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Gall midges (Diptera: Cecidomyiidae) new to the Danish fauna

SIMON HAARDER, HANS HENRIK BRUUN, KEITH M. HARRIS & MARCELA SKUHRAVÁ

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First records of twenty-three gall midge species in Denmark are reported: *Asphondylia ervi* Rübsaamen, *Contarinia acetosellae* Rübsaamen, *C. viburnorum* Kieffer, *Dasineura astragalorum* (Kieffer), *D. fructum* (Rübsaamen), *D. harrisoni* (Bagnall), *D. lotharingiae* (Kieffer), *D. papaveris* (Winnertz), *D. saxifragae* (Kieffer), *D. traili* (Kieffer), *Herbomyia robusta* Möhn, *Jaapiella chelidonii* Fedotova, *Lasioptera arundinis* Schiner, *L. calamagrostidis* Rübsaamen, *Mayetiola festucae* Ertel, *M. phalaris* Barnes, *M. ventricola* (Rübsaamen), *Mycodiplosis coniophaga* (Winnertz), *Parallelodiplosis galliperda* (Löw), *Piceacecis abietiperda* (Henschel), *Rabdophaga strobilina* (Bremi), *Taxomyia taxi* (Inchbald) and a probably undescribed species of *Contarinia* Rondani. Thus, 363 fully identified gall midge species are now documented from Denmark along with 25 species, which have been identified to genus level only. The species number per subfamily is 335 Cecidomyiinae (311 fully identified and 24 identified to the genus level only), 0 Winnertziinae and 14 Porricondyliinae (13 fully identified and one identified to the genus level only), 24 Micromyinae and 15 Lestremiinae.

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Gall midges (Cecidomyiidae) is a species-rich dipteran family with over 6000 species described Worldwide, half of which occur in the Palaearctic Region (Gagné & Jaschhof 2014). In general, adults are minute to small (1 mm to 5 mm) insects with elongated legs, reduced wing venation and long, often moniliform (string-of-beads shaped) antennae (Fig. 1). As a family-specific trait, larvae are equipped with a sclerotized structure, the sternal spatula, on the ventral side below the head (Fig. 1.). This structure has, however, been lost in some species. Gall midge larvae exhibit great variety in shape, often adapted to the specific environment, but there is a tendency for phytophagous gall-inducing species in the sub-

family Cecidomyiinae to have brightly coloured barrel-shaped larvae (Mamaev & Krivosheina 1993). In addition to Cecidomyiinae, the family consists of five more subfamilies: Catotrichinae, Lestremiinae, Micromyinae, Porricondyliinae and Winnertziinae (Gagné & Jaschhof 2014). Among those almost all species are mycetophagous or saprophagous.

This paper is focused on species of Cecidomyiinae. They exhibit a number of different feeding strategies, such as zoophagy (other insects, mites etc.), mycetophagy and phytophagy. The activity of phytophagous larvae often results in characteristic and striking galls on the affected plant organs. It is this capacity – gall induction –



Figure 1. The gall midge *Cupressatia siskiyou* (Felt, 1917). An adult male (left) and a larva removed from its seed gall on *Chamaecyparis lawsoniana* (right). Key family characters are marked as la: long antennae; ll: long legs; rwv: reduced wing venation; ss: sternal spatula.

Gallmyggan *Cupressatia siskiyou* (Felt, 1917). En vuxen hane (till vänster) och en larv urplockad ur sin frögall på ädelcypress (till höger). Kännetecken för familjen är långa antenner (la), långa ben (ll), få och ogrenade vingribbor (rwv), och bröstben eller sternal spatula (ss). Foton: SH.

that has served as an inspiration for the common name of the family.

Gall midges have been studied in Denmark by a number of amateur and professional scientists for the last 150 years (summarized by Skuhrová et al 2006). By the beginning of the 21st century, the Danish Cecidomyiidae fauna was known to consist of 178 species, and the family was ranked as one of the least investigated dipteran families in this territory (Petersen & Meier 2001). A few years later, a revised checklist including 286 species was reported by Skuhrová et al. (2006). This impressive increase was based on field investigations carried out by Marcela Skuhrová and Vaclav Skuhrový near Copenhagen in 2002, Jørgen Jørgensen's investigations from 1997 to 2003 on the island of Læsø, and a revision of the entire gall midge collection in the Natural History Museum in Copenhagen. This important work sparked a renewed interest in the faunistics of this group (Bruun & Skuhrová 2011, Bruun et al. 2012, Bruun et al. 2014, Jørgensen 2009). The current paper reports the finding of 23 species from the subfamily Cecidomyiinae not previously recorded from Denmark.

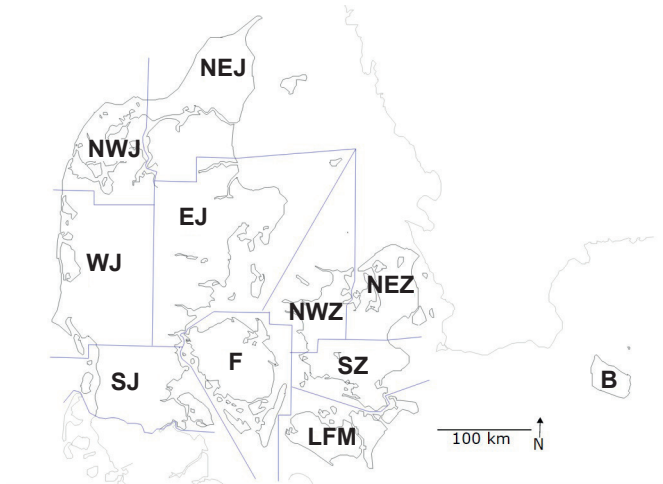
Methods

The new records primarily result from more or less opportunistic searches by the first two authors. However, systematic recording of fungal biodiversity in a set of 130 study sites under the nationwide research project BioWide has resulted in a significant bycatch of rarely recorded species of gall midges, including as many as three of the species reported here. This work has been conducted by Dr. Thomas Læssøe. Common to these species is gall position on basal plant parts close to the ground, and a field mycologist's tool – the 'truffle rake' – being instrumental in the discoveries. This tool (in fact, just a hand rake from any plant nursery) was used to probe for fungal fruitbodies found in leaf litter, deep in dense grass turf or below tall and entangled herbs and vines – i.e. positions convenient to neglect. In addition, the two first authors have made systematic surveys of plant galling arthropods in about half of the BioWide sites using the field method described by Skuhrová & Skuhrový (2009).

Most of the species reported here have been identified through a combination of generic larval characters and species-specific host plant

Figur 2. The fauna provinces of Denmark. From Enghoff & Nielsen (1977): SJ: South Jutland; EJ: East Jutland; WJ: West Jutland; NWJ: Northwest Jutland; NEJ: Northeast Jutland; F: Funen; LFM: Lolland-Falster-Møn; SZ: South Zealand; NWZ: Northwest Zealand; NEZ: Northeast Zealand; B: Bornholm.

