

## Gall midges (Diptera: Cecidomyiidae: Cecidomyiinae) of Norway

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**Abstract.** Thirty-eight species of the subfamily Cecidomyiinae were found during investigations in 1995 around Harstad in northern Norway and 56 species in 2003 around Trondheim in central Norway, altogether 73 species of which 46 are new records for Norway. The present fauna of gall midges of the family Cecidomyiidae of Norway includes 238 species of which 119 species in 37 genera belong to Cecidomyiinae, 4 species to Porricondyliinae, 109 species to Lestremiinae and 6 are unplaced species. An annotated list of species of the subfamily Cecidomyiinae and a list of host plants and associated gall midges is given. Zoogeographical analysis: 51% are European, 23% Euro-Siberian, 15% Euro-Asian, 8.5% Holarctic and 2.5% alien species. Harstad, about 300 km north from the Arctic Circle, is for 38 species the most northern situated known locality of distribution area in Europe. Frequency: 42% species occur very scarcely, 18.5% scarcely, 28% medium frequently, 8.5% frequently and 3% very frequently. *Dasineura tortilis* (Bremer, 1847) causing leaf galls on *Alnus incana* (L.) Moench, *Dasineura ulmaria* (Bremer, 1847) on leaves of *Filipendula ulmaria* (L.) Maxim. and *Oligotrophus juniperinus* (Linnaeus, 1758) on branches of *Juniperus communis* L. are very frequent. *Iteomyia capreae* (Winnertz, 1853) inducing galls on leaves of *Salix caprea* L. and other *Salix*-species is the most frequent species occurring in Norway. Alien species: *Contarinia quinquenotata* (F. Löw, 1888) causing galls on flower buds of *Hemerocallis fulva* L., *Rhopalomyia chrysanthemi* (Ahlberg, 1939) inducing galls on leaves, stems, buds or flowerheads of autumn commercial chrysanthemums, and the zoophagous species *Feltiella acarisuga* (Vallot, 1827) which has been introduced into Norway as a biological agent for control of *Tetranychus urticae* Koch, 1836 in greenhouses. *Dasineura kellneri* Henschel, 1875), a European species, causing galls on *Larix decidua* L. is evaluated as alien in Norway. *Hygrodiplosis vaccinii* (Kieffer, 1897) and *Contarinia* sp. associated with *Vaccinium uliginosum* L., *Jaapiella vaccinatorum* (Kieffer, 1913) with *Vaccinium myrtillus* L. and *Dasineura vitisidaea* (Kieffer, 1909) with *Vaccinium vitis-idaea* L., occurring in Scandinavia and at localities situated at high altitudes in European mountains, are Arctic-Alpine species. Relation to host plants: 119 gall midge species are associated with 87 plant species of 34 plant families. About one half of host plant species are trees and shrubs and the other half are herbaceous plants. Most (24 gall midge species) are associated with Salicaceae and 13 species with Rosaceae. The highest species number (8 species) for a single host species is associated with *Populus tremula* L. and 17 species with several *Salix*-species. During the 20th century about 30 gall midge species were reported as pests of agricultural plants and forest trees in Norway.

**Key words.** Faunistics, zoogeography, distribution, frequency, plant-animal interactions, economic importance, Diptera, Cecidomyiidae, Norway, Europe, Palaearctic Region.

### INTRODUCTION

Gall midges comprising the family Cecidomyiidae are one of the most species rich families of Diptera. Altogether 5,700 gall midge species are known to occur in the world (Gagné 2004, 2010) of which about 3,200 occur in the Palaearctic Region and 1800 in Europe (Skuhravá 1986, 2006, Skuhravá & Skuhravý 2010). The family is composed of four subfamilies: Catotrichinae, Lestremiinae, Porricondyliinae and Cecidomyiinae. Adults are usually small flies, minute to medium-sized (0.5–3.0 mm), rarely up to 8 mm, very fine and fragile, usually dark in colour, sometimes with a grey, yellow or reddish coloured abdomen. The head bears large holoptic eyes in both sexes. Antennae consist of 6 to 40, usually 12 or 14, flagellomeres, covered with microtrichia and whorls of long setae and circumfila plus other sensoria. Wing veins are reduced in number, usually with

only three or four long veins present. Legs are usually long and the first tarsomere (metatarsus) is much shorter than the second tarsomere, except in Lestremiinae where it is longer. The larvae have on the ventral side of the prothoracic segment a sternal spatula, a sclerotised organ, which is a unique synapomorphy indicating the monophyly of the family and important for identification at generic and specific levels. On the basis of larval feeding habits, gall midges may be divided into three biological groups: phytophagous, mycophagous (including saprophagous), and zoophagous. Many phytophagous larvae are gall makers, inducing galls on various plants, whilst some live free in flower heads or in the stems of plants, without forming galls. Several species are serious pests of cultivated plants and forest trees but, on the other hand, several phytophagous species are used in the biological control of weeds. Zoophagous larvae are predators of other gall midges, aphids, mites, coccids, or other small arthropods. Some of them are used in the biological control of pests. Mycophagous and saprophagous larvae are associated with fungi. The life span of an adult is very short, only a few hours or five days at the most (Skuhravá et al. 1984a, Skuhravá 1997a, 2006, Skuhravá & Skuhravý 2010, Darvas et al. 2000, Roques & Skuhravá 2000).

