal shoot, attended by *Camponotus herculeanus* (Linnaeus, 1758). **B–C**. Apterae with young on a 2 year-old twig, attended by *Formica polyctena* Förster, 1850.

Fig. 89. *Cinara (Cinara) pini* (Linnaeus, 1758). Freeze-dried apterae. **A–B**. Adults. **C**. Full-grown juvenile.

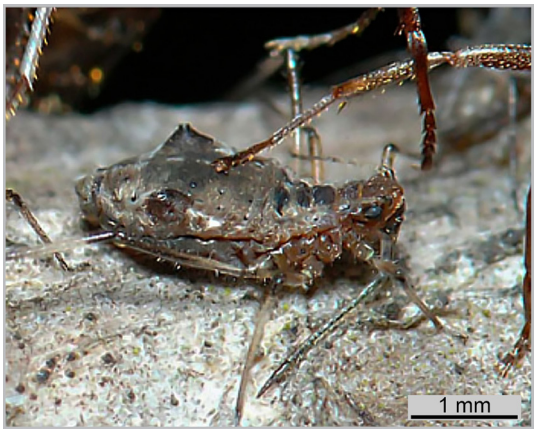

Fig. 90. *Cinara (Cinara) acutirostris* Hille Ris Lambers, 1956. Aptera on *Pinus nigra* (from Dransfield & Brightwell 2015, licensed under Creative Commons Attribution 3.0, downloaded 2 Mar. 2016).

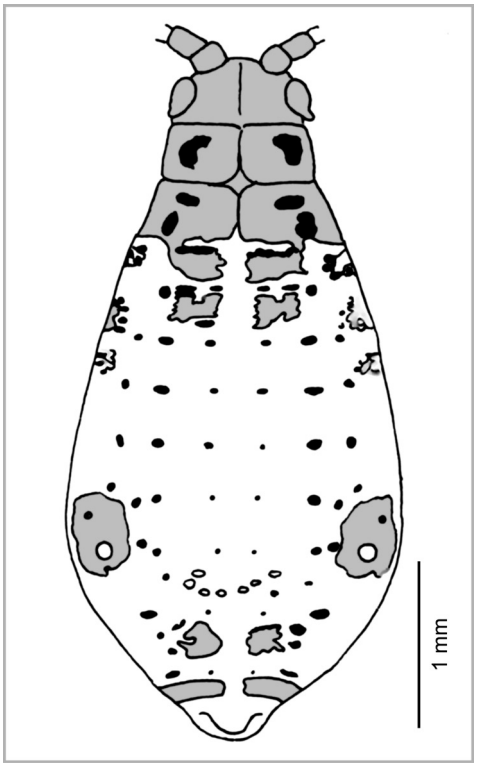

Fig. 91. *Cinara (Cinara) cembrae* (Seitner, 1936). Head, thorax and abdomen (after Pintera 1966, redrawn).

Fig. 92. *Cinara (Cinara) nigritergi* Mamontova-Solukha, 2002. Apterae and juveniles on *Pinus sylvestris*. **A–B**. Colonies on young shoot, attended by *Lasius niger* (Linnaeus, 1758). **C**. Colony on 2–3 year-old twig.

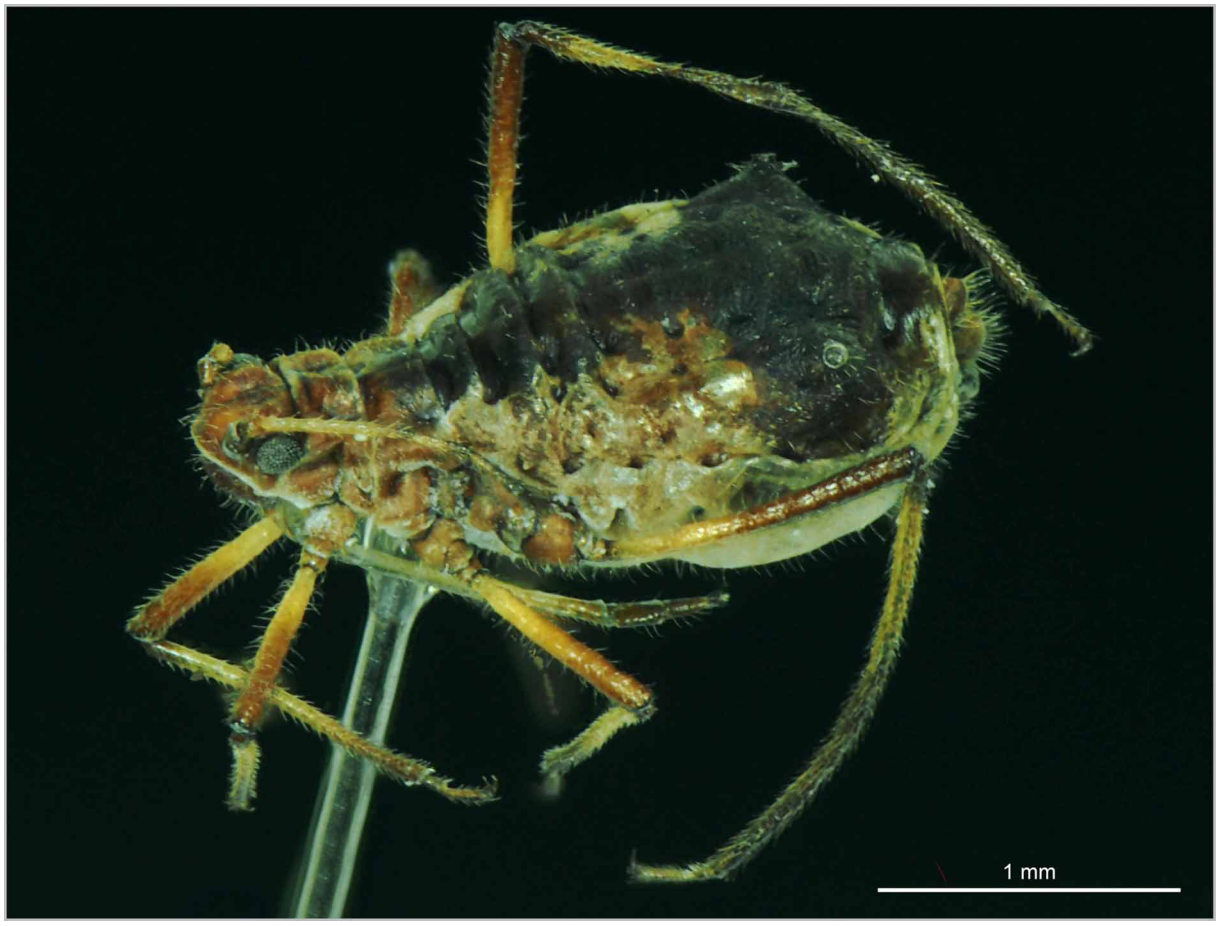

Fig. 93. *Cinara (Cinara) nigritergi* Mamontova-Solukha, 2002. Aptera (freeze-dried specimen).

Fig. 94. *Cinara (Cinara) pinihabitans* (Mordvilko, 1895). Oviparae on *Pinus sylvestris*.