Faunaprovinsler i Danmark. Från Enghoff & Nielsen (1977): SJ: Sønderjylland; EJ: Østjylland; WJ: Vestjylland; NWJ: Nordvestjylland; NEJ: Nordøstjylland; F: Fyn; LFM: Lolland-Falster-Møn; SZ: Sydsjælland; NWZ: Nordvestsjælland; NEZ: Nordøstsjælland; B: Bornholm.



identity, galled plant part and gall morphology (e.g. Buhr 1964-1965, Redfern & Shirley 2011). For all the species reported here, this was sufficient for correct identification. Nevertheless, rearing of adults was attempted as often as sufficient numbers of mature third instar larvae were found, but often failed (for reasons discussed below). For the genera *Lasioptera* and *Mayetiola* larvae were identified to species using Möhn (1955) and Ertel (1975), respectively. Yukawa (1985) provided diagnostic features for the pupa of *Asphondylia ervi*. For these species, rearing was not tried, except for *L. arundinis*, due to the plentiful larval material available.

Abbreviations and demarcations of fauna districts are in accordance with Enghoff & Nielsen (1977) (Fig. 2). Collector ("leg." in text) abbreviations are as follows: Aksel Jørgensen (AJ), Ditte Arp (DA), Erik A. Thomsen (EAT), Hans Henrik Bruun (HHB), Ken Alminde (KA), Rasmus Ejrnæs (RE), Simon Haarder (SH), Søren Johan Abel Nielsen (SJAN) and Thomas Læssøe (TL).

Results

Accounts for the newly recorded species, including biology, Danish records and known distribution, are provided below in alphabetical order:



Figure 3. Pod gall of *Asphondylia ervi* on *Vicia sativa*. A single pupa is visible in the opened pod (right).

Gall förorsakad av *Asphondylia ervi* på balja av äkervicker (*Vicia sativa*). En puppa är synlig i den öppnade baljan (till höger). Foto: SH

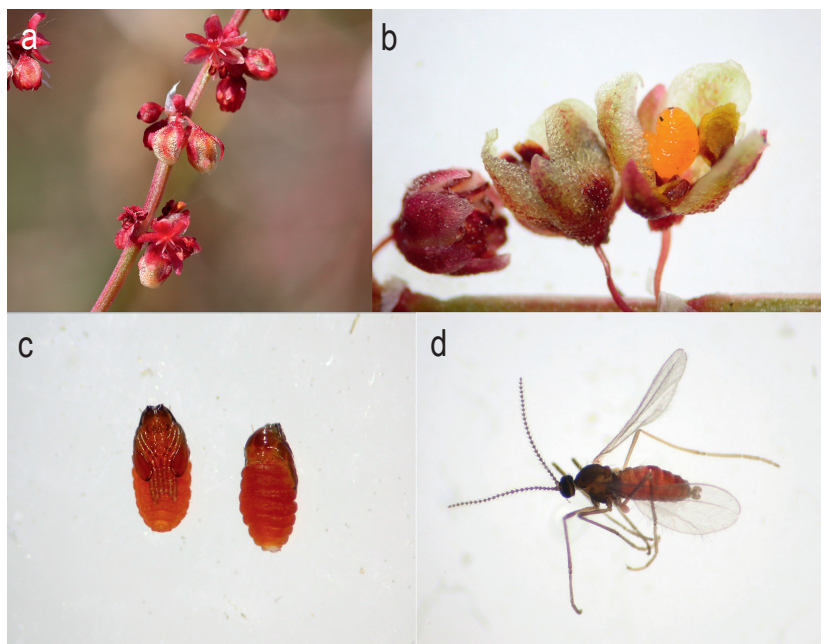


Figure 4. *Contarinia acetosellae* on *Rumex acetosella* – a) Flower bud galls, – b) Larvae in opened gall, – c) Pupae isolated from galls, – d) A reared adult male specimen.

Contarinia acetosellae i honblommor av rödsyra (*Rumex acetosella*) – a) Galler, – b) Larv i öppnad gall, – c) Puppor, – d) En nykläckt vuxen hane. Foto: SH.

Asphondylia ervi Rübsaamen, 1895

A single pupa was found in a basally swollen pod of *Vicia sativa* L. (Fig. 3) The inside of the gall was lined with white mycelium. *Vicia hirsuta*, *V. sylvatica* L. and *V. tetrasperma* have been reported as hosts elsewhere in Northern Europe (Skuhrová et al. 2014, Roskam & Carbonnelle 2015). The larvae live gregariously and pupate in the gall, as observed.

Material examined: NEZ: The University Gardens at Frederiksberg (55°41'07.9"N 12°32'35.2"E), urban park, 20.vii.2015, leg. SH. No rearing was tried, as the pupa was stored in 70% ethanol for identification.

Distribution: Euro-Siberian. This species is listed as rare in Belgium, the Netherlands, France, Poland and the UK (Redfern & Shirley 2011, Roskam & Carbonnelle 2015, Skuhrová et al. 2005, 2008). In Germany, however, it occurs frequently (Skuhrová et al. 2014).

Contarinia acetosellae Rübsaamen, 1891

Orange larvae were found individually in unopened and slightly swollen flower buds of the dioecious *Rumex acetosella* L. (Polygonaceae) (Fig. 4) – most often in female flowers, but occasionally in male flowers. Roskam & Carbon-

nelle (2015) also lists *Rumex acetosa* L. as a host plant. Internal pupation in galled buds was observed. Imagoes emerged 10.vii.2015 were unambiguously assigned to the genus *Contarinia* (Fig. 4).

Material examined: NEZ: Melby Overdrev (56°01'25.1"N 11°59'48.9"E), coastal acidic grassland, 10.vi.2015 & 02.vii.2015, leg. SH & SJAN. Flower bud galls containing second-instar larvae were found at several additional sites: SZ: Ulvshale Klit (55°03'17.0"N 12°16'11.6"E), sandy grassland, 11.vi.2015, leg. SH & SJAN; F: Hestebakke (55°07'51.1"N 10°14'42.0"E), dry grassland, 13.vi.2015, leg. SH; NWZ: Vesterlyng (55°43'46.1"N 11°15'39.2"E), coastal grassland, 22.vii.2015, leg. HHB; Disbjerg (55°49'35.5"N 11°26'12.8"E), dry grassland, 24.vii.2015, leg. HHB; NWJ: Uggerby (55°49'35.5"N 11°26'12.8"E), old-field, 27.vii.2015, leg. HHB; Råbjerg Kirke (57°37'33.6"N 10°21'16.5"E), inland dunes, 30.vii.2015, leg. HHB. Larvae in younger stages cannot be definitely assigned to genus. Thus, the species *Jaapiella rubicundula* (Rübsaamen, 1891), also associated with *R. acetosella* flowers, cannot be ruled out. The latter species has never been recorded from Denmark.



Figure 5. Flower bud galls of *Contarinia viburnorum* on *Viburnum lantana*.

Blomknoppgaller på parkolvon (*Viburnum lantana*) förorsakade av *Contarinia viburnorum*. Foto: SH.