Species of the family Cecidomyiidae are distributed throughout the world unequally which is conditioned above all by the geographical position and environmental conditions but also by the intensity of investigations and presence of researchers in different areas. Much more is known about the gall midge fauna of Europe than faunas of other continents. Of the 41 countries of Europe for which such data are known, Germany, with about 836 species, is at the top and Norway with 65 species is in 26th place (Skuhravá & Skuhravý 2010).

Gall midges in Norway have been poorly studied in the past, which is reflected in a relatively low species number – only 65 gall midge species – recorded from this country up to 1982, the dead-line for completion of the *Catalogue of Palaearctic Diptera* (Skuhravá 1986). It is the lowest species number of all Fennoscandinavian countries: 135 species were known from Finland, 160 in Denmark and 261 species from Sweden. For comparison, more than 500 gall midge species were known from the Czech Republic (Skuhravá 1994a, b) and 350 species from the Slovak Republic (Skuhravá 1991). We sought to find reasons for this low species number and came to the conclusion that it was – above all – because only a few researchers devoted attention to the investigation of the gall midge fauna of this country. This fact was the reason why we decided to undertake investigations of gall midges in northern Norway beyond the Polar Circle – in the surroundings of Harstad on the island Hinnøya in 1995 and in the surroundings of Trondheim in the middle part of Norway in 2003.

In the present paper, after a short history of research and a description of the country, we provide an annotated list of gall midges of the subfamily Cecidomyiinae recorded in Norway in the period 1838–2011. Then we evaluate the results from the point of view of zoogeography and economic importance. The subfamilies Porricondyliinae and Lestremiinae, which do not induce galls, are not included in the annotated list and evaluation. Their members are mentioned only when they were components of one undivided family in the past.

## HISTORY

The first two gall midge species recorded from Norway were described by Zetterstedt (1838, 1850) – *Cecidomyza monilicornis* (now: *Monardia monilicornis* belonging to Lestremiinae) and *Cecidomyza niveitarsis* (now: *Claspettomya niveitarsis* belonging to Porricondyliinae). The third species *Campylomyza alpina* described by Siebke (1863) also belongs to Lestremiinae. Siebke (1877) included these three species in the first catalog of Diptera occurring in Norway.

Investigations of gall causing gall midges forming the subfamily Cecidomyiinae started at the end of the 19th century and were made by foreign researchers. The first galls caused by gall

midges, together with other gall-causing insects, were collected in Norway in 1878 and 1887 by J. Trail. He was a professor of botany at the University of Aberdeen in Scotland. Trail found galls of 18 gall midge species during his visit to Bergen, Trondheim and Christiania (now: Oslo) which was organized by the Scottish Alpine Botanical Club (Trail 1889). In 1886 the Austrian physician Dr. J. Lütkemüller, who searched for plant galls mainly in the Alps, undertook a scientific journey to Scandinavia. He found at several localities in Norway ten galls of gall midges that he sent to the Austrian entomologist F. Löw for identification and verification of his findings. Löw (1888) published the results of Lütkemüller's catch. Hieronymus (1890), a custodian of the Museum of Botany in Breslau, Silesia (now: Wrocław, Poland), summarized scattered records on the occurrence of plant galls in Europe in a comprehensive work where he recorded 233 galls caused by Cecidomyiidae on various host plants in several countries of Europe. Among them, he recorded also galls of three gall midge species found in Norway. Lagerheim (1893), a Swedish botanist and mycologist, cecidologist and professor of botany at the University in Stockholm, contributed to the Norwegian fauna with the finding of galls of *Wachtliella caricis* on *Carex*. At the end of the 19th century about 30 gall midge species were known to occur in Norway.

Also in the 20th century foreign researchers contributed to faunal investigations in Norway. Italian cecidologist Trotter (1923) found 20 galls of various insect species of which five were caused by gall midges. Swedish entomologist Andersson (1958) found galls of two species, *Iteomyia capreae* and *Lasioptera populnea* in northern Norway.