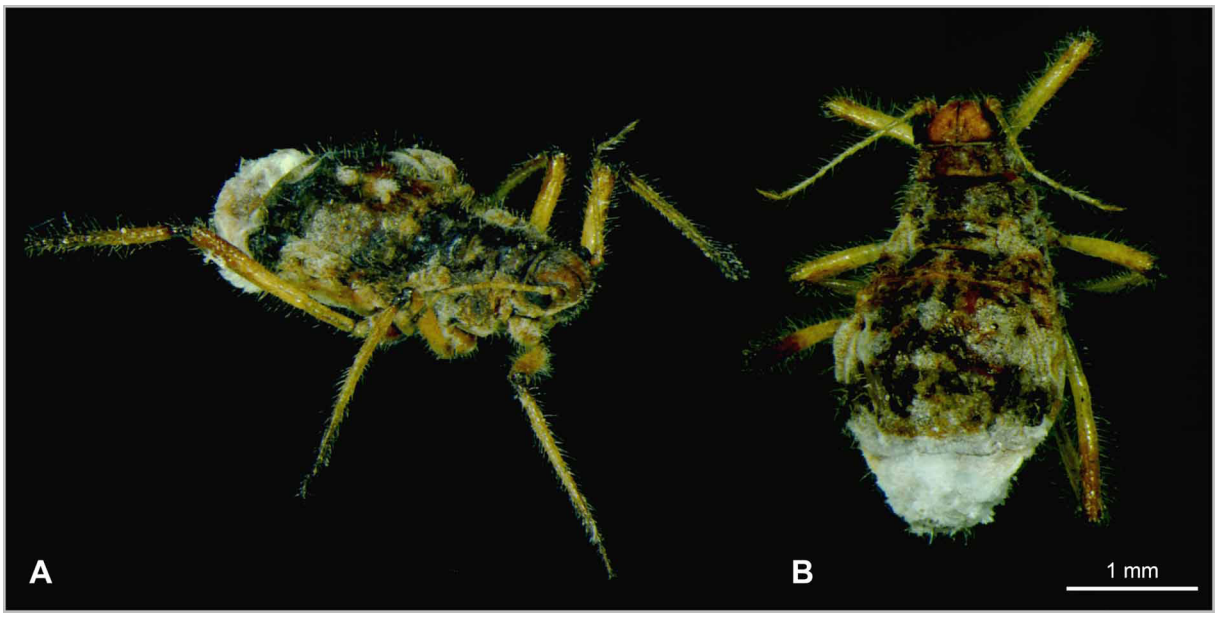

Fig. 95. *Cinara (Cinara) pinihabitans* (Mordvilko, 1895). Ovipara (freeze-dried specimens).

Fig. 96. *Cinara (Cinara) nuda* Mordvilko, 1895. Colony on trunk of young *Pinus sylvestris*, attended by *Lasius niger* (Linnaeus, 1758).

Fig. 97. *Cinara (Cinara) nuda* Mordvilko, 1895. Apterae (freeze-dried specimens).

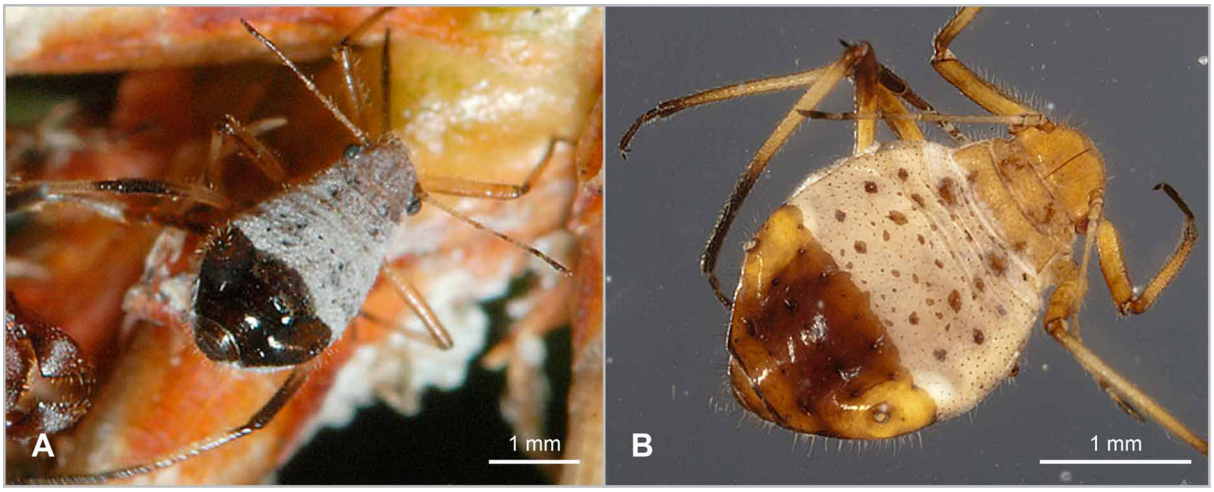

Fig. 98. *Cinara (Cinara) brauni* Börner, 1940. Apterae. **A**. *In vivo* on *Pinus nigra*. **B**. In alcohol. From Dransfield & Brightwell 2015 (downloaded on 20 Mar. 2016).

Fig. 99. *Cinara (Cinara) pilosa* (Zetterstedt, 1840). Apterae on old *Pinus sylvestris*. **A–B**. Small colony between and below male flowers, attended by *Myrmica rubra* (Linnaeus, 1758). **C**. Aptera on terminal bud. **D**. Aptera on needle in colony of *Schizolachnus pineti*.

Fig. 100. *Cinara (Cinara) pilosa* (Zetterstedt, 1840). Apterae (freeze-dried specimens).

Fig. 101. *Cinara (Cinara) pinea* (Mordvilko, 1895). Apterae and juveniles on young shoots of *Pinus sylvestris*.

Fig. 102. *Cinara (Cinara) pinea* (Mordvilko, 1895). Apterae (freeze-dried specimens).

