

***Symydobius nanae* sp. n. (Sternorrhyncha: Aphidoidea: Aphididae) and other aphids living on *Betula nana* in the Šumava National Park, Czech Republic**

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Abstract. Two host-specific and 3 oligophagous aphid species are recorded from *Betula nana* L. in southern Bohemia. *Symydobius nanae* sp. n. (apterous viviparous female, ovipara and male) is described and its intraspecific variation is compared with that of *S. oblongus* (von Heyden). New morphological data on *Calaphis arctica* Hille Ris Lambers are presented, which possibly differentiate the Greenland and the Central European populations of this species. A key is given to European *Calaphis* spp. Occasionally, summer generations of *Calaphis flava* Mordvilko reproduce on *B. nana*, whereas it is possible that *Calaphis betulicola* (Kaltenbach) and *Euceraphis punctipennis* (Zetterstedt) are vagrants.

INTRODUCTION

Betula nana L. is a typical Arcto-Alpine element of the European flora. It is distributed discontinuously from Greenland, westward across Iceland, Scotland, Scandinavia north of Oslo and Stockholm, the whole of Finland, Estonia and European Russia north of approximately 58°N (Čermák et al., 1955). Further south in Europe, isolated populations occur in northern Germany, northern Poland, Lithuania, Latvia, in the Alps and in a few localities in the central European Hercynic mountains (Fig. 1). Usually, the latter localities are raised peat bogs and *B. nana* occurs here in the plant association Pinetum mughi betuleto-sum nanae Kästner & Flössner, 1933 (Sofron & Šandová, 1972).

The present study is based on aphids collected on *B. nana* at three localities in the Šumava National Park, Southern Bohemia, Czech Republic: 1) Jezerní slat' near Horská Kvilda (about 1.2 km², 1,050 m a.s.l.), which, with the exception of the Alps, has the largest population of *B. nana* in central Europe; 2) a small bog (about 0.3 km², 1,030 m a.s.l.) 0.5 km north of Kvilda and 3) Rokytská slat' (Weitfeller Filz, cca 1,300 m a.s.l.).

Unless stated otherwise, the collections were made by the author and all the material, including the types of the new species, is deposited in the Institute of Entomology, Czech Academy of Sciences.

Abbreviations used in the text: apt., apterae – apterous viviparous females; al., alatae – alate viviparous females; ovip. – oviparous females; HT2 – hind tarsal segment 2; URS – ultimate rostral segment; III – antennal segment III; VIa – base of antennal segment VI; PT – processus terminalis.