In the 20th century several Norwegian researchers devoted attention to gall midges which caused injury to cultivated plants and forest trees. Gall midges as forest pests were studied by Eide (1927). He investigated seed in cones of spruce (*Picea abies*). He analysed a large amount of spruce cones from various parts of Norway and came to the conclusion that the spruce seed is seriously destroyed by *Kaltenbachiola strobi*, mainly in the most northern areas of Norway. Later Bakke (1955, 1963) investigated the biology of insect pests in spruce cones, including *Kaltenbachiola strobi*. Also a Polish forest entomologist Skrzypczyńska (1987) contributed to the knowledge of gall midges and other insects associated with spruce cones.

Schøyen was the Norwegian state phytopathologist for a long time and reported on gall midges as pests in several contributions (Schøyen 1914, 1916, 1917, 1919, 1926, 1932, 1940). At the end he summarized his knowledge on pests and diseases occurring in Norway in a publication, Schøyen & Jørstad (1942). His successor Fjelddalen (1954, 1957, 1963, 1994) who worked in the Norwegian Plant Protection Institute, Division of Entomology in Vollebakk, later in Ås, reported several gall midge species occurring as pests of cultivated plants in Norway. Valset (1960) recorded the first occurrence of *Thomasiniana theobaldi* (now correctly: *Resseliella theobaldi*), a pest of cultivated raspberries in Norway. Stenseth (1972, 1977, 1978) studied mainly the biology of gall midges associated with *Rubus idaeus*, viz. *Resseliella theobaldi* and *Lasioptera rubi* which seriously damaged stands of *Rubus idaeus* in Norway at that time. Edland (1991) recorded *Dasineura mali* as a new pest of apple in Norway.

Also non-galling gall midges were studied in Norway. Økland & Hågvar (1994) and Økland (1995) studied mycophagous gall midges associated with fungi and Økland & Mamaev (1997) gall midges of the subfamily Lestremiinae. A review of so called "wood midges" (= Lestremiinae) occurring in Norway is given in an extensive article of Jaschhof & Jaschhof (2009) where 109 species are reported as occurring in Norway. Non-galling species of the subfamily Porricondylinae were reviewed by Panelius (1965) with several records from Norway.

British entomologist Leatherdale (1959) compiled a preliminary catalog of Norwegian plant galls based on the collection of plant galls held at the Zoological Museum, University of Bergen, which he extended by the inclusion of available records in the scattered literature. He enriched the collection of plant galls also by his own findings in the surroundings of Bergen and Oslo.

His catalog comprises 273 galls of various gall causers which are associated with 122 host plant species. Among them, he gave 41 galls which are caused by gall midge species.

Skuhrová (1986) summarized the occurrence of gall midge species of all countries of the Palearctic Region and gave 65 species of Cecidomyiidae that were known to occur at that time in Norway. Gagné (2004, 2010) in his catalog gave only three gall midge species of the subfamily Cecidomyiinae (*Dasineura berti*, *D. interbracta* and *Karschomyia oklandi*). Other gall midge species occurring in Norway are in the catalog probably hidden under the terms “widespread Europe” and “widespread Palearctic”.

A relatively low species number of gall midges known to occur in Norway in comparison mainly with species richness in Sweden was the reason why we undertook two scientific journeys to Norway to try to increase the gall midge species number.

#### STUDY AREA

Norway is a country in northern Europe occupying the western part of the Scandinavian Peninsula and adjacent islands. It has a total area of 385,252 km<sup>2</sup>. It is situated between latitudes 57° and 81°, and longitudes 4° and 32° E. The majority

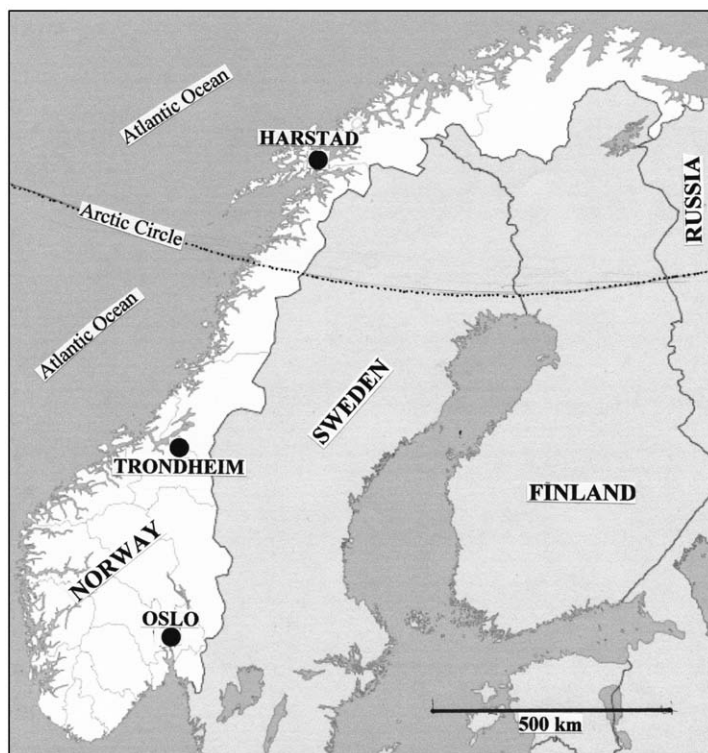


Fig. 1. Norway and its position in the Scandinavian Peninsula, with Oslo, the capital city, where several researchers collected gall midge galls in the past, and two areas : around Trondheim in the central part and around Harstad on the island Hinnøya, about 300 km beyond the Arctic Circle where Marcela and Václav Skuhrová investigated gall midges in 1995 and 2003 (the basic map was taken from Wikimedia Commons).