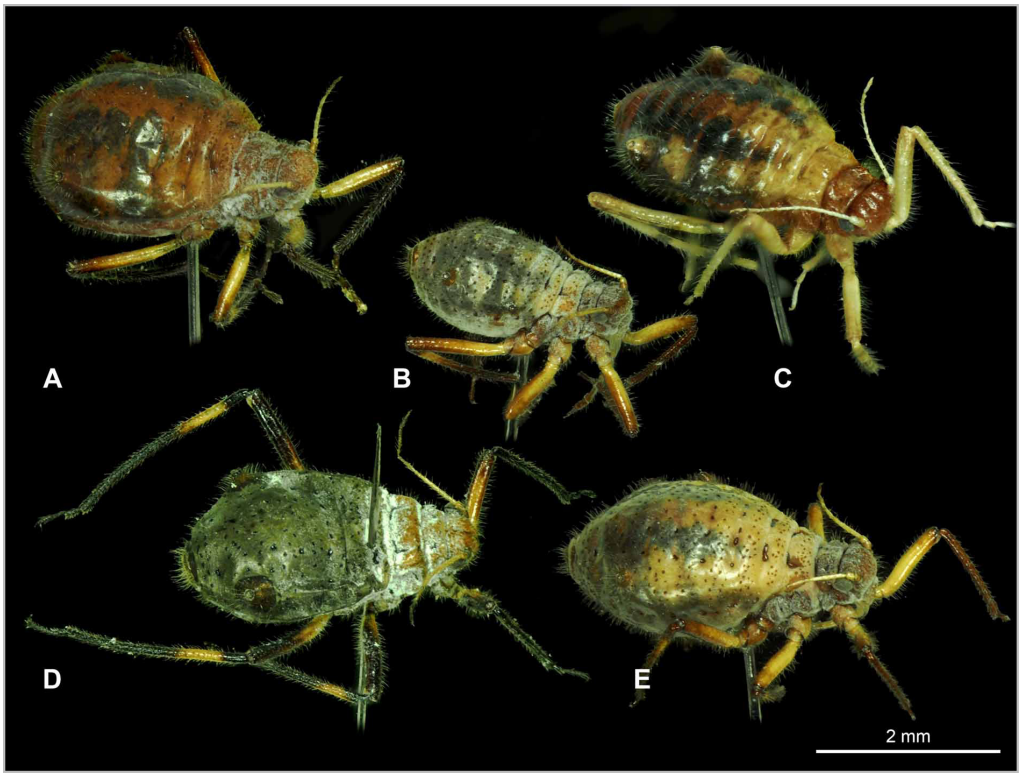

Fig. 103. *Cinara (Cinara) pinea* (Mordvilko, 1895). Freeze-dried specimens. **A**, **C**–**D**. Adult apterae. Teneral, appendages and hair-base sclerites still pale on C. **B**, **E**. Juvenile apterae.

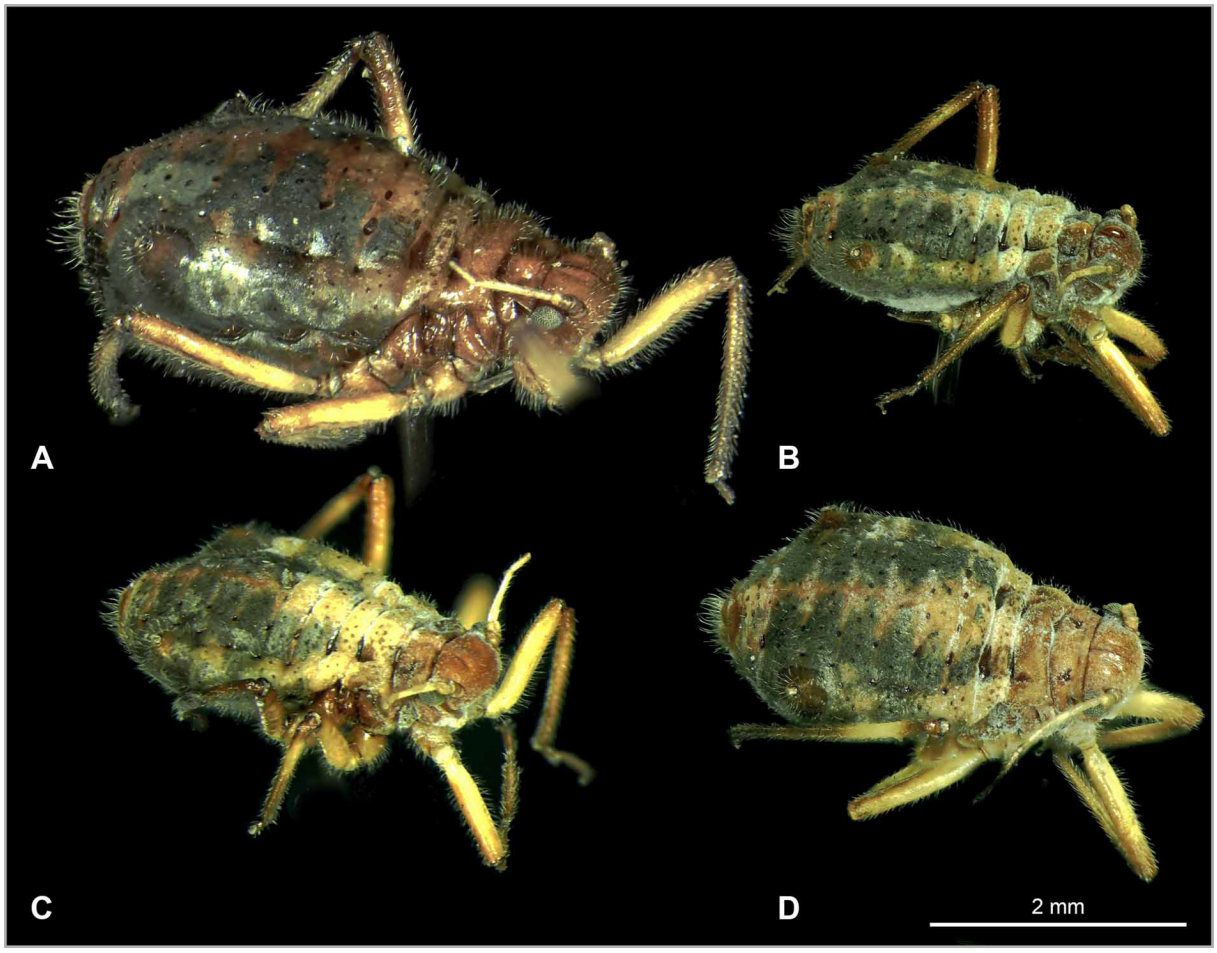

Fig. 104. *Cinara (Cinara) piniphila* (Ratzeburg, 1844). Freeze-dried specimens.

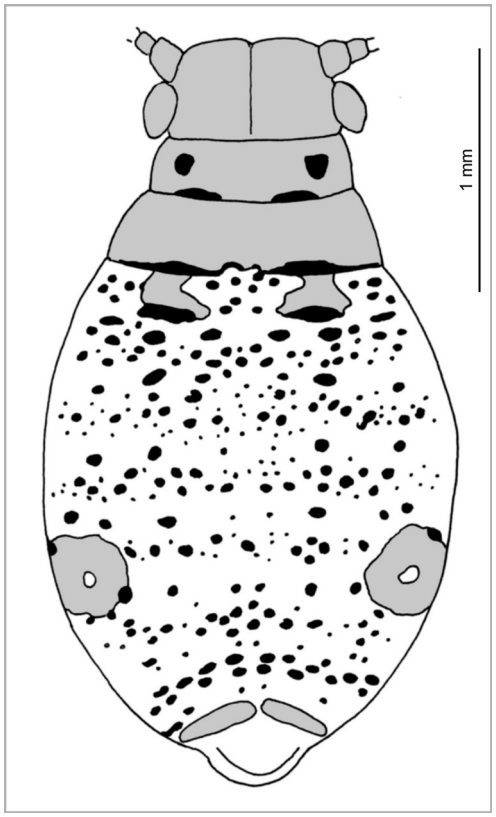

Fig. 105. *Cinara (Cinara) piniphila* (Ratzeburg, 1844). Aptera (from Pintera 1966, redrawn).