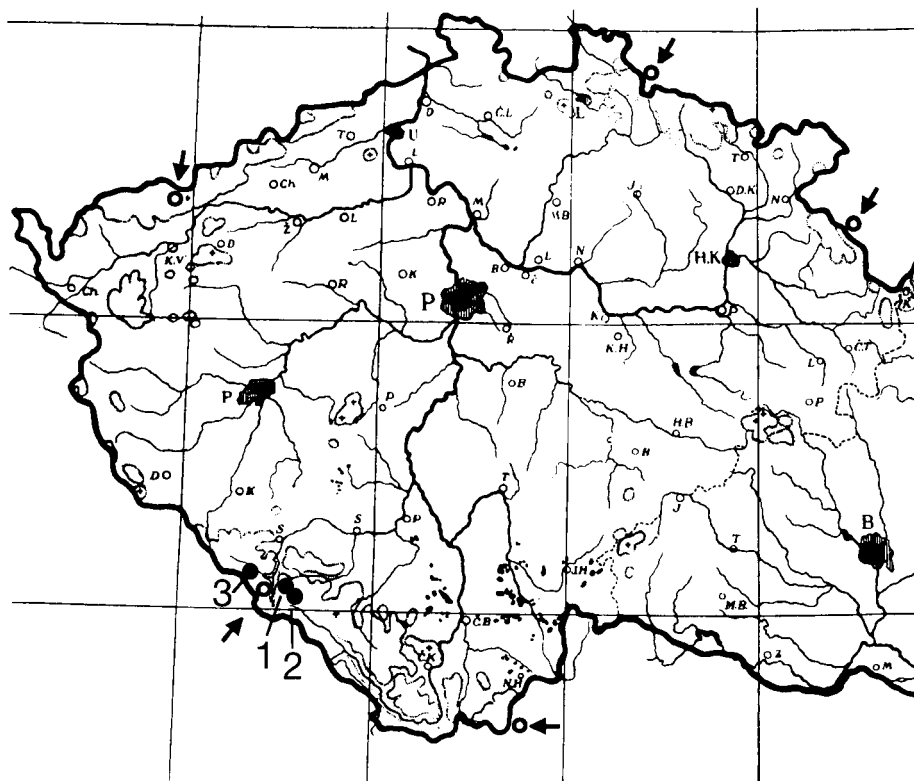


Fig. 1. Distribution of *Betula nana* L. in Bohemia and adjacent territories. Solid circles: investigated localities 1-3.

Symydobius nanae sp. n.

Apterous viviparous female (4 specimens, ultimate generation).

Morphological characters. Alatiform, i.e., with ocelli, secondary rhinaria and broad mesothorax but without well differentiated pterothorax. Dorsal abdominal pattern (Fig. 2A) consisting of marginal sclerites on segments 1-7, narrow band across tergum 8 and spinopleural bands of unequal size on terga 1-7 of which those on terga 4-6 are the largest and those on 1-3 narrow, tending to be perforate or partly broken. Dorsal hairs long, fine and acute, in irregular groups on thorax and proximal abdominal terga, less numerous posterad. Spinals 20-30, 18-25, 10-13, 4-7, 2-3, 2 and 2-3 on terga 1-7, respectively. Pleural hairs mostly multiple on proximal terga, one pair on segments 4-6. Marginal hairs numerous on all terga to abdominal 7. Tergum 8 with 10-11 hairs in a single row. Marginal tubercles not present. Antennae about 0.60-0.85 of the length of the body. Segment III relatively short, subequal to or slightly exceeding the width of the head. The longest hairs on antennal segment III 0.050-0.060 mm, 1.4-1.7 $\times$ and 1-1.2 $\times$ the basal and middle diameter of that segment, respectively. Base of segment VI bears only 0-1 hairs (Fig. 2C), processus terminalis subequal to the base of VI. First tarsal segment with 9 ventral hairs, on fore and middle legs often with one pair of dorsal hairs. Secondary rhinaria widely

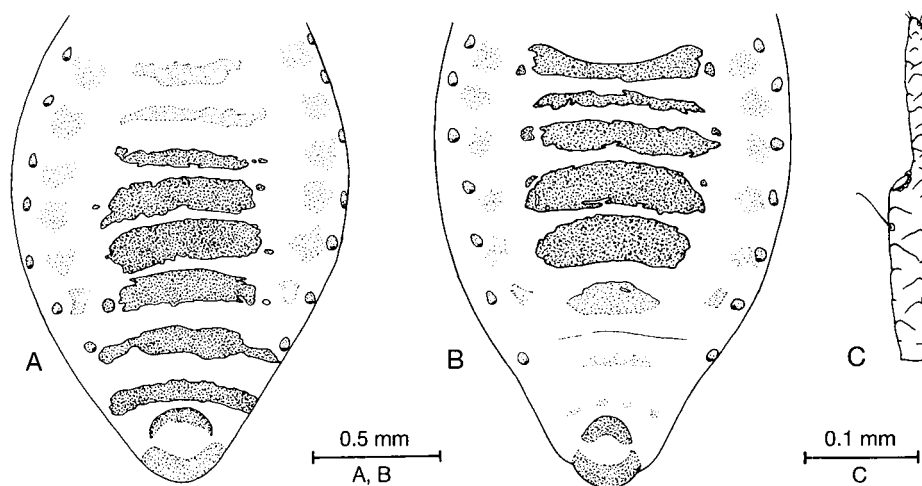


Fig. 2. *Symydobius nanae* sp. n. A – apterous viviparous female (holotype), sclerotization of abdominal dorsum (hairs omitted); B – oviparous female, idem; C – apterous viviparous female, antennal segment VI.

oval, 6–14 on basal half of antennal segment III. Other characters as in summer apterae of *Symydobius oblongus*.