Distribution: European, introduced in North America (Gagne & Jaschhof 2014). In general, it is infrequently recorded in Europe. The reference to Denmark in Harris (2003) is a mistake. The species has not formally been recorded from Sweden, however, Sylvén (1983) reported larvae of a *Contarinia* sp. from flower buds of *Rumex acetosella* on Öland, which strongly suggests that *C. acetosellae* belongs to the Swedish fauna.

***Contarinia viburnorum* Kieffer, 1913**

A large number of flower bud galls, containing gregarious orange larvae, were discovered on *V. lantana* L. (Fig. 5). The host shrub was brought into the garden in 1991 (gardener Elsebeth Larsen, pers. comm. 2015). *V. opulus* L. (Caprifoliaceae) is the most commonly reported host plant. In southern Spain, however, *C. viburnorum* is found exclusively on *Viburnum tinus* L. (Sanchez et al. 2012). A visit to the locality a week after the first observation revealed no larvae in the remaining galls, thus indicating pupation in the soil which is in accordance with the literature (Coulianos & Holmåsén 1991) Material examined: NEZ: The University Gardens at Frederiksberg (55°41'11.1"N 12°32'34.9"E), urban park, 20.vii.2015, leg. SH (on *V. lantana*). Rearing failed in spite of plenti-

ful material.

Distribution: European; known from 14 countries. It is moderately widespread in Germany, France and Belgium with 4 records from each country. Also known from southern Sweden and Norway (on *V. opulus*) (Coulianos & Holmåsén 1991).

***Contarinia* sp.**

White larvae, living gregariously, were recovered from thickened and rolled leaf margins on a single specimen of *Berberis vulgaris* L. (Berberidaceae) (Fig. 6). The afflicted shrub was imported to the garden in the 1950s, however, the origin is not known (gardener Steen-Allan Fredensborg, pers. comm. 2015). *Dasineura berberidis* (Kieffer, 1909) induces a similar gall on the same host plant.

Material examined: NEZ: The University Gardens at Frederiksberg (55°41'11.1"N 12°32'34.9"E), urban park, 20.vii.2015, leg. SH. Rearing was unfortunately not successful.

Distribution: Euro-Siberian. One old literature record from Bavaria (Germany), and also reported recently from Armenia and Georgia (Ross 1922, Mirumian 2011, Skuhravá et al. 2013). These records probably refer to the same taxon as the one reported here.

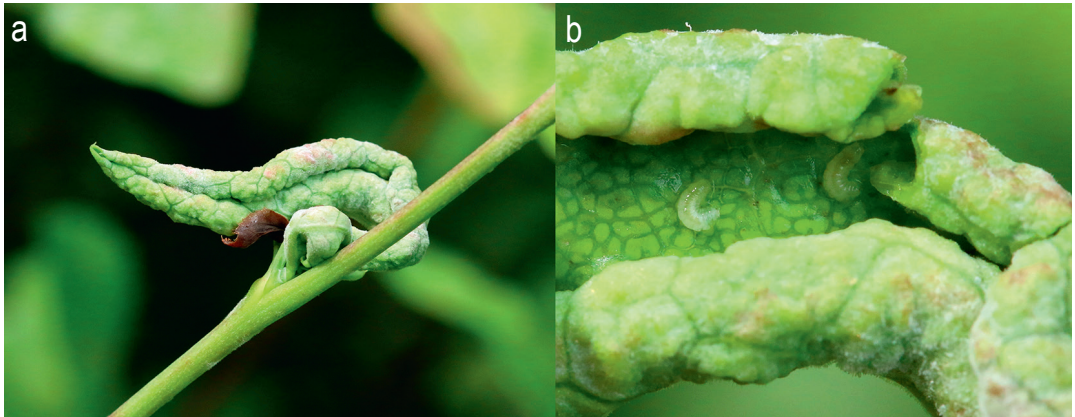


Figure 6. – a) Fleshy leaf-margin galls on *Berberis vulgaris* caused by *Contarinia* sp., – b) The larvae are white.

– a) Hopprullat och köttigt blad av vanlig berberis (*Berberis vulgaris*), förorsakat av *Contarinia* sp., – b) Larverna är vita. Foto: SH.



Figure 7. Whitish larvae of *Dasineura astragolorum* in one of several gall chambers in a swollen stem of *Astragalus glycyphyllos*.

Ett flertal småkamrar i en svullen stjälek av sötvedel (*Astragalus glycyphyllos*), varav en med en synlig vit larv av *Dasineura astragolorum*. Foto: HHB

Dasineura astragolorum (Kieffer, 1909)

Whitish larvae were found individually in gall chambers in plurilocular swellings in the stem of *Astragalus glycyphyllos* L. (Fabaceae), typically just below an internode (Fig. 7). In Central Europe, *Astragalus arenarius* L. is recorded as an additional host (Skuhrová et al. 2014).

Material examined: NWZ: Røsnæs (55°44'05.1"N 10°53'36.7"E), thermophilous scrub, 23.viii.2014, leg. HHB. No rearing attempted due to scarcity of material, but a univoltine life cycle with overwintering in the gall seems plausible. Henriksen & Tuxen (1944) described a find (as “?Cecidomyiidae sp.”) on the same host plant from Tisvilde Hegn, 18.vii.1894, leg. Ove Rostrup, matching this species, which was recognized by Buhr (1964-1965), but not by Skuhrová et al. (2006). Thus, it seems to be a hitherto overlooked species.

Distribution: Czech Republic, France, Germany, Poland and Romania – in all countries considered an uncommon species.

Dasineura fructum (Rübsaamen, 1895)

Orange larvae were found gregariously in fruits of *Cerastium fontanum* Baumg. (Caryophyllaceae) (Fig. 8). The capsules were very slightly swollen or twisted, but the orange colour of the larvae was visible through the wall. Pupation is considered to take place in the soil (Harris & Frankum 2012). Perhaps other perennial *Ceras-*



Figure 8. Orange larvae of *Dasineura fructum* cause galls in fruits of *Cerastium fontanum*.

Orangefärgade larver av *Dasineura fructum* i en lätt svullen fruktkapsel av hönsarv (*Cerastium fontanum*). Foto: SH.

tium species may be used as host plant.

Material examined: LFM: Hegnede Bakker (55°01'27.8"N 12°17'58.8"E), old field, 11.vi.2015, leg. SH & SJAN; SZ: Ornebjerg (55°01'50.2"N 11°55'36.3"E), lawn, 05.vii.2015, leg. SH; Elseengen in Sønder-skov (55°24'33.8"N 11°35'32.2"E), forest meadow, 10.viii.2015, leg. HHB; NWJ: Ugerby (55°49'35.5"N 11°26'12.8"E), oldfield, 27.vii.2015, leg. HHB. Rearing has not been attempted.