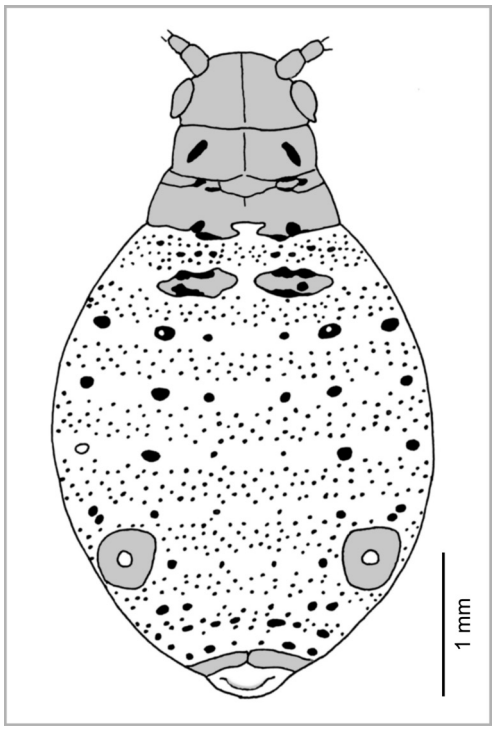

Fig. 106. *Cinara (Cinara) schimitscheki* Börner, 1940. Aptera (after Pintera 1966, redrawn).

Fig. 107. *Cinara (Cinara) hyperophila* (Koch, 1855). Colony on young shoot of *Pinus sylvestris*, attended by *Lasius niger* (Linnaeus, 1758). **A–B**. Adult apterae and juvenile alatae. **C–D**. Juvenile alatae.

Fig. 108. *Cinara (Cinara) hyperophila* (Koch, 1855). Apterae and juvenile alatae on young shoot of *Pinus sylvestris*. Scale bars: 2 mm.

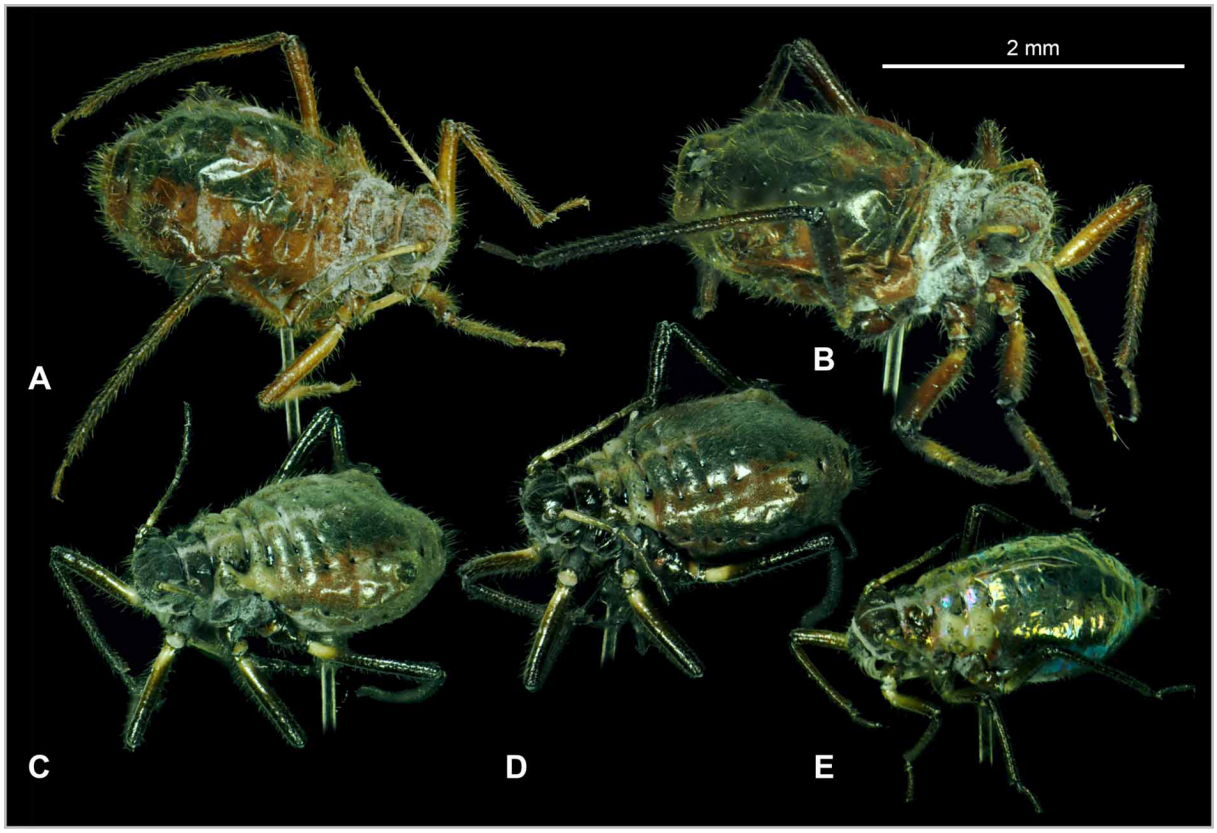

Fig. 109. *Cinara (Cinara) hyperophila* (Koch, 1855). Freeze-dried material. **A–B**. Adult apterae **C–E**. Juvenile apterae.

Fig. 110. *Prociphilus (Stagona) pini* (Burmeister, 1835). Apterae and juveniles on mycorrhizal roots of *Pinus sylvestris* in galleries of *Lasius flavus* (Fabricius, 1782).

Fig. 111. *Cinara (Cupressobium) smolandiae* Danielsson & Carter, 1993. Colony in *Gymnosporangium*-induced wound on *Juniperus communis*, attended by *Formica polyctena* Förster, 1850.

Fig. 112. *Cinara (Cupressobium) smolandiae* Danielsson & Carter, 1993. Colony in *Gymnosporangium*-induced wound on *Juniperus communis*, attended by *Formica polyctena* Förster, 1850.

Fig. 113. *Cinara (Cupressobium) juniperi* (De Geer, 1773). Colonies on young shoots of *Juniperus communis*, in B attended by *Formica cinerea* Mayr, 1853.

Fig. 114. *Cinara (Cupressobium) juniperi* (De Geer, 1773) on *Juniperus communis*. **A–B**. Fundatrix with offspring on previous year's twig, attended by *Formica rufa* Linnaeus, 1761. **C–D**. Colony on current year's growth, attended by *Lasius niger* (Linnaeus, 1758).

Fig. 115. *Cinara (Cupressobium) juniperi* (De Geer, 1773). Colonies on current and previous year's twigs of *Juniperus communis*, in F attended by *Myrmica rubra* (Linnaeus, 1758).