Colour. In vivo brown to dark brown, with dark appendages except for two pale rings on distal half of the antennae. In cleared specimens head, sclerotized areas on thorax, spinopleural bands on abdominal segments 3–7, the band on segment 8 and legs dark brown to black, proximal spinopleural bands and marginal sclerites distinctly paler. Antennae concolorous with the head except for yellow-white basal half of segments IV and V.

Oviparous female (170 specimens)

Morphological characters. Abdomen behind siphunculi elongate and with reduced dorsal pattern: the spinopleural band on tergum 6 trapezoidal, that on tergum 7 reduced to diffuse flecks at the base of spinal hairs or absent, transverse band on tergum 8 absent (Fig. 2B). Dorsal abdominal chaetotaxy as in apterous viviparous female with the exception of more numerous (20–38, average 25) hairs on tergum 8. Secondary rhinaria 2–14 in number. Hind femora slightly swollen, with 0–60 (average 11.4), mostly double, scent-plaques on basal 1/3–2/3. Other characters, including the well-developed ocelli and colour, as in the apterous viviparous female.

Apterous male (1 specimen)

Morphological characters. Similar to viviparous females but smaller and more slender. Body 2.1 mm long. Dorsal pattern and dorsal abdominal chaetotaxy as in viviparae, tergum 8 with 9 hairs. Antennae about 0.8 of the length of the body. Length of segment III slightly greater than the width of the head and about 1.95× the length of segment VI. Secondary rhinaria widely oval to circular, 26 (22), 0 (0) and 4 (5) on segments III, IV and V,

respectively. Antennal hairs long and fine, with those on segment III up to 0.055 mm long, nearly twice as long as the basal diameter of that segment. Base of VI bearing 2 (1) hairs. Other characters and colour as in the viviparous females.

TYPE MATERIAL: Holotype (apterous viviparous ♀, slide 22 222/apt. 1): Bohemia m., Šumava Mts, Jezerní slat, 19.ix.1991. Paratypes: Same data, 3 apt., 115 ovip. and 1 ♂; ibidem, 23.ix.1983, 52 ovip.; ibidem, 23.ix.1992, 3 ovip.

BIOLOGY. The oviparae were found singly or in small aggregations on young branches of *Betula nana* L., attended by *Formica* (*Serviformica*) *lemanii* Bondriot, 1917. The feeding site and behaviour of fundatrices and summer viviparous generations is unknown. In spite of searching on *B. nana* for aphids on frequent occasions in 1990–94, *S. nanae* was not found before the last decade of September.

SYSTEMATIC POSITION. Four species of *Symydobius* have been reported from the Palaearctic: *S. oblongus* (von Heyden, 1837), which is widespread in Europe and northern Asia east to Vladivostok; *S. alniarius* (Matsumura, 1917) and *S. kabae* (Matsumura, 1917) from Mongolia to Japan and *S. minutus* Quednau & Shaposhnikov, 1988 from Primorskii Region (Russia) and from Korea.

Symydobius nanae is related to *S. oblongus*, the only other European species of the genus. In both species the spinal hairs on the abdominal terga tend to decrease in number

progressively posteriorly, and the siphunculi are subcylindrical, pale or slightly sclerotized and lack basal hairs. The Asian species are evenly and densely haired on abdominal terga 1–7 or, at least, on terga 1–5 (in *S. minutus*) and have widely cylindrical to cone-shaped siphunculi with a dark wide sclerotized base bearing four or more hairs.

The apterous viviparous females and oviparae of *S. nanae* differ from those of *S. oblongus* in having:

a) few (usually 1–2, often 0, rarely 3) hairs on the base of antennal segment VI (Fig. 3);

b) relatively shorter antennal segment III, longer segment VI and, consequently, smaller III/VI ratio (Fig. 4);

c) only two, rarely 3 spinal hairs on abdominal terga 5–7 (versus 4–6, rarely 3 on terga 6–7 and up to 15 on tergum 5 in *S. oblongus*);

d) a relatively longer processus terminalis: ratio PT/VIa = 0.77–1.20 (average = 0.95, n = 60) but rarely less than 0.85 and then on one antenna only (versus maximum 0.85 but rarely more than 0.80).