Distribution: Recorded from Czech Republic, Germany, Poland and the UK. In Germany, it has only been recorded from two federal states (Brandenburg and Berlin), with no new findings for almost a century (Skuhravá et al. 2014). It is probably rare in Poland and even considered regionally extinct in the Czech Republic (Skuhravá 2005); in the UK, however, it is more frequent and new records have recently been reported (Harris & Frankum 2012). Sylván (1983) recorded "*D. sp.* (jfr *D. fructum* (Rübsaamen))" from fruits of *Cerastium pumilum* Curtis at several sites on the Baltic island Öland but was unable to make a positive identification.

Dasineura harrisoni (Bagnall, 1922)

One rather large red-brown fleshy multilocular

gall was found at the base of a stem of *Filipendula ulmaria* (L.) Maxim (Rosaceae) in a groundwater-fed rich fen (Fig. 9). In each gall chamber was found an individual orange larva in a white papery cocoon. The gall appeared to have been formed from one entire leaf, but strongly distorted. No adults emerged within one week, and so they are likely to overwinter in the gall, which is consistent with literature records (Harris 2010). Given the hydrological conditions at the site, periodical inundation of galls during winter is likely.

Material examined: NEJ: Gravlev Kær (56°49'58.8"N 9°49'11.8"E), rich fen, 07.ix.2015, leg. TL & EAT.

Distribution: Recorded from the Czech Republic, Germany, the Netherlands, Poland, Romania, Serbia and the UK. No recent findings have been reported from the UK (Harris 2010). The species is said to occur frequently in Germany (Skuhravá et al. 2014). However, we suspect that ambiguous use of the name has led to confusion with another species forming fleshy red galls in leaf midribs of *Filipendula vulgaris* in dry grasslands ("*Dasineura sp. A*" sensu Harris 2010). The separate identity of the two species seems very likely, but will need further scrutiny.



Figure 9. Gall of *Dasineura harrisoni* on *Filipendula ulmaria*. The gall is multilocular with each larva overwintering in a papery cocoon.

Gall förorsakad av *Dasineura harrisoni* på älggräs (*Filipendula ulmaria*). Gallen är ganska stor och köttig med flera kamrar med en larv i vardera. Larverna övervintrar i var sin pappersliknande kokong. Foto: HHB

Dasineura lotharingiae (Kieffer, 1888)

Orange larvae, living gregariously, were found in shoot-tip galls on *Cerastium fontanum* Baumg. (Caryophyllaceae) (Fig. 10). The galls consist of one or more pairs of concave leaves on much-shortened internodes. In late summer and in the autumn, perennating axillary buds near the ground seem to be preferred (HHB, personal observation). On one occasion, larvae have been found in swollen unopened flower buds of plants with bud galls, no doubt of the same species. Pupation has been found to take place inside the galls (Harris & Frankum 2012), but rearing of adults has so far only resulted in two females, both from overwintering galls formed during summer, suggesting a univoltine life cycle.

Material examined: NWZ: Kårup Strand (55°49'16.4"N 11°22'55.6"E), summer cottage lawn, 29.vii.2013 & 20.ix.2015, leg. HHB; NEZ: Bolund (55°42'14.6"N 12°05'53.4"E), grassland, 27.ix.2015, leg. HHB.

Distribution: Known from 11 European countries, including Norway, Sweden and Finland (Coulianos & Holmåsén 1991, Jaschhof et al. 2014). It is considered scarce in France while it is considered a very frequent species in Germany (Skuhrová et al. 2014).



Figure 10. Shoot-tip gall of *Dasineura lotharingiae* on *Cerastium fontanum*.

Gall i skottspets av hönsarv (*Cerastium fontanum*) förorsakad av *Dasineura lotharingiae*. Foto: HHB.



Figure 11. Flower bud galls of *Dasineura saxifragae* on *Saxifraga granulata*. Several larvae develop in each gall.

Blomknoppgaller på mandelblomma (*Saxifraga granulata*), förorsakad av *Dasineura saxifragae*. Det finns ofta 2-4 larver i varje gall. Foto: HHB.

Dasineura papaveris (Winnertz, 1853)

Reddish larvae were found in a gall of *Aylax papaveris* (Perris, 1840) (Hymenoptera: Cynipidae) on *Papaver dubium* L. Other hosts include *P. rhoeas* L., *P. somniferum* L. and additional members of Papaveraceae. This species is recognized as a secondary pest of poppy: Female midges of the spring generation deposit eggs in exit holes on seed capsules made by the weevil *Neoglocianus maculaalba* (Herbst). Larvae of the summer generation also develop inside seed capsules and are known to overwinter either inside the galls or in the soil. However, it has been suggested that *D. papaveris* can complete its life cycle independently of *N. maculaalba* (Darvas et al. 2000). *N. maculaalba* has not been recorded from Denmark.

Material examined: NEZ: The University Gardens at Frederiksberg (55°41'07.9"N 12°32'35.2"E), urban park 08.ix.2014, leg. SH. Rearing was attempted, but with no success.

Distribution: Euro-Asian. Recorded with varying frequency from many European countries; found as far south as Malta (Mifsud 2011, with map of distribution) and as far east as Armenia, Georgia, Kazakhstan and Israel (Fedotova 2000, Mirumian 2011, Skuhrová et al. 2013)

Dasineura saxifragae (Kieffer, 1891)

Gregarious yellow larvae were found in swollen and purplish discolored and somewhat swollen flower buds of *Saxifraga granulata* L. (Saxifragaceae) (Fig. 11). Also empty galls were

found, so pupation must be external.

Material examined: NWZ: Rævebjerg (55°48'10.3"N 11°23'18.0"E), grassland, 17.v.2014, leg. HHB; Rævebjerg (55°48'10.1"N 11°23'20.3"E), old grassland, 25.v.2015, leg. HHB; SZ: Stejlebanke (55°08'40.5"N 11°48'57.5"E), old grassland, 18.v.2014, leg. SH; EJ: Musebakke (56°03'55.5"N 9°42'11.7"E), grassland on old field, 07.vi.2016, leg. HHB. No rearing was attempted.

Distribution: Recorded from the Czech Republic, France, Germany, Hungary, Norway, Sweden and the UK. A rarely reported species; e.g. no recent records are known from the UK (Redfern & Shirley 2011). It is listed as a critically endangered species in the Czech Republic (Skuhrová 2005).

Dasineura traili (Kieffer, 1909)

Pale yellow larvae were found living gregariously in flower bud galls on *Ranunculus acris* L. and *Ranunculus* sp. (Ranunculaceae) (Fig. 12). The flower buds were found to be small and stunted or swollen and purplish discoloured. The larvae pupate in the soil (Coulianos & Holmåsén 1991).

Material examined: NWZ: Bjergene (55°48'10.3"N 11°23'18.0"E), grassland (on *R. acris*), 07.vi.2014, leg. HHB; NEJ: Gravlev Kær (56°49'58.8"N 9°49'11.8"E), rich fen (on *R. acris*), 09.vi.2015, leg. HHB; NEZ: Solbjerg Engso (55°59'24.1"N 12°15'00.5"E), vegetation near lake (on *Ranunculus* sp.), 09.vi.2015,



Figure 12. Gall of *Dasineura traili* in *Ranunculus acris* flower bud.