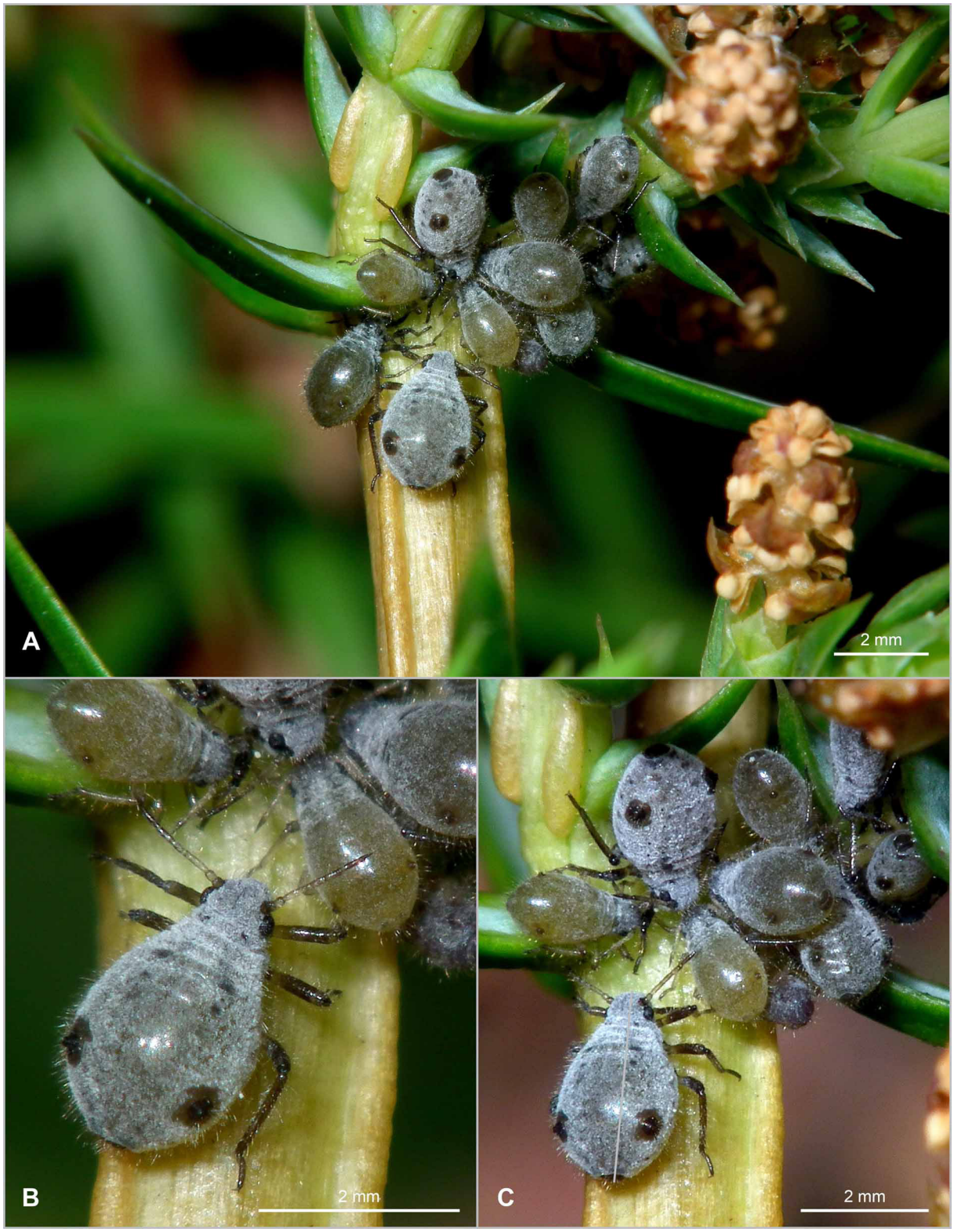

Fig. 116. *Cinara (Cupressobium) mordvilkoi* (Pasek, 1954). Colonies on current year's twigs of *Juniperus communis*.

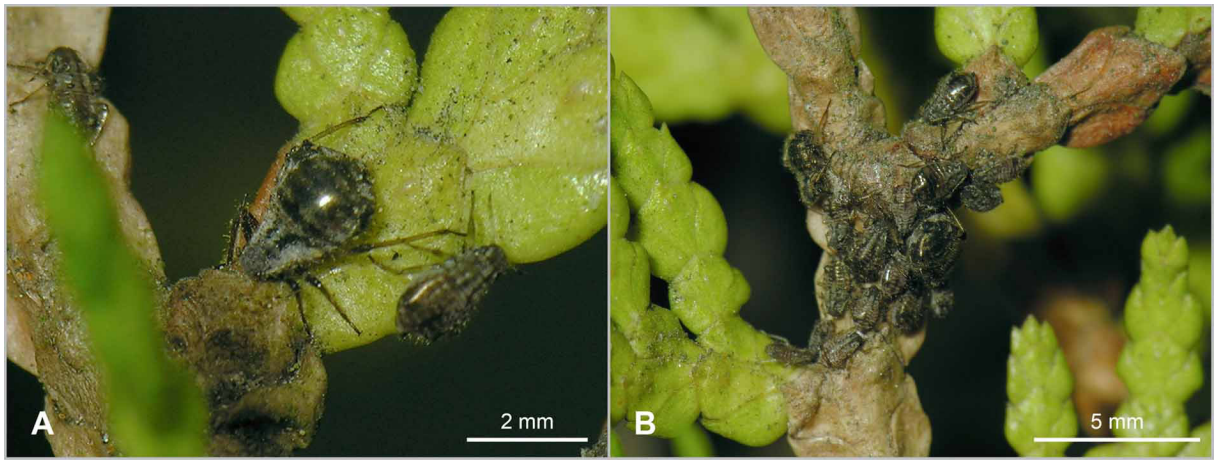

Fig. 117. *Cinara (Cupressobium) cupressi* (Buckton, 1881). Small colony on last year's growth of *Thuja occidentalis*, attended by *Lasius niger* (Linnaeus, 1758).