of the country shares a border to the east with Sweden, its northern most region is bordered by Finland to the south and Russia to the east. In its south Norway borders the Skagerrak Strait. To the north, west and south, Norway is bordered by the North Atlantic Ocean and the Barents Sea (Fig. 1). The country is dominated by mountainous or high terrain, with a great variety of natural features caused by prehistoric glaciers. The Gulf Stream influences the climate of Norway: there are higher temperatures and more precipitation than can be expected at such northern latitudes. The mainland experiences four distinct seasons, with colder winters and less precipitation inland. The northernmost part has a mostly maritime sub-arctic climate. Because of the large latitudinal range of the country and the varied topography and climate, Norway has a larger number of different habitats than almost any other European country. The southern and western parts of Norway have more precipitation and milder winters than the southeastern part.

From the biogeographical point of view, Udvardy (1975) divided Norway into three biogeographical provinces: the Subarctic Birchwood Province in the northern part, the West European Taiga Province in the central part and the Boreo-nemoral Province in the middle and the most southern parts. Noirfalise (1987) divided it according to the natural vegetation into four parts. (1) Arctic heathlands and Oro-Caledonian zone with *Betula nana*, *Juniperus communis*, *Vaccinium myrtillus*, *Salix glauca*, *S. lapponum*, *S. phyllicifolia*; (2) Subarctic heathlands and forests in the northern part, with the birch woodlands in the north, pine-birch woodlands in the south and coastal heaths with birch in the fjords of northern Norway; (3) Boreal mixed forests with *Quercus robur*, *Ulmus glabra*, *Tilia cordata*, *Acer platanoides*, *Fraxinus excelsior*, *Corylus avellana* and some *Fagus sylvatica* in the extreme south. *Taxus baccata* reaches its most northerly limit in this unit; and (4) Suboceanic mixed forests in southern Norway in the Oslo Basin.

## MATERIAL AND METHODS

We gathered data on the occurrence of gall midges occurring in Norway from articles of various researchers published in entomological and zoological journals and journals of applied forestry and applied agricultural entomology. Because the number of gall midge species seemed to us to be relatively low when compared with results in other countries of Europe, we decided to try to enlarge this number by our own investigations of gall midge occurrence in Norway. We used the time and area collecting method. This involves surveying each selected locality visually by walking through it slowly over a period of at least one up to three hours. Two persons walk through various biotopes at the locality and search for gall midge galls and collect them on herbs, shrubs and trees. This method was described in articles by Skuhrova & Skuhrova (2009, 2010a).

Identification of galls is based on the keys of Houard (1908–1909), Buhr (1964–1965), Redfern et al. (2002) and Skuhrova (2011, unpublished report), identification of larvae is based on Mohn (1955), of adults on Skuhrova (1997a), nomenclature of gall midge species is based on Skuhrova (1986, 1989) and Gagne (2004, 2010). Nomenclature of host plants is based on Tutin et al. (1964–1980). Data about gall midges gathered during these investigations were analysed and evaluated from the zoogeographical point of view using methods described by Skuhrova (1987, 1991, 1994a, b, 1997b) and Skuhrova et al. (1984).

Gall midge galls (voucher specimens), larvae, pupae and adults are deposited in the collection of Marcela Skuhrova in Praha, Czech Republic.

### Localities examined

In August 1995 we investigated gall midge composition on various plants in the surroundings of the city of **Harstad**, in the County of Troms, in northern Norway, about 300 km north from the Arctic Circle. It is situated on the island Hinnoya, 68° 48' N latitude, 16° 30' E longitude, at altitudes from sea level up to 20 m a. s. l. Harstad and its surroundings have a subpolar oceanic climate with relatively mild winters and cool summers. Nature is under the influence of the Gulf Stream which influences the climate of the east coast of North America from Florida to Newfoundland, and the west coast of Europe (Fig. 1, 4).