Gall av *Dasineura traili* i blomknopp av smörblomma (*Ranunculus acris*). Foto: HHB



Figure 13. Numerous larvae of *Herbomyia robusta* underneath leaf sheaths of *Carex elata*.

Massor av larver av *Herbomyia robusta* vid basen av bladslidor på bunkestar (*Carex elata*). Foto: HHB.

leg. SH & SJAN. No rearing was carried out.

Distribution: It is found frequently in the Netherlands and Belgium (Roskam & Carbonnelle 2015) and in Poland (Skuhrová et al. 2008). It is widespread in Sweden and also recorded from Norway (Coulianos & Holmåsén 1991).

***Herbomyia robusta* Möhn, 1955**

Reddish orange larvae were found living gregariously – sometimes in large masses – under leaf sheaths of *Carex elata* All. (Cyperaceae) (Fig. 13). While the shoots appeared healthy, the leaf sheaths were clearly damaged where masses of larvae were present.

Material examined: SZ: Elseengen in Sønderkov (55°24'33.8"N 11°35'32.2"E), damp forest meadow, 09.viii.2014, leg. HHB.

Some dozens of larvae were transferred to moist soil and first kept at room temperature for a week and then at 5°C. After one month, adults emerged over a ten-day period (Fig. 14). This

suggests a bivoltine life cycle and overwintering as larvae. The observation is in contrast to Möhn's (1955) original description. He found larvae in late August and had adults emerging in late April of the subsequent year, suggesting one generation per year. The reared adults were compared with the description and figures given in the original paper (Möhn 1955).

A few larvae of an unidentified *Lestodiplosis* species were found among the *Herbomyia* larvae. Distribution: Hitherto only known from the type locality Dauborn in Hessen, Germany (Skuhrová et al. 2014).

***Jaapiella chelidonii* Fedotova, 2008**

Gregarious pinkish larvae were found in a single stunted and swollen flower bud of *Chelidonium majus* L. (Papaveraceae) (Fig. 15). The host plant is probably non-native to Denmark, but very widely distributed and abundant. The university gardens bought the particular plant

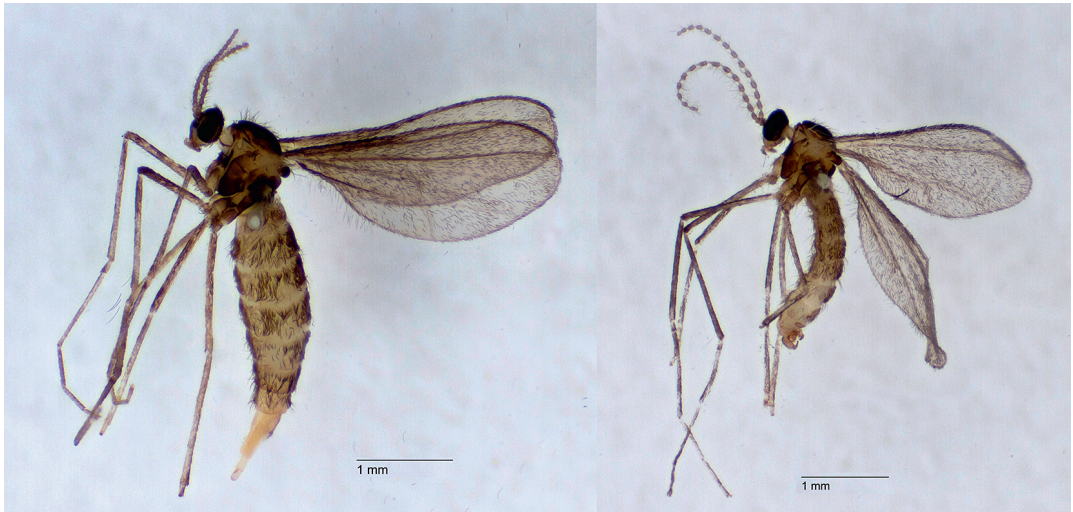


Figure 14. Adult female (left) and male (right) of *Herbomyia robusta*.

Vuxen hona (vänster) och hane (höger) av *Herbomyia robusta*. Foto: SH

in 1996 from an unknown supplier – perhaps abroad (gardener Lars Birck, pers. comm., 2015). External pupation.

Material examined: NEZ: The University Gardens at Frederiksberg (55°40'51.8"N 12°32'24.1"E), urban park, 19.viii.2014, leg. SH. Unfortunately, rearing was not successful.

Distribution: The type locality is in Russia (Fedotova 2008). The species may also be the unidentified species recorded in Hamburg in 1929 - as *Jaapiella* sp. (Buhr 1964-1965) - and recently in Serbia (Simova-Tošić 2014).

Lasioptera arundinis Schiner, 1854

Whitish larvae, living gregariously, were found in shortened and slightly swollen lateral shoots on *Phragmites australis* (Cav) Trin. (Poaceae); the inside of the gall is covered with black mycelium (Fig. 16). The larvae overwinter in the gall and pupate the following spring (Skuhravá & Skuhravý 1981).

Material examined: NEZ: Amager Fælled (55°38'46.6"N 12°34'39.7"E), urban wilderness, 07.iv.2014, leg. SH; Fælledparken (55°42'08.3"N 12°33'55.0"E), urban park, 23.iv.2014, leg. HHH; Østre Anlæg (55°41'23.9"N 12°34'48.2"E), urban park, 07.i.2015, leg SH; Bagsværd Søpark

(55°45'56.3"N 12°27'39.6"E), lake-margin reedbed, 08.ii.2015, leg. SH; Valbyparken (55°38'39.0"N 12°31'21.6"E), urban park, 09.iii.2015, leg. SH; Hvalsø (55°35'25.0"N 11°52'36.6"E), old gravel pit, 29.iii.2015, leg. SH; SZ: Ornebjerg (55°02'11.0"N 11°55'44.7"E), lake-margin reedbed, 17.iv.2014, leg. SH. Larvae from Amager Fælled and Ornebjerg pupated readily and many males and females emerged

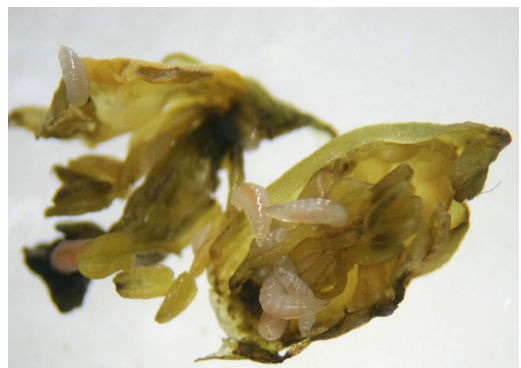


Figure 15. Larvae of *Jaapiella chelidonii* in a swollen flower bud on *Chelidonium majus*.

Larver av *Jaapiella chelidonii* i svullen blomknopp av skelört (*Chelidonium majus*). Foto: SH.