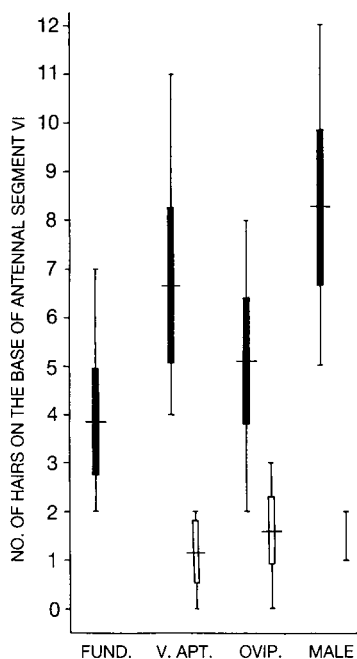


Fig. 3. *Symydobius oblongus* (von Heyden) (solid bars) and *S. nanae* sp. n. No. of hairs on the base of antennal segment VI in fundatrices, apterous viviparous females, oviparous females and males. No. of specimens/samples measured as in Fig. 4.

In addition, the oviparae differ in having only slightly swollen hind tibiae with as few as 0–60 (average = 15.8) scent-plaques and a reduced sclerotization on tergum 8 (200–300 scent-plaques on strongly incrassate hind tibia and a narrow, occasionally broken transverse band on tergum 8 in oviparae of European *S. oblongus*).

Notes on the European species of *Symydobius*

Comparisons of the same morph and generation of the two species are given, since there are considerable intraspecific seasonal differences in morphology. For example, there are differences in the structure of the antennae of fundatrices and fundatrigeniae. The newborn fundatrices of *Symydobius oblongus* differ from newborn fundatrigeniae in the length of appendages. The difference corresponds to a developmental advance of one instar in the fundatrigeniae (Holman, 1990). As a result of differential postnatal growth, the differences are partly compensated for as the two morphs grow to maturity. In both fundatrices and fundatrigeniae the antennal segments are fully differentiated after the second moult and the newly formed segment III in 3rd instar nymphs of both morphs is, on average, of about equal length. As a result of the greater growth rates of the basal part of the antennal flagellum in fundatrices antennal segment III in adults of this morph is distinctly longer than in the fundatrigeniae, both absolutely and also in relation to antennal segment VI (cf. Fig. 4).

Provided the same developmental mechanisms exist in *S. nanae*, the ratio of antennal segments III/VI in fundatrices of *S. nanae* is presumably greater than in the other morphs and is comparable with that of the fundatrigeniae and subsequent viviparous generations of *S. oblongus*.

The opposite situation exists with respect to the numbers of hairs on the base of antennal segment VI. The latter, in fundatrices of *S. oblongus*, is significantly less hirsute than in subsequent generations. The difference arises during the postnatal period (Fig. 5), as newborn specimens of all morphs have nearly equal numbers of hairs (1–3, average about 2). No differentiation of new hairs takes place and some trichogenic complexes disappear during the first moult in fundatrices, since the 2nd instar of this morph has only 1–3 hairs on VIa and the average number is even less than in newborn larvae. A slight increase is apparent after the 2nd moult (average = 2.15) and most hairs are differentiated during the 3rd and 4th moult. In fundatrigeniae of *S. oblongus* the number of hairs is doubled (average = 4.1) already during the first moult and increases slightly also in subsequent instars.

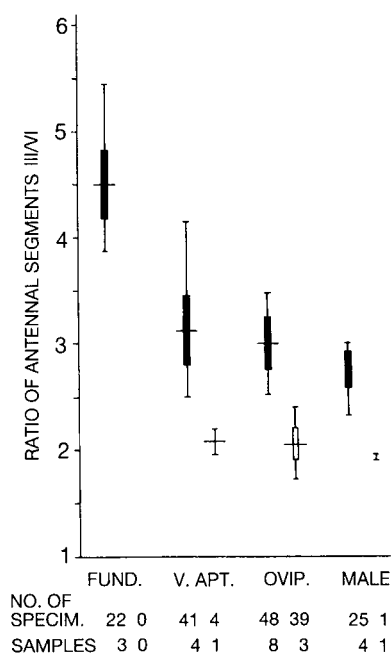


Fig. 4. *Symydobius oblongus* (von Heyden) (solid bars) and *S. nanae* sp. n. Ratio of antennal segments III/VI in fundatrices, apterous viviparous females, oviparous females and males.