In August 2003 we investigated ten localities situated in central Norway near the city of **Trondheim**, the administrative centre of Sor-Trondelag county. Trondheim lies on the south shore of the Trondheimsfjord at the mouth of the river Nidelva, 63° 25' N, 10° 25' E. This area has a predominantly oceanic climate but the borders have a humid continental and subarctic climate. Localities where we investigated gall midges are arranged alphabetically. The following data are given for each locality: the name of locality, its altitude, short ecological characteristics, dates of investigations and at the end in parentheses the reference number of the locality, indicating its position on the map (Fig. 2). The following abbreviations are used: NT – Nord-Trondelag; ST – Sor-Trondelag.

**Asen** (NT), 70–80 m a. s. l.: trees and shrubs along the path between fields and shrubs and standing around the lake; *Pinus sylvestris*, *Betula pendula*, *Ulmus scabra*, *Populus tremula*, *Larix decidua*, *Juniperus communis*; 4 August 2003 (1).

**Flornes** (NT), 200 m a. s. l.: vegetation near the village and in the valley of a small river; *Alnus incana*, *Betula pubescens*, *Salix capraea*; 7 August 2003 (5).

**Oberby** near Stjordal, 50–100 m a. s. l.: vegetation along a small path between fields, trees and shrubs in a small grove on a hill; *Populus tremula*, *Salix caprea*, *Betula pubescens*, *Sorbus aucuparia*; 3 August 2003 (7).

- Skatval**, 70 m a. s. l.: trees and shrubs on a small hill near a village with relatively rich vegetation; *Alnus glutinosa*, *Populus tremula*, *Salix caprea*, *Betula pubescens*, *Sorbus aucuparia*, *Juniperus communis*; 10 August 2003 (2).
- Stjørdal**, 0–7 m a. s. l.: vegetation along a path among houses, along the river, mixed forest with *Betula pubescens*, *Ulmus*, *Populus tremula*, *Alnus incana*, *Juniperus communis*, *Sorbus aucuparia*; 2 August 2003 (3).
- Storlien**, 560 m a. s. l.: this locality is situated at the boundary with Sweden and partially on its territory; a large peat-bog with a lake on the Norwegian territory with typical bog vegetation, *Betula nana*, various *Salix* spp., *Juniperus communis*, *Alnus glutinosa* (Fig. 5); 9 August 2003 (8).
- Sveberg**, 110 m a. s. l.: shrubs and small trees around a small village, *Betula pubescens*, *Salix* spp., *Sorbus aucuparia*, *Populus tremula*; 11 August 2003 (6).
- Tømra**, 160 m a. s. l.: vegetation on the peat-bog, shrubs and small trees along the road; *Pinus sylvestris*, *Betula pubescens*, *Alnus incana*, *Sorbus aucuparia*, *Populus tremula*, *Salix* (Fig. 6); 8 August 2003 (9).
- Tydal**, 400 m a. s. l.: peat-bog on a hill, surrounded by small trees and shrubs; *Betula nana*, *Betula pubescens*, *Salix glaucosericea*, *Salix caprea*, *Salix aurita*, *Alnus incana*, *Juniperus communis*, *Vaccinium uliginosum*; Memorial of the Battle on 31 December 1718 between Swedens and Norwegians; 6 August 2003 (10).
- Værnes**, 5–6 m a. s. l.: vegetation along the path to the aeroport; shrubs and small trees on rocks; *Alnus*, *Betula*, *Populus tremula*, *Rubus caesius*, *Salix* spp.; 5 August 2003 (4).

## RESULTS

In August 1995 during investigations in the surroundings of Harstad in northern Norway we found galls of 38 gall midge species of the subfamily Cecidomyiinae, of which 17 were found by earlier researchers and 21 were new records for Norway. Harstad is for most of these gall midges the most northern locality of their distribution area in Europe.

In August 2003 in the course of investigations in the surroundings of Trondheim at ten localities at altitudes from sea level up to 560 m a. s. l. we found galls of 56 gall midge species of which 25 were new records for Norway. In the course of our two expeditions in Norway in 1995 and 2003 we found altogether 73 gall midge species of the subfamily Cecidomyiinae of which 46 are new records for Norway. Together with species found by earlier researchers, the subfamily Cecidomyiinae of Norway includes 119 recorded species.

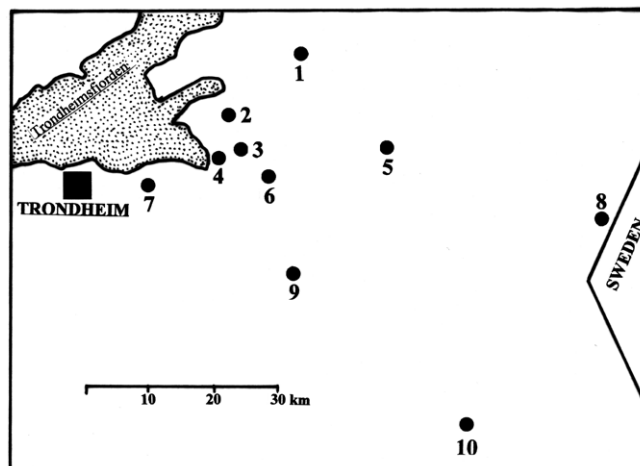


Fig. 2. Part of central Norway around Trondheim with localities where investigations of gall midges were carried out in August 2003: 1 – Åsen, 2 – Skatval, 3 – Stjørdal, 4 – Værnes, 5 – Flornes, 6 – Sveberg, 7 – Øberby, 8 – Storlien, 9 – Tømra, 10 – Tydal.