Figure 16. Galls of *Lasioptera arundinis* in side shoot of *Phragmites australis* (top). Opened gall with several larvae, each with a distinct sternal spatula (bottom).

Larver av *Lasioptera arundinis* i sidokott av vass (*Phragmites australis*) tillsammans med svart svampmycel (ovan). Observera larvens tydliga bröstben (*spatula sternalis*) på den infällda bilden. Foto: SH.

ultimo April and primo May 2015, respectively (Fig. 17).

Distribution: A widespread and frequently recorded species throughout Europe, but hitherto not recorded from Scandinavia.

***Lasioptera calamagrostidis* Rübssaamen, 1893**

Orange larvae were found in weak depressions underneath leaf sheaths of *Calamagrostis epigeios* (L.) Roth. (Fig. 18) Other Poaceae can also act as hosts. Pupation takes place inside the gall (Möhn 1968; MS, personal observations).

Material examined: NEZ: The University Gardens at Frederiksberg (55°41'10.1"N 12°32'35.8"E), urban park, 27.ii.2015, leg. SH; Amager Fælled (55°39'12.7"N 12°34'58.9"E), urban wilderness, 13.iii.2015, leg. SH; Valby (55°40'07.8"N 12°30'48.1"E), overgrown industrial ground, 17.iv.2015, leg. SH; SZ: Ornebjerg (55°01'59.0"N 11°55'58.8"E), mixed



Figure 17. An adult male of *Lasioptera arundinis* reared from gall on *Phragmites australis*.

Vuxen hane av *Lasioptera arundinis*, kläckt från gall i skott av vass (*Phragmites australis*). Foto: SH.

forest, 06.iv.2015, leg. SH. Rearing was not attempted. One *Lestodiplosis* sp. larva was found amongst larvae of *L. calamagrostidis* at the first locality (The University Gardens) (Fig. 17).

Distribution: European, known from 9 countries. Widespread in Germany and Hungary, elsewhere considered a rare species. No records from Norway, Sweden or Finland.

***Mayetiola festucae* Ertel, 1975**

White larvae were found living individually under leaf sheaths of *Festuca rubra* L. (Poaceae) on the basal part of the stem, deep in the turf. The leaf sheath itself is not particularly distorted, but the presence of the larva induces dense growth of adventitious roots, which come to form an irregular tangled structure similar to an untidy ball of yarn. In the original diagnosis by Ertel (1975), the slightly swollen leaf sheath is described as the normal form, with the root

Figure 18. Larvae of *Lasioptera calamagrostidis* underneath leaf sheaths of *Calamagrostis epigeios*. A small *Lestodiplosis* larva may also be seen.

Larver av *Lasioptera calamagrostidis* i bladslidor av berggrör (*Calamagrostis epigeios*). Den mindre larven tillhör en art av släktet *Lestodiplosis*. Foto: SH.



Figure 19. Gall of *Mayetiola festucae* in shoot of *Festuca rubra*. It resembles the gall of *Mayetiola radificica* on *Poa nemoralis*.

Gall av *Mayetiola festucae* på bladslidor av rödsvingel (*Festuca rubra*). En enskilda larv finns i en bladslida omsluten av "spagetti" av birötter. Foto: TL.



tangle as an exceptional case, much resembling the gall caused by *Mayetiola radificica* (Rübsaamen, 1895) on *Poa nemoralis* L. She found no indication that this alternative gall type would represent another species (Ertel 1975); all mentioned records are of the 'tangled spaghetti' form (Fig. 19). Presumably, the species has a univoltine life cycle.

Material examined: EJ: Strandkær (56°13'19.8"N 10°35'14.2"E), meadow, 02.ix.2015, leg. TL & RE; NWJ: Kællingdal (57°07'00.9"N 8°39'20.4"E), chalk grassland, 06.ix.2015, leg. TL & EAT; NEJ: Gravlev Kær (56°49'58.8"N 9°49'11.8"E), rich fen, 07.ix.2015, leg. TL & EAT; Vandplasken (57°31'04.0"N 9°52'47.8"E), meadow, 03.x.2015, leg. TL; WJ: Ejstrup (56°10'02.2"N

8°23'17.9"E), meadow, 29.ix.2015, leg. TL. Identification was based on the larvae, thus no rearing was initiated. In some cases the larvae were dead or not fully grown, but as no other gall midge species is known to induce such a gall morphotype on *Festuca rubra*, we believe they should be recorded as *Mayetiola festucae*.

Distribution: Hitherto only known from the type locality St. Idesbald in Belgium (Roskam & Carbonnelle 2015). The frequency of new finds in Denmark strongly suggests that the species is generally overlooked.

***Mayetiola phalaris* Barnes, 1927**

A white larva and a pupa, hibernating in puparia, were found in a slightly elongated depression in the stem underneath the leaf sheath of *Phalaris*



Figure 20. Two puparia of *Mayetiola phalaris* in leaf sheaths of *Phalaris arundinacea*, containing a larva and a pupa.

Puparier av *Mayetiola phalaris* i bladslida och i en grop i halmen av rörflen (*Phalaris arundinacea*), den ena med en larv inuti, den andra med en puppa. Foto: SH.



Figure 21. Onion shaped galls of *Mayetiola ventricola* in shoots of *Molinia caerulea*.

Lökliknande galler av *Mayetiola ventricola* i svullna skott av blåtåtel (*Molinia caerulea*). Foto: TL.

arundinacea L. (Poaceae) (Fig. 20). Shoots are reported to often exhibit growth retardation (Skuhrová et al. 2014).

Material examined: SZ: Lekkende Dyrehave (55°04'03.6"N 12°00'06.6"E), grassland, 26.iv.2015, leg. SH. No rearing (identification based on larva).

Distribution: European; Czech Republic, Germany (only recorded from Mecklenburg-Vorpommern) and the UK.

***Mayetiola ventricola* (Rübsaamen, 1899)**

White larvae were found gregariously in slender onion-shaped swellings, consisting of clustered leaf sheaths of *Molinia caerulea* (L.) Moench (Poaceae) (Fig. 21), invariably found just above the single node and thus close to the ground. The larva has an irregular chitin plate posterior to the sternal spatula and hibernates in the puparium (Fig. 22). The species is known to have a univoltine life cycle (Buhr 1964-1965).

Material examined: SJ: Gråbjerg Mose (55°01'04.3"N 8°59'08.9"E), bog woodland, 27.viii.2015, leg. TL & RE; F: Stævnningen (55°09'05.6"N 10°27'06.1"E), peat bog, 10.x.2015, leg. TL; NWJ: Kokkærvand (57°03'51.7"N 8°38'30.9"E), moist heathland, 20.x.2015, leg. TL. No rearing was attempted (identification based on larvae).

Distribution: Recorded from the Czech Republic, Germany, Latvia, the Netherlands and the UK. While generally considered scarce, this species seems to have a rather wide distribution in Germany (Skuhrová et al. 2014). It is considered common in the UK (Redfern & Shirley 2011).