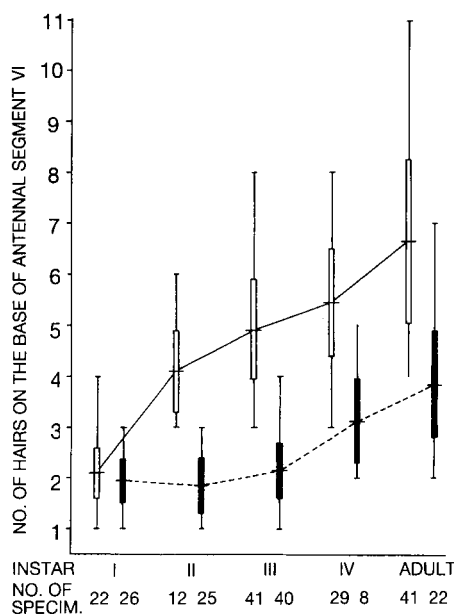


Fig. 5. *Symydobius oblongus* (von Heyden). No. of hairs on the base of antennal segment VI in the course of ontogeny of the fundatrices (solid bars) and apterous viviparous females.

North European populations (Heie, 1982) and marginal tubercles are developed in examined apterae and alatae from Sweden. The many specimens from central and eastern Europe and western Siberia show no traces of rudimentary marginal tubercles and the males are alate or brachypterous. Brachypterous males have been reported from Finland (Heikinheimo, 1987).

Absence of siphunculi is characteristic of some populations in Scotland (Stroyan, 1977). The oviparae from Mongolia have only 50–120 scent plaques on slightly incrassate hind tibiae. Oviparae on *Betula pubescens carpatica* in the Šumava Mountains tend to have only one pair of spinal hairs on terga 6 and 7, and in some specimens a few scent plaques are present on the middle tibiae in addition to numerous plaques on the hind tibiae.

Recently two samples (1 + 4 apterae) of *Symydobius* were collected near Imatra in Finland on underground parts of the twigs of *B. nana*. One sample (1 specimen) might be classified as *S. nanae* (1 and 2 hairs on VIa, III/VI = 2.4–2.5, PT/VIa = 0.85–0.90). Other specimens are *S. oblongus* (4–8 hairs on VIa, III/VI = 2.8–3.1, PT/VIa = 0.64–0.72) but have fewer spinal hairs on abdominal dorsum (7–12, 3–10, 3–4, 2–3 and 2 on terga 3–7, respectively). In this respect they resemble *S. nanae* and also the population of *S. oblongus* on *B. pubescens carpatica* in Šumava Mountains.

The difference between *S. nanae* and *S. oblongus* in the chaetotaxy of antennal segment VI probably arises during the postnatal development as well. The newborn larvae of the two species do not differ. Zero or low rates of differentiation of new trichogenic complexes, which does not compensate for the loss in the course of postnatal development, results in a low average number of hairs on the base of antennal segment VI in the adults of *S. nanae*. This may explain the absence of hairs on VIa from one antenna in some specimens. Provided the same mechanisms are involved, the fundatrices of *S. nanae* should not differ substantially in this character from other morphs.

It is likely that some populations of *S. oblongus* are morphologically differentiated. According to Stroyan (1977), the males of *S. oblongus* are apterous and females have rudimentary marginal tubercles present as groups of small facets, not larger than the hair bases, posterolaterally on the pronotum and abdominal marginal sclerites. Apterous males appear to be common also in some

Other aphids on *Betula nana* in Czech Republic

Colaphis arctica Hille Ris Lambers, 1952

RECORDS (all Bohemia m., Šumava Mts). Jezerní slat: 6.vi.1989 (2 apt.), 25.vi.1990 (27 apt., 1 al.), 26.vi.1991 (59 apt.), 19.ix.1991 (2 apt., 19 ovip., 4♂) and 23.ix.1992 (2 ovip., 2♂). Kvilda: 23.ix.1983 (8 ovip., 1♂), 16.vii.1991 (75 apt.), 20.ix.1991 (2 apt., 3 ovip., 19♂) and 23.ix.1992 (16 ovip.). Rokytská slat: 16.vii.1992 (54 apt., 3 al.).

BIOLOGY. Lives singly or in small groups on the underside of the leaves and is not attended by ants.