In the following part we give an annotated list of all gall midge species of this subfamily found in Norway, including species recorded by earlier researchers. An asterisk (\*) before the species name indicates a new record for Norway obtained during our investigations in 1995 or 2003. Then follows a review of host plants and their gall midges and evaluation of results from the zoogeographical and economic points of view.

### Annotated list of gall midge species

The following data are given for each species: species name, author and date of description, synonyms (if any), short description of the biology (if known), shape of the gall, host plant species and family, occurrence with names of localities where galls were found in the past and new records obtained during our investigations in 1995 and 2003, references to authors and pattern of distribution in the Palaearctic region. New records are arranged according to the abbreviations used in the map showing divisions of Norway for faunistic records (Leatherdale 1959): NT: Nord-Trøndelag, ST: Sør-Trøndelag, TR: Troms.

#### \**Anisostephus betulinus* (Kieffer, 1889)

Larvae cause parenchymatous galls on leaves of *Betula pubescens* Ehrh. and *B. pendula* Roth. (Betulaceae). Only one generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. NT: Åsen, Flornes, Øverby, Skatval, Storlien; ST: Sveberg, Tømra, Tydal (2003).

DISTRIBUTION. Euro-Siberian.

#### *Clinodiplosis cilicrus* (Kieffer, 1889)

Larvae are phytosaprophagous and develop in decaying plant matter of various plant species belonging to different plant families. Females lay their eggs on plant tissue, which becomes dry or processes of decay start to develop. Larvae hatch from eggs and live and develop in such tissues. Two or more generations develop a year. Larvae pupate in the soil (Skuhravá 1973).

OCCURRENCE. Arendal in Southern Norway (Skrzypcynska 1987, from cones of *Picea abies* (L.) Karst.

DISTRIBUTION. Euro-Siberian.

#### \**Contarinia campanulae* (Kieffer, 1895)

Larvae live in swollen flower buds of *Campanula rapunculoides* L. (Campanulaceae). Usually one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Åsen, Flornes, Øverby, Skatval (2003).

DISTRIBUTION. European.

#### \**Contarinia craccae* Kieffer, 1897

Larvae live in swollen flower buds of *Vicia cracca* L. (Fabaceae). One or two generations develop a year. Larvae pupate and hibernate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian.

#### *Contarinia crispans* Kieffer, 1909

Larvae live in folded and twisted leaf parts of *Valeriana officinalis* L. (Valerianaceae). One generation develops a year. Larvae hibernate in the soil. Trail (1889) found these galls in Norway at Odde, in Hardanger, in 1878 and described galls without giving a name. Kieffer (1909) gave the scientific name to this gall based on Trail's finding.

DISTRIBUTION. European.

***Contarinia loti* (De Geer, 1776)**

Larvae live in swollen flower buds of *Lotus corniculatus* L. (Fabaceae). One or two generations develop a year. Larvae pupate and hibernate in the soil.

OCCURRENCE. Vik (Trail 1889); Oslo, Vang (Fjelddalen 1994). – New records: TR: Harstad (1995), NT: Værnes (2003).

REFERENCE. Leatherdale (1959).

DISTRIBUTION. European.

**\**Contarinia molluginis* (Rübsaamen, 1889)**

Larvae cause artichoke galls formed of many deformed leaves on stem tips of *Galium mollugo* L. (Rubiaceae). One or two generations develop a year. Larvae pupate and hibernate in the soil.

OCCURRENCE. NT: Øverby (2003).

DISTRIBUTION. Euro-Siberian.

***Contarinia nasturtii* (Kieffer, 1888)**

Yellow jumping larvae live in swollen flower buds of *Raphanus raphanistrum* L. (Brassicaceae) and may develop on various species and genera of the family Brassicaceae, namely *Brassica* (cultivated forms) and *Raphanus sativus*. It is a minor pest in Europe, mainly on heavy clay soils (Darvas et al. 2000), and a new invasive pest in North America (Chen et al. 2009). Two or three overlapping generations may develop in a year. Larvae pupate in the soil.

OCCURRENCE. First recorded in Norway in 1909 (Schøyen 1910).

REFERENCES. Barnes (1946a), Fjelddalen (1994), Rygg & Brække (1980).