***Mycodiplosis coniofaga* (Winnertz, 1853)**

Mycetophagous larvae were found feeding on spores of different rust fungi (Fig. 23) (see "material examined" for details). The species has

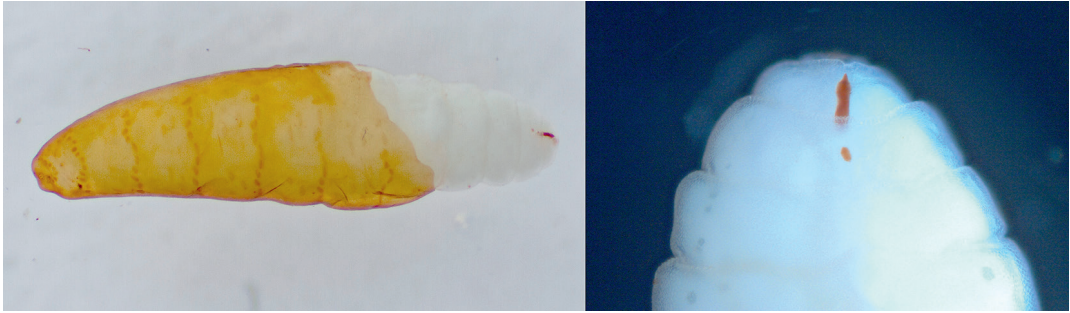


Figure 22. Larva of *Mayetiola ventricola* in opened puparium. The species-specific chitin plate is seen below the sternal spatula.

Larv av *Mayetiola ventricola* i öppnat puparium (till vänster). Bröstben och den för arten karakteristiska lilla kitinplattan under (till höger). Foto: SH.

been recorded from a variety of rust fungi species and host plants (Holz 1970).

Material examined: NEZ: University Gardens at Frederiksberg (55°40'48.1"N 12°32'34.3"E), urban park (feeding on spores of *Puccinia coronata* Corda on *Rhamnus utilis* Decne), 06.vi.2014, leg. SH; Søllerød Sø (55°48'56.4"N 12°29'35.0"E), near lake (feeding on spores of *Puccinia pulverulenta* Grev. on *Epilobium hirsutum* L.), 28.vi.2015, leg. AJ. Rearing was not carried out in either case.

Distribution: Holarctic. Reported rare in France, the Netherlands and Poland, but very widespread in Germany; it has been suggested that the species is overlooked (Roskam & Carbonnelle 2015). *Mycodiplosis saundersi* Barnes 1927, a species first recorded in Denmark by



Figure 23. Larvae of *Mycodiplosis coniophaga* feeding on aeciospores of *Puccinia coronata* on *Rhamnus utilis*.

Larver av *Mycodiplosis coniophaga* äter sporer av skålröststadiet av kronröst (*Puccinia coronata*) på blad av *Rhamnus utilis*. Foto: SH.

Skuhravá et al. (2006), is likely to be a junior synonym of *M. coniophaga*. This, however, remains to be formally demonstrated.

***Parallelodiplosis galliperda* (Löw, 1889)**

One or two orange larvae were found as inquilines under spangle galls, i.e. galls of the asexual generation of the gall wasp *Neuroterus quercusbaccurum* L. on *Quercus robur* L. (Fagaceae) (Fig. 24). The larvae live in the cavity between



Figure 24. Larvae of *Parallelodiplosis galliperda* live underneath galls of *Neuroterus quercusbaccurum* on *Quercus robur*.

Larver av *Parallelodiplosis galliperda* syns under en lös-gjort linsgall förorsakad av gallstekeln *Neuroterus quercusbaccurum* på blad av bergek (*Quercus robur*). Foto: HHB.



Figure 25. Gall containing orange larvae of *Piceacecis abietiperda* on shoot of *Picea abies*.

Orangefärgade larver av *Piceacecis abietiperda* i skottgall på gran (*Picea abies*). Foto: SH.

leaf lamina and wasp-induced gall. Their presence leads to morphological changes to the gall (more concave shape, dark spots on the surface), eventually causing the death of the original gall inhabitant.

Material examined: NWZ: Orhøje (55°48'35.0"N 11°23'44.3"E), old grassland, 06.ix.2014, leg. HHB. Subsequently, a search for the species was instituted on the citizen science website fugleognatur.dk, rapidly resulting in more than 60 records throughout Denmark. Some of the records concerned the said gall wasp species on *Quercus petraea* (Matt.) Liebl.,

while others were from the related gall wasp *N. albipes* Schenck. Bruun (2014) provided a fuller account (in Danish) of the findings and the biology of the species.

Distribution: Reported from most of Western and Central Europe. In Scandinavia, it has been recorded from both Norway and Sweden (Arts-Databanken 2010; Artdatabanken 2010).

Piceacecis abietiperda (Henschel, 1880)

Solitary orange larvae were found in discrete swellings, often several together, under the bud scales of young twigs on *Picea abies* (L.) Karsten (Pinaceae) (Fig. 25). The host tree was brought to the garden in 1946 from a nursery in Kolding, Denmark (gardener Lars Birck, pers. comm., 2015). Larvae pupate in the galls. Gagné & Graney (2014) recently revised the taxonomy of the species and described its biology.

Material examined: NEZ: University Gardens at Frederiksberg (55°40'52.0"N 12°32'35.3"E), urban park, 13.ii.2015, leg. SH. Rearing was not attempted, due to scanty material.

Distribution: European, recently recorded from North America (Gagné & Graney 2014). Once widely distributed in Europe, but few recent findings have been reported, and it has been suggested that the species is extinct in Europe (Skuhravá et al. 2005). However, in addition to the finding reported here from Denmark, the



Figure 26. Larvae of *Rabdophaga strobilina* live as inquillines in galls of *Rabdophaga rosaria* (center) on *Salix alba*.

Larver av *Rabdophaga strobilina* finns som inhyssingar mellan ytterbladen i skottspetsgall ('videros') förorsakad av *Rabdophaga rosaria* (mitt) på vitpil (*Salix alba*). Foto: HHB.

species was recently found in southern England (Lorraine Graney, pers. comm. 2015).

***Rabdophaga strobilina* (Bremer, 1847)**

Slender reddish-orange larvae were found living gregariously as inquilines in galls of *Rabdophaga rosaria* (Loew) on *Salix alba* L. (Fig. 26). While the gall-inducing larva resides in a central chamber, the inquiline larvae live 1-3 together at the base of the much broadened artichoke-like leaf bases. Presumably, the species has a univoltine life cycle, with pupation taking place in the gall, as with *R. rosaria* (Skuhravá et al. 2014). Rearing attempts have so far been unsuccessful.

Material examined: NEZ: Copenhagen, Kongens Have (55°41'05.5"N 12°34'47.4"E), urban park, 05.ix.2015, leg. HHB; Risø (55°41'59.9"N 12°06'27.6"E), hedgerow, 27.ix.2015, leg. HHB; EJ: Kvak Møllesø (55°42'03.6"N 9°25'48.4"E), alder swamp, 17.xii.2015, leg. KA; Rask Skov (55°52'34.0"N 9°35'43.1"E), mixed forest, 18.xii.2015, leg. KA.