COMPARATIVE NOTES. The original description is based on two adult apterous females collected on *B. nana* in southern Greenland (Grönnedal). Later Hille Ris Lambers (1959) gave a fuller description of apterous viviparous females and added descriptions of alate viviparous females, oviparous females and males based on material collected on *B. nana* near Bernried (Bavaria, Germany). He stated that the apterous females from Germany differ from the types in being much smaller (1.25–1.60 mm versus 1.90–2.04 mm), in having shorter, slightly thicker and often darkened dorsal hairs (0.045–0.070 mm versus 0.070–0.085 mm) and blunt, very short (0.005 mm) hairs on antennal segment III (acuminate, 0.010–0.015 mm in the types).

The apterae from Šumava are 1.6–2.0 mm long, the largest specimens being comparable in size with the type specimens. They also are short-haired, but in some specimens frontal and dorsal hairs are longer (up to 0.08 mm, spinal hairs on terga 8 sometimes up to 0.1 mm) and in a few specimens distal hairs on antennal segment III are acuminate, about 0.01 mm long as in the types.

A comparison with the original description (Hille Ris Lambers, 1952, p. 22) reveals other differences between the Greenland and central European specimens. a) The latter are generally more strongly pigmented: the apical third of the siphunculi and the tips of femora are black, the whole of the distal half of the antennal flagellum or at least the apices of segments III–V and the area around the primary rhinarium on segment VI are strongly darkened, dorsal hair-bearing papillae and some hairs are usually pigmented. b) Abdominal terga 1–7 in adult apterae, independent of their size, usually bear 6, rarely on some terga 7 or even 8 hairs (8–11 hairs on terga 2–5 of the type). The apterous viviparous females and oviparae from Finland do not differ substantially from specimens from the Czech Republic. If confirmed, by further material from Greenland, the above differences indicate that the European populations represent a separate taxon.

Additional features and measurements. Apterous viviparous female: URS/HT2 = 0.8–1.0 (usually 0.85–0.95), secondary rhinaria 2–6, with that most basal situated between 0.15–0.40 and that most distal between 0.38–0.65 of the length of segment III measured from base. Oviparous female: URS as in the apterae, secondary rhinaria more numerous (4–11), situated as in the apterae, PT/V1a = 1.65–1.95.

The European *C. arctica* shares with *C. betulicola* (Kaltenbach) the same distribution of secondary rhinaria and pattern of pigmentation but differs in having a short terminal rostral segment, like *C. flava*.

Calaphis betulicola (Kaltenbach, 1843)

RECORD. Bohemia m., Šumava Mts, Jezerní slat: 25.vi.1990 (1 al.).

BIOLOGY. Oligophagous, recorded on most European and some far-eastern *Betula* spp., and also on introduced North American *B. papyrifera* Marsh. According to Stroyan (1957), this species lives mostly on seedlings and small bushes of up to 1 m in height. The only published records on *B. nana* are those of Ossiannilsson (1959, 1964) from Sweden (Bergian Garden, Stockholm, apt.).

In the Šumava, it was recorded from *B. pubescens carpatica*. It is likely that it is a vagrant on *B. nana* as the few records are of adults.

Calaphis flava Mordvilko, 1928

RECORDS (all Bohemia m., Šumava Mts). Jezerní slat: 14.ix.1962, leg. A. Pintera (3 apt. and 2 al. 1 alate ♂ and numerous nymphs), 26.vi.1991 (1 al.), 19.ix.1991 (1 al. and 1 alate ♂). Kvilda: 1.viii.1968 (2 apt. and nymphs), 16.vii.1991 (1 apt. and nymphs).

BIOLOGY. Oligophagous on *Betula* spp., like the preceding species, but with a wider host range and more extensive area of distribution. On *B. nana* it has been recorded from the Botanical Garden in Warsaw, Poland (Szelegiewicz, 1967) and the Bergian Garden in Stockholm, Sweden (Ossiannilsson, 1964). The viviparae reproduce and develop on *B. nana* but oviparae and fundatrices have not been collected on this plant.