DISTRIBUTION. European.

***Contarinia petioli* (Kieffer, 1898)**

Larvae cause globular galls on petioles of *Populus tremula* L. (Salicaceae) (Fig. 11). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Trondheim (Löw (1888); Trondheim, Oslo (Trotter 1923); Reff, Bordalen, Ulfsbakk, Molkenes, Oslo, Trondheim (Leatherdale (1959); Halden, Eidsberg, Vestby, Ås, Nesodden, Hurum, Hole, Ådal, Ål, Uvdal, Gjerpen, Gransherad, Tvedestrand, Leikanger (Fjelddalen 1994). – New records: TR: Harstad (1995). NT: Øverby, Skatval, Stjørdal, Værnes; ST: Sveberg (2003).

DISTRIBUTION. Euro-Siberian.

***Contarinia pisi* (Loew, 1850)**

*Cecidomyia pisi* Winnertz, 1854

Larvae live in swollen flower buds, clustered leaves at vegetative tips or in malformed pods of *Pisum sativum* (Fabaceae). One or two generations develop a year. Larvae pupate and hibernate in the soil. This species may be locally a major pest in areas where peas have been grown intensively (Darvas et al. 2000). In Norway first recorded in 1917.

REFERENCES. Barnes (1946a), Fjelddalen (1994), Husas (1945), Schøyen (1926).

DISTRIBUTION. Euro-Siberian.

***Contarinia populi* (Rübsaamen, 1917)**

Yellow-whitish larvae cause small globular galls on the leaves of *Populus tremula* L. (Salicaceae). Each gall projects on both sides of the leaf and has a small circular opening on the upper or the lower side. One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Trondheim (Löw 1888, as “epiphyllé Blattgalle”). – New records: TR: Harstad (1995); NT: Skatval, ST: Tømra (2003).

REFERENCE. Trail (1889).

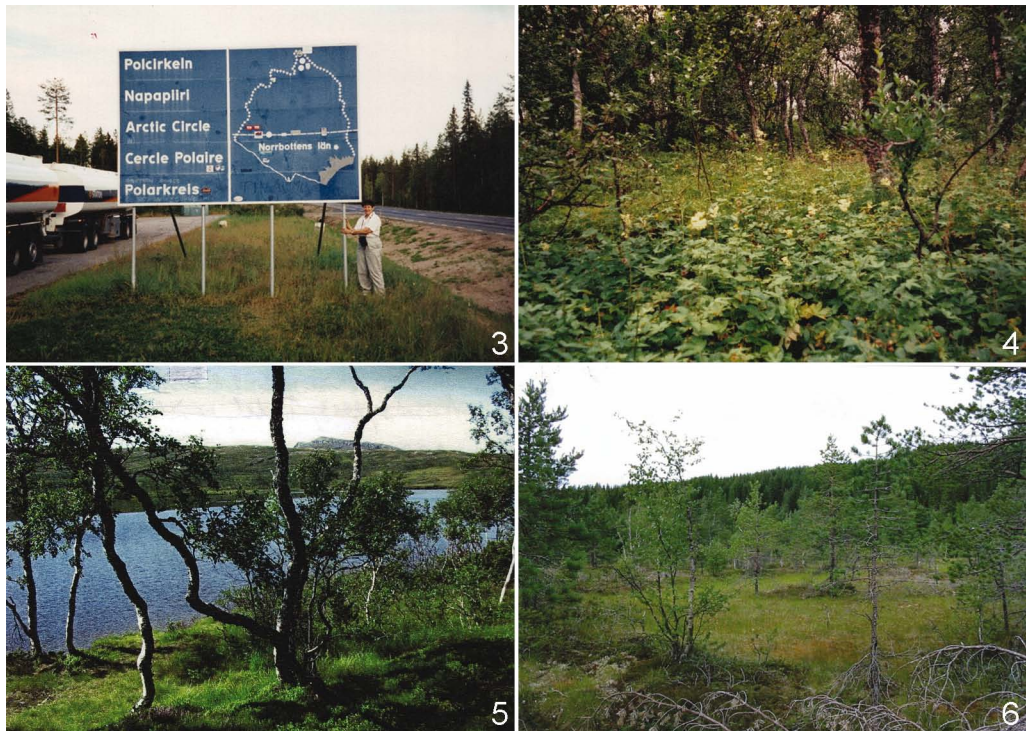
DISTRIBUTION. Euro-Siberian.

***Contarinia pyrivora* (Riley, 1886)**

Yellowish-white larvae develop inside the fruits of *Pyrus communis* L. (Rosaceae). Attacked fruits are stunted and misshapen. Only one generation develops a year. Larvae hibernate in the soil. It is a major pest of pear in Europe (Darvas et al. 2000), in North America (Barnes 1948a, Gagné 1989) and a common pest in southern Norway since about 1912.