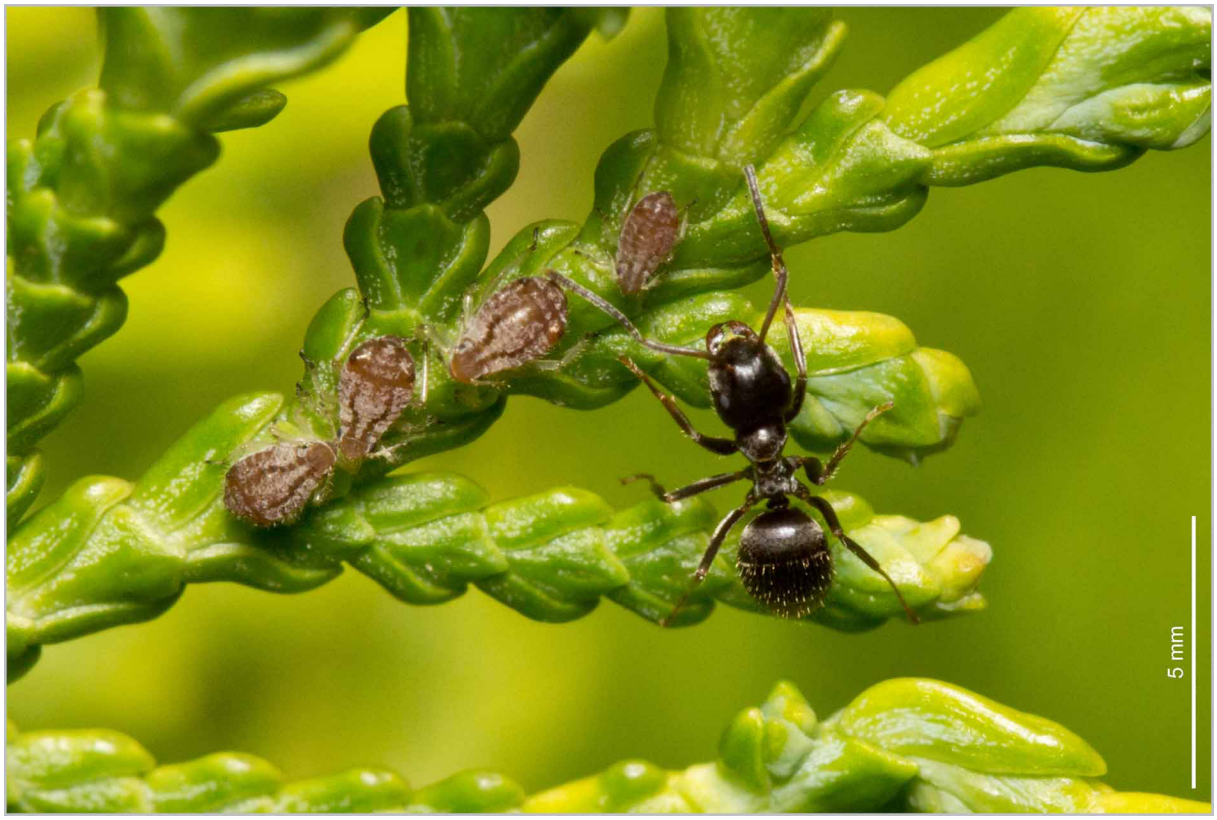

Fig. 118. *Cinara (Cupressobium) tujafilina* (Del Guercio, 1909) on young growth of *Thuja occidentalis*, attended by *Lasius niger* (Linnaeus, 1758). Photo Carlos Delgado (CC BY SA 3.0, http://creativecommons.org/licenses/by-sa/3.0, downloaded 12 Nov. 2015 via https://commons.wikimedia.org/wiki/File:Lasius_niger_y_Cinara_tujafilina_en_Thuja_orientalis.jpg#filelinks).

Appendix 1

Summary of the host relationships of conifer-feeding aphids of northern Europe

Dioecious species from primary host are denoted with [I], from secondary host with [II]. * = my own records from Finland. N* and S* = my own records from Norway and Sweden respectively.

PINOPHYTA Gorozh.
PINALES Gorozh.
Pinaceae Spreng.
Abies Mill.
- *Adelges laricis* [II]
- *Adelges nordmannianae* [II]
- *Adelges pectinatae* [II]
- *Adelges piceae*
- *Cinara confinis*
  - *Cinara curvipes*
  - *Cinara pectinatae*
- *Elatobium abietinum*
- *Prociphilus bumeliae* [II]
- *Prociphilus fraxini* [II]

Abies alba Mill.
- *Adelges merkeri* [II]
- *Adelges nordmannianae* S* [II]
- *Adelges pectinatae** [II]
- *Adelges piceae*
- *Cinara confinis*
- *Cinara pectinatae* S*
- *Mindarus abietinus*
- *Prociphilus bumeliae* [II]
- *Prociphilus fraxini* [II]
- *Prociphilus xylostei*? [II]

Abies amabilis (Dougl. ex Loud.) Dougl. ex Forbes
- *Adelges pectinatae** [II]
- *Adelges piceae*

Abies balsamea (L.) Mill.
- *Adelges nordmannianae* [II]
- *Adelges pectinatae** [II]
- *Adelges piceae*
- *Cinara confinis*
- *Cinara curvipes*
- *Cinara pectinatae*
- *Mindarus abietinus*
- *Prociphilus fraxini* [II]
- *Prociphilus xylostei*? [II]

Abies cephalonica Loudon
- *Adelges nordmannianae* [II]
- *Adelges piceae*
- *Cinara confinis*
- *Elatobium abietinum*
- *Mindarus abietinus*

Abies concolor (Gordon & Glend.) Lindl. ex Hildebr.
- *Adelges nordmannianae* II
- *Adelges pectinatae** II
- *Adelges piceae*
- *Cinara confinis*
- *Cinara curvipes*
- *Mindarus abietinus*

Abies forrestii Coltm.-Rog.
- *Adelges piceae*

Abies fraseri (Pursh) Poir.
- *Adelges pectinatae** II

Abies grandis (Douglas ex D. Don) Lindl.
- *Adelges nordmannianae* II
- *Adelges pectinatae** II
- *Adelges piceae*
- *Cinara confinis*
- *Cinara pectinatae*
- *Mindarus abietinus*

Abies holophylla Maxim.
- *Cinara confinis**

Abies homolepis Siebold & Zucc.
- *Elatobium abietinum*
- *Mindarus abietinus*

Abies koreana E. H. Wilson
- *Adelges pectinatae** II
- *Adelges piceae*
    - *Cinara curvipes*

Abies lasiocarpa (Hook.) Nutt.
- *Adelges pectinatae** II
- *Adelges piceae*
- *Cinara confinis*
    - *Cinara curvipes*
- *Elatobium abietinum*
- *Mindarus abietinus*

Abies nordmanniana (Steven) Spach
- *Adelges merkeri*? II
- *Adelges nordmannianae* II
- *Adelges pectinatae* II
- *Adelges piceae*
- *Cinara confinis*
- *Cinara pectinatae*
- *Elatobium abietinum*
- *Mindarus abietinus*
- *Pineus strobi*? II
- *Prociphilus fraxini* II

Abies pindrow (Royle ex D. Don) Royle
- *Cinara confinis*
- *Mindarus abietinus*

Abies procera Rehder
- *Adelges nordmannianae* II

Adelges pectinatae II
Adelges piceae
Cinara confinis
Mindarus abietinus

Abies sibirica Ledeb.
*Adelges pectinatae** II
Adelges nordmannianae II
Adelges piceae
*Cinara confinis**
Cinara pectinatae
*Mindarus abietinus**
Prociphilus fraxini II

Abies veitchii Lindl.
Adelges pectinatae II
Adelges nordmannianae II
Cinara pectinatae
Mindarus abietinus
Prociphilus bumeliae II

Larix Mill.
Adelges laricis II
Adelges viridis II
Cinara cuneomaculata
Cinara kochiana
Cinara laricis

Larix decidua Mill.
*Adelges laricis** II
Adelges viridanus
*Adelges viridis** II
Aphis fabae II
*Cinara cuneomaculata**
Cinara kochiana
*Cinara laricis**

Larix decidua × *kaempferi*
Adelges laricis II
Adelges viridis II
Adelges viridanus
Cinara laricis

Larix gmelinii (Rupr.) Kuzen.
Adelges laricis II
Adelges viridanus
Cinara cuneomaculata
Cinara confinis?
Cinara kochiana
Cinara laricis

Larix kaempferi (Lamb.) Carrière
*Adelges laricis** II
Adelges viridanus
Adelges viridis II
Aphis fabae II
*Cinara cuneomaculata**

Cinara kochiana
Cinara laricis
Larix laricina (Du Roi) K. Koch
*Adelges laricis** II
Cinara cuneomaculata
Larix lyallii Parl.
*Adelges laricis** II
Larix sibirica Ledeb.
*Adelges laricis** II
Adelges tardoides II
Adelges viridanus
*Adelges viridis**
Adelges viridulus II
*Cinara cuneomaculata**
Cinara kochiana
*Cinara laricis**
Picea A. Dietr.
Picea abies (L.) H. Karst.
*Adelges abietis** S*
*Adelges lapponicus**
*Adelges laricis** S*
Adelges nordmannianae
Adelges pectinatae
Adelges tardoides
*Adelges tardus** S*
*Adelges viridis**
Aulacorthum solani
*Cinara costata**
*Cinara piceae**
*Cinara piceicola**
*Cinara pilicornis**
*Cinara pruinosa**
*Elatobium abietinum**
*Pachypappa populi** II
*Pachypappa tremulae** II
Pachypappa vesicalis II
*Pachypappella lactea** II
Pineus cembrae
*Pineus pineoides**
*Prociphilus xylostei** II
Picea engelmannii (W. Parry ex Engelm.) Engelm.
Adelges abietis
Adelges cooleyi I
Adelges viridis I
Cinara costata
Cinara pilicornis
Elatobium abietinum
Mindarus obliquus
Prociphilus xylostei II