Distribution: The species has been recorded from Scandinavia (Norway and Sweden) through Eurasia to Japan.

***Taxomyia taxi* (Inchbald, 1861)**

Two pupae and a dead adult female were recovered from the characteristic artichoke-like galls on *Taxus baccata* L. (Taxaceae) (Fig. 27). Only one larva develops per gall. The development may take one or two years; the galls are larger and more pronounced in the latter case (Redfern & Hunter 2005).

Material examined: EJ: Munkebjerg Skov (55°41'20.3"N 9°36'53.5"E), mixed deciduous forest, 30.v.2015, leg. DA. No rearing. Munkebjerg Skov is considered to have the only remaining natural population of *T. baccata* in Denmark (Svenning & Magård 1999).

Distribution: European, up to Caucasus (Skuhravá et al. 2008, p. 124 map of distribution in Europe; Skuhravá et al. 2013, occurrence in Georgia). Widespread in many countries, e.g. Belgium, Germany and the Netherlands. It is known from southern Sweden and there is a single published record from Norway (Skuhravá & Skuhravý 2012).



Figure 27. A pupa of *Taxomyia taxi* from a shot-tip gall on *Taxus baccata*. The outer whorl of needles has been removed.

En puppa av *Taxomyia taxi* i en skottspettsgall på idegran (*Taxus baccata*). Den yttre barrkransen har borttagits. Foto: SH.

Discussion

This paper reports the finding of 23 gall midge species not previously recorded from Denmark. Of these, twelve were deemed as likely members of the Danish fauna according to a biogeographical study by Petersen & Meier (2001). For sixteen of the species, our record constitutes the first record for Scandinavia; however, *Mycodiplosis coniophaga* may not be new if the name *M. saundersi* (recorded from Sweden and Norway) is indeed a junior synonym (see comment above). None of the *Lasioptera* and *Mayetiola* species have been found in Fennoscandia, but it can likely be attributed to a lack of focused search effort. Amongst our findings, *Dasineura lotharingiae* is the only species recorded from Finland, a country where the gall midge fauna is poorly known (Jaschhof et al. 2014). Comparison to countries with a particularly well-investigated gall midge fauna shows that fifteen of the species have been reported from the Netherlands, whereas all but *Contarinia* sp. (from *Berberis vulgaris*), *Herbomyia robusta*, *Jaapiella chelidonii* and *Mayetiola festucae* have been re-

corded from the Czech Republic and the United Kingdom; *M. festucae* is the only species not found in Germany. The actual distribution pattern of these newly recorded species – and gall midges in general – is obviously difficult to determine as the number of active workers are different between countries, and are generally few.

As noted in the results section, rearing of larvae failed for many of the species. Species pupating in soil are notoriously hard to keep alive until maturity and to rear, as they often require a specific microenvironment, which can be difficult to recreate in an artificial setting. It is difficult, if not impossible, to identify cecidomyiid larvae to species, but is often possible to assign them to the level of genus. If the larval characters matched a particular genus and if the host plant, galled plant part and gall morphology matched a species with no confusion with known species possible, we considered it a safe identification. This was especially relevant for the large genera *Dasineura*, *Jaapiella* and *Contarinia*. In contrast, *Mayetiola* and *Lasioptera* species were identified solely on the basis of larvae and *Asphondylia ervi* from the pupa. In other cases, e.g. concerning *Herbomyia robusta*, adults had to be reared in order to correctly identify the species. Thus, depending on the species involved and the literature available, larvae, pupae or adult insects – alone or a combination – must be used for identification.

Several of the newly recorded species have been found in areas of Denmark which, traditionally, have been somewhat neglected, e.g. parts of the Jutland peninsula. However, the fact that a substantial portion of records have been made in North-East Zealand (fauna district NEZ), which is by far the fauna district with the longest list of recorded species, indicates the potential for adding to the cecidomyiid fauna of Denmark by increased sampling effort.

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- D. harrisoni* (Bagnall) på skottbasen på älgräs (*Filipendula ulmaria*), *D. lotharingiae* (Kieffer) i skottspetsar på hönsarv, *D. papaveris* (Winnertz) i kapslar på rågvallmo (*Papaver dubium*), *D. saxifragae* (Kieffer) i blomknoppar på mandelblomma (*Saxifraga granulata*), *D. traili* (Kieffer) i blomknoppar av smörblomma (*Ranunculus acris*), *Herbomyia robusta* Möhn i bladslidor på bunkestar (*Carex elata*), *Jaapiella chelidonii* Fedotova i blomknoppar på skelört (*Chelidonium majus*), *Lasioptera arundinis* Schiner i sidokott av vass (*Phragmites australis*), *L. calamagrostidis* Rübsaamen i bladslidor av bergör (*Calamagrostis epigeios*), *Mayetiola festucae* Ertel i bladslidor av rödsvingel (*Festuca rubra*), *M. phalaris* Barnes i bladslidor av rörflen (*Phalaris arundinacea*), *M. ventricola* (Rübsaamen) i bladslidor av blååtel (*Molinia caerulea*), *Mycodiplosis coniophaga* (Winnertz) på sporer av rostsvampar, *Parallelodiplosis gallicherda* (Löw) som inhysing hos linsgallstekeln *Neuroterus quercusbaccurum* på bergesk (*Quercus robur*), *Piceacecis abietiperda* (Henschel) på gran (*Picea abies*), *Rabdophaga strobilina* (Bremi) som inhysing hos *Rabdophaga rosaria* på vitpil (*Salix alba*) och *Taxomyia taxi* (Inchbald) i skottspetsar av idegran (*Taxus baccata*). Dessutom rapporteras ett fynd av en förmodligen obeskriven art av *Contarinia* i skottspetsar av berberis (*Berberis vulgaris*). Den samlade danska faunan av gallmyggor uppgår till 363 fullt identifierade arter, och 25 arter bara bestämda till släkte. Fördelad på underfamiljer är artantalet 335 Cecidomyiinae (311 fullt identifierade och 24 bara bestämda till släkte), 14 Porricondyliinae (13 fullt identifierade og en bestämd till släkte), 24 Micromyinae och 15 Lestremiinae.

Sammanfattning

Vi redovisar de första danska fynden av 23 arter gallmyggor, varav en bara kunnat identifieras till släkte. De nya arterna är: *Asphondylia ervi* Rübsaamen i baljor av åkervicker (*Vicia sativa*), *Contarinia acetosellae* Rübsaamen i honblommor av rödsyra (*Rumex acetosella*), *C. viburnorum* Kieffer i blomknoppar av parkolvon (*Viburnum lantana*), *Dasineura astragalorum* (Kieffer) i stjälkar av sötvedel (*Astragalus glycyphyllos*), *D. fructum* (Rübsaamen) i fruktkapslar av hönsarv (*Cerastium fontanum*),