REFERENCES. Barnes (1948a), Fjelddalen (1954, 1994), Leatherdale (1959), Schøyen (1914, 1916, 1932, 1940).

DISTRIBUTION. European, secondarily Holarctic.



Figs 3–6. 3 – The stopping place in Sweden on the route to Narvik and Harstad in Norway in August 1995 just at the Arctic Circle at latitude 66°33'44" where the geographic boundary runs between the Arctic zone to the north and the Northern Temperate zone to the south. 4–6 – Localities in Norway that were investigated. 4 – The forest near Harstad on the island Hinnøya with rich vegetation dominated by *Filipendula ulmaria*, August 1995. 5 – Storlien, a large peat bog at the boundary of Sweden, with a lake, August 2003. 6 – Tømra, a peat bog where galls of 12 gall midge species were found, also galls of *Contarinia* sp. on leaves of *Vaccinium uliginosum*, August 2003.

**\**Contarinia quinquenotata* (Löw, 1888)**

Larvae live in swollen, deformed and unopened flower buds of *Hemerocallis fulva* L. (Liliaceae). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Stjørdal (2003).

DISTRIBUTION. European. This species is included among alien species in Europe (Skuhrová et al. 2010).

***Contarinia rhamni* (Rübsaamen, 1892)**

Yellow jumping larvae live in swollen flower buds of *Frangula alnus* Mill. (Rhamnaceae). One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. between Bulken and Eide (Leatherdale 1959).

DISTRIBUTION. European.

**\**Contarinia sorbi* Kieffer, 1896**

White larvae develop in pod-like folded leaflets of *Sorbus aucuparia* L. (Rosaceae) (Fig. 13). One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995). NT: Skatval, Stjørdal; ST: Sveberg, Tømra (2003).

DISTRIBUTION. European.

**\**Contarinia steini* (Karsch, 1881)**

Whitish-yellow larvae live in swollen flower buds of *Silene pratensis* (Rafn.) Godr. (= *S. alba* Mill., *Melandrium album* (Mill.) (Caryophyllaceae). Two generations develop a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian.

***Contarinia tiliarum* (Kieffer, 1890)**

Yellow jumping larvae cause globular swellings on flower stalks, leaf petioles and young twigs of *Tilia cordata* Mill. (Tiliaceae) (Fig. 14). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Eide (Leatherdale 1959), Ås, Oslo, Ringsaker, Stange, Hamar, Røyken, Lier, Hurum, Stokke, Drammen, Nome, Grimstad, Bergen (Fjelddalen 1994).

DISTRIBUTION. Euro-Siberian.

***Contarinia tritici* (Kirby, 1798)**

Lemon or golden yellow gregarious larvae develop in spikelets of *Triticum vulgare* L. (Poaceae). It is an inconspicuous and often overlooked, but serious pest of wheat. Loss of seed results. One main generation develops a year but it may develop a numerically small partial second generation. *C. tritici* is a serious pest of wheat in Europe (Darvas et al. 2000). In Norway first recorded in 1916 (Schøyen 1917).

REFERENCES. Fjelddalen (1994), Barnes (1956), Gagné (1989), Skuhrová et al. (1984b).

DISTRIBUTION. European, secondarily Holarctic.

**\**Contarinia* sp.**

Pink larvae develop in small depressions on the lower surface of leaves of *Vaccinium uliginosum* L. (Ericaceae). The upper part of the gall is usually red coloured and surrounded by a yellow patch (Fig. 16). One generation develops a year. Larvae leave galls and hibernate in the soil.

OCCURRENCE. ST: Tømra, Tydal (2003).

DISTRIBUTION. Holarctic and Arctic-Alpine species.

NOTE. Galls caused by this species were found in the Alps at altitudes 1700–2200 m a. s. l. in South Tyrol (Skuhrová et al. 2002, Skuhrová & Skuhrový 2003, 2005, 2010b), in the Knížecí Pláně peat-bog, in the Šumava National Park at altitude 1024 m a. s. l. on 10 June 2001 and at the peat-bog near the Prášílské Lake in the Bohemian Forest at altitude 1079 m a. s. l., 24 June 2008, both in the Czech Republic (Skuhrová, unpubl.) and at high altitudes in mountains in Washington State in the USA (Gagné 1989).

### ***Craneobia corni* (Giraud, 1863)**

Orange-yellow larvae produce large hard galls on leaves of *Cornus sanguinea* L. (Cornaceae). Galls are up to 12 mm high. Each gall appears on the upper surface as a rounded swelling, on the lower surface as a flask-shaped projection and has one or several cavities, each cavity with a single larva. Full grown larvae leave galls and overwinter in the soil. One generation develops a year.

OCCURRENCE. Vildern near Oslo (Leatherdale (1959). This is probably the most