Picea glauca (Moench) Voss
- *Adelges abietis*
- *Adelges cooleyi* [I]
- *Adelges laricis* [I]
- *Adelges lapponicus**
- *Adelges pectinatae* [I]
- *Adelges tardus*
- *Adelges viridis** [I]
- *Cinara costata**
- *Cinara piceae*
- *Cinara piceicola*
- *Cinara pilicornis**
- *Cinara pruinosa*
- *Elatobium abietinum*
- *Mindarus obliquus**
- *Pachypappa vesicalis* [II]
- *Prociphilus xylostei* [II]

Picea glehnii (Fr. Schmidt) Masters
- *Adelges pectinatae* [I]
- *Cinara costata*
- *Cinara piceae*
- *Cinara pilicornis*
- *Elatobium abietinum*
- *Pineus cembrae* [I]

Picea jezoensis (Sieb.& Zucc.) Carriere
- *Adelges abietis*
- *Adelges cooleyi* [I]
- *Adelges lapponicus*
- *Adelges pectinatae* [I]
- *Cinara costata*
- *Cinara piceae*
- *Cinara piceicola*
- *Cinara pilicornis*
- *Elatobium abietinum*
- *Pineus cembrae* [I]
- *Pineus orientalis* [I]

Picea koraiensis Nakai
- *Adelges laricis* [I]
- *Adelges pectinatae* [I]
- *Adelges viridis* [I]
- *Cinara piceae*
- *Cinara pilicornis*
- *Cinara pruinosa*
- *Pineus cembrae* [I]

Picea mariana (Mill.) Britton, Sterns & Poggenb.
- *Adelges cooleyi* [I]
- *Adelges lapponicus*
- *Adelges laricis* [I]
- *Cinara costata*
- *Elatobium abietinum*

Mindarus obliquus
(*Pineus strobi*, see text) [I]
Picea omorika (Pancic) Purk.
Adelges nordmannianae [I]
Adelges viridis [I]
*Cinara costata**
*Cinara piceae**
*Cinara pilicornis**
Elatobium abietinum
Mindarus obliquus
Pineus pineoides
Picea orientalis (L.) Link
Adelges abietis
Adelges laricis [I]
Adelges merkeri [I]
Adelges nordmannianae [I]
Adelges viridis [I]
Cinara costata
Cinara piceae
Cinara piceicola
Cinara pilicornis
Cinara pruinosa
Elatobium abietinum
Pachypappa tremulae [II]
Pineus cembrae [I]
*Pineus orientalis** [I]
Picea pungens Engelm.
Adelges abietis
Adelges cooleyi [I]
Adelges lapponicus
Adelges laricis [I]
Adelges tardus
Adelges viridis [I]
*Cinara costata**
Cinara piceae
Cinara piceicola
Cinara pilicornis
Cinara pruinosa
*Elatobium abietinum**
Pineus orientalis [I]
Picea sitchensis (Bong.) Carrière
*Adelges abietis**
Adelges cooleyi (usually) [I]
Adelges lapponicus
Adelges laricis [I]
Adelges pectinatae [I]
Adelges tardus
Adelges viridis [I]
Aphis fabae [II]
Aulacorthum solani

Cinara costata
Cinara piceae
Cinara piceicola
Cinara pilicornis
Cinara pruinosa
Elatobium abietinum
Mindarus obliquus
Neomyzus circumflexus
Pachypappa tremulae II
Pachypappa vesicalis II
Pachypappella lactea II
Pineus similis
Prociphilus xylostei II

Picea tianschanica Lindl.
Cinara costata
Cinara piceae
Cinara pilicornis
Cinara pruinosa
Elatobium abietinum

Picea torano (Siebold ex K.Koch) Koehne (syn. polita)
Pineus orientalis I

Pinus L.

Pinus banksiana Lamb.
*Cinara pinea**
Cinara pini?
*Eulachnus agilis**
Eulachnus alticola
Eulachnus rileyi
Pineus pini
*Schizolachnus pineti**

Pinus cembra L.
Cinara cembrae
Cinara pini?
Eulachnus agilis
Eulachnus cembrae
Eulachnus rileyi
*Pineus cembrae** II
Schizolachnus pineti

Pinus contorta Douglas ex Loudon
Aphis fabae II
Cinara pini?
Prociphilus pini II
Schizolachnus pineti

Pinus koraiensis Sieb. & Zucc.
Cinara kochiana?
Pineus cembrae II

Pinus mugo Turra
Cinara hyperophila
Cinara neubergi
Cinara nuda

*Cinara pilosa**
*Cinara pinea**
*Cinara pini**
Cinara pinihabitans
Cinara schimitscheki
Eulachnus alticola
*Eulachnus agilis**
Eulachnus brevipilosus
*Eulachnus rileyi**
Pineus orientalis [II]
*Pineus pini**
Schizolachnus obscurus
*Schizolachnus pineti**

Pinus nigra J. F. Arnold
Cinara acutirostris
Cinara brauni
Cinara nuda
Cinara pilosa
Cinara pinea S*
Cinara pini?
Cinara schimitscheki
Eulachnus agilis
Eulachnus brevipilosus
Eulachnus nigricola
Eulachnus rileyi
Pineus pini
Schizolachnus obscurus
Schizolachnus pineti

Pinus peuce Griseb.
Eulachnus cembrae
Eulachnus rileyi
Pineus strobi [II]

Pinus pinaster Aiton
Cinara hyperophila
Cinara pini?
Eulachnus agilis
Eulachnus brevipilosus
Eulachnus rileyi
Pineus pini
Schizolachnus obscurus
Schizolachnus pineti

Pinus pinea L.
Cinara acutirostris
Cinara pini?
Cinara pinea
Cinara schimitscheki
Eulachnus agilis
Eulachnus rileyi
Pineus pini
Schizolachnus obscurus

Schizolachnus pineti

Pinus ponderosa Douglas ex Lawson
- *Cinara pinea*
- *Eulachnus alticola*
- *Pineus pini*
- *Schizolachnus pineti*

Pinus pumila (Pall.) Regel
- *Pineus cembrae*

Pinus rigida Mill.
- *Eulachnus agilis*
- *Eulachnus alticola*
- *Eulachnus rileyi*
- *Pineus pini*

Pinus sibirica Du Tour
- *Cinara brauni*
- *Cinara pinea*
- *Cinara pini*?
- *Elatobium abietinum*
- *Eulachnus agilis*
- *Pineus cembrae* II

Pinus strobus L.
- *Cinara pini*?
- *Eulachnus cembrae*
- *Pineus strobi* II

Pinus sylvestris L.
- *Cinara brauni*
- *Cinara hyperophila**
- *Cinara nuda**
- *Cinara nigritergi** S*
- *Cinara pilosa** N*
- *Cinara pinea**
- *Cinara pini**
- *Cinara pinihabitans**
- *Cinara piniphila**
- *Eulachnus agilis**
- *Eulachnus alticola*
- *Eulachnus brevipilosus**
- *Eulachnus nigricola*
- *Eulachnus rileyi*
- *Pineus orientalis* II
- *Pineus pini**
- *Prociphilus pini** II
- *Schizolachnus obscurus*
- *Schizolachnus pineti**