Key to alate and apterous viviparous females of European species of *Calaphis*
(after Stroyan, 1957, with additions)

- 1 The most basal secondary rhinarium situated at 0.13–0.40 (usually more than 0.20) of the length of antennal segment III measured from base. Apical half or at least flange and opercular apodemes of siphunculi dusky to black 2
- The most basal secondary rhinarium situated at 0.05–0.11 of the length of antennal segment III measured from base. Siphunculi usually pale. [URS 0.12–0.15 mm, about as long as or slightly longer than HT2. Dorsal abdominal hairs 0.08–0.10 mm and 0.02–0.04 mm long in the apterae and alatae, respectively. The last generation of alatae often with longer dorsal hairs, siphunculi dark at apex and tergites 3–5 with dark spinal markings.] *Calaphis flava* (Mordvilko)
- 2 URS 0.10–0.12 mm, 0.8–1.0 times as long as HT2, with 2–4 hairs besides the 3 apical pairs. Dorsal abdominal hairs 0.05–0.08 mm and 0.02–0.03 mm long in the apterae and alatae, respectively, rarely longer on distal terga *Calaphis arctica* Hille Ris Lambers
- URS 0.15–0.17 mm long, distinctly longer than HT2, with 6–8 hairs besides the 3 apical pairs. Dorsal hairs on all terga 0.09–0.11 and 0.03–0.06 mm long in the apterae and alatae, respectively *Calaphis betulicola* (Kaltenbach)

Euceraphis punctipennis (Zetterstedt, 1828)

RECORDS. Bohemia m., Šumava Mts, Jezerní slat: 16.vii.1991 (3 IVth instar nymphs and 1 adult al.). Kvilda 19.ix.1991 (5 IVth instar nymphs and 1 adult al.).

BIOLOGY. Oligophagous on *Betula* spp., in Europe preferring *B. pubescens* and related taxa. On *B. nana* it has been recorded from Sweden (Ossiannilsson, 1964) only and is presumed to be a vagrant in Šumava as, in both localities, *E. punctipennis* was abundant on nearby small trees of *B. pubescens carpatica*.

NOTE. An undescribed *Euceraphis* sp. of the *betulae* group with a distinct karyotype is recorded from *B. nana* in Finland as well as from *B. glandulosa* in subarctic Canada (Blackman, 1988). It has URS 0.109–0.142 mm long, 0.52–0.61× HT2 (versus 0.178 mm, about 0.66× HT2 in the above *E. punctipennis* from *B. nana*).

DISCUSSION

The first records of aphids on *Betula nana* were of *Calaphis arctica* and *Betulaphis pelei* from Greenland (Hille Ris Lambers, 1952).

B. pelei has now been recorded from Norway, northern Sweden, Finland (Heie, 1982, Heikinheimo, 1984) and the Kola peninsula (Shaposhnikov, 1964). Records of *C. arctica* (or, possibly, a closely related taxon) come from Finland and the relict central European populations of *B. nana*.

Apart from these three species, *Calaphis betulicola*, *C. flava* and *Euceraphis punctipennis* have been found on *B. nana* in central and northern Europe. These species are to various degrees oligophagous on *Betula* spp. The age structure of samples suggests they are vagrants or, at most, reproduce on *B. nana* only occasionally.

In addition *Betulaphis brevopilosa* Börner, 1940 was found and evidently reproduces on *B. nana* in Sweden (Ossiannilsson, 1972) and Finland (Heikinheimo, 1963 and A.F.G. Dixon, unpublished).

Other birch aphids of the genera *Glyphina*, *Callipterinella* and *Clethrobius* have not yet been found on *B. nana*.

The aphid fauna of *Betula nana* is more specific than that of any other Palaearctic species of *Betula*. *Calaphis arctica* and *Symydobius nanae* are known only from *B. nana*, *Betulaphis pelei* from *B. nana* and a hybrid *B. nana* × *B. pendula* (Heikinheimo, 1984). Some oligophagous aphids common on other birches (e.g. *C. betulicola* and *E. punctipennis*) either avoid *B. nana* or settle on it only temporarily.

However the summer generations of *B. brevopilosa* and *C. flava*, the latter species with the widest host range among the birch aphids, evidently reproduce on *B. nana*. Alate viviparous females are extremely rare or absent in samples of host-specific aphids on *B. nana* in Šumava, whereas in other birch aphids alatae are relatively common or are the only viviparous morph.

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