Pseudotsuga Carrière
- *Prociphilus pini* II

Pseudotsuga menziesii (Mirb.) Franco
- *Adelges cooleyi* S* II
- *Elatobium abietinum*
- *Mindarus abietinus*

Pachypappa vesicalis II
Prociphilus xylostei II
Tsuga (Endl.) Carrière
Tsuga canadensis (L.) Carrière
Prociphilus pini II
Tsuga heterophylla (Raf.) Sarg.
Aphis fabae II
Cinara pilicornis?
Cedrus Trew
Cedrus deodara (Roxb.) G.Don
Cinara curvipes
CUPRESSALES Link
Cupressaceae Gray
Chamaecyparis Spach
Chamaecyparis lawsoniana (A. Murray bis) Parl.
Cinara cupressi
Cinara tujafilina
Cryptomeria D. Don
Cryptomeria japonica (L. f.) D. Don
Brachycaudus helichrysi? II
Cinara fresai
Cupressus L.
Cinara cupressi
Cinara fresai
Cinara tujafilina
Juniperus L.
Cinara tujafilina
Juniperus chinensis L.
Cinara cupressi
Cinara juniperi
Cinara tujafilina
Juniperus communis L.
Cinara confinis?
Cinara cupressi
*Cinara juniperi**
*Cinara mordvilkoi**
*Cinara smolandiae**
Cinara tujafilina
Gootiella tremulae II
Juniperus procumbens (Siebold ex Endl.) Miq.
Cinara tujafilina
Juniperus sabina L.
Cinara cupressi
Cinara juniperi
Gootiella tremulae II
Juniperus scopulorum Sarg.
Cinara cupressi
Juniperus squamata Buch.-Ham. ex Lamb.
Cinara juniperi
Juniperus virginiana L.

Cinara cupressi
Cinara juniperi
Cinara tujafilina
Thuja L.
Cinara tujafilina
Thuja occidentalis L.
*Cinara cupressi**
Cinara juniperi
Cinara tujafilina
Thuja plicata Donn ex D. Don
*Cinara cupressi**
Myzus persicae? II
Thujopsis Siebold & Zucc.
Thujopsis dolabrata Siebold & Zucc.
Cinara tujafilina

Appendix 2

Summary of the aphid-ant relationships of the conifer-feeding aphids of northern Europe

Dioecious species from primary host are denoted with [I], from secondary host with [II]. * = my own records from Finland. S* = my own records from Sweden.

Formicidae Latreille, 1809
Myrmicinae Lepeletier, 1835
Myrmica Latreille, 1804
Myrmica rubra (Linnaeus, 1758)
- *Cinara juniperi**
- *Cinara piceicola**
- *Cinara pilicornis**
- *Cinara pilosa**
- *Cinara pinea**
- *Cinara pruinosa**

Myrmica ruginodis Nylander, 1846
- *Cinara pinea**
- *Cinara pruinosa**

Formicinae Lepeletier, 1836
Camponotus Mayr, 1861
- *Cinara smolandiae*

Camponotus herculeanus (Linnaeus, 1758)
- *Cinara piceae**
- *Cinara pinea**
- *Cinara pini**

Camponotus ligniperda (Latreille, 1802)
- *Cinara pinea**

Lasius Fabricius, 1804
sg. Lasius Fabricius, 1804
Lasius (Lasius) alienus (Förster, 1850)
- *Cinara schimitscheki* (*alienus* group?)

Lasius (Lasius) niger (Linnaeus, 1758)
- *Cinara cupressi**
- *Cinara hyperophila**
- *Cinara juniperi**
- *Cinara laricis**
- *Cinara nigritergi**
- *Cinara nuda**
- *Cinara piceae**
- *Cinara piceicola**
- *Cinara pilicornis**
- *Cinara pinea**
- *Cinara pruinosa**
- *Cinara schimitscheki*
- *Cinara tujafilina*
- *Mindarus obliquus**

Lasius (Lasius) platythorax Seifert, 1991
- *Cinara hyperophila**
- *Cinara nuda**

*Cinara pinea**
sg. *Cautolasius* Wilson, 1955
Lasius (Cautolasius) flavus (Fabricius, 1782)
*Prociphilus pini** [II]
sg. *Dendrolasius* Ruzsky, 1912
Lasius (Dendrolasius) fuliginosus (Latreille, 1798)
*Cinara juniperi**
Cinara nigritergi S*
*Cinara piceicola**
Formica Linnaeus, 1758
Cinara smolandiae
sg. Formica Linnaeus, 1758
Formica (Formica) pratensis Retzius, 1783
*Cinara piceicola**
*Cinara pini**
Formica (Formica) truncorum Fabricius, 1804
*Cinara hyperophila**
*Cinara nuda**
*Cinara piceae**
*Cinara piceicola**
*Cinara pilicornis**
*Cinara pinea**
*Cinara pini**
*Cinara pruinosa**
Formica (Formica) aquilonia Yarrow, 1955
*Cinara nuda**
*Cinara piceicola**
*Cinara pilicornis**
*Cinara pinea**
*Cinara pini**
*Cinara pruinosa**
Formica (Formica) lugubris Zetterstedt, 1838
Cinara kochiana
*Cinara piceicola**
*Cinara pilosa**
*Cinara pruinosa**
Formica (Formica) polyctena Förster, 1850
*Cinara hyperophila**
*Cinara juniperi**
*Cinara nuda**
Cinara pectinatae S*
*Cinara piceae**
*Cinara pinea**
*Cinara pini**
*Cinara pruinosa**
*Cinara smolandiae**
Formica (Formica) rufa Linnaeus, 1761
Cinara acutirostris (*F. rufa* group?)
Cinara brauni (*F. rufa* group?)
Cinara cembrae (*F. rufa* group?)

*Cinara confinis**
*Cinara cuneomaculata**
Cinara curvipes (*F. rufa* group?)
*Cinara hyperophila**
*Cinara juniperi**
*Cinara laricis**
*Cinara pinea**
*Cinara pini**
sg. *Coptoformica* Müller, 1923
Formica (Coptoformica) pressilabris Nylander, 1846
*Cinara pinea**
sg. *Raptiformica* Forel, 1913
Formica (Raptiformica) sanguinea Laverne, 1798
*Cinara hyperophila**
*Cinara piceicola**
*Cinara pini**
Cinara schimitscheki
sg. *Serviformica* Forel, 1913
Formica (Serviformica) cinerea Mayr, 1853
*Cinara hyperophila**
*Cinara juniperi**
*Cinara nuda**
*Cinara pinea**
*Cinara pini**
*Cinara piniphila**
Formica (Serviformica) fusca Linnaeus, 1758
*Cinara hyperophila**
*Cinara juniperi**
*Cinara nuda**
*Cinara pilicornis**
*Cinara pinea**
*Cinara pini**
Formica (Serviformica) lemani Bondroit, 1917
*Cinara pinea**
*Cinara pini**
Formica (Serviformica) clara Forel, 1886
*Cinara juniperi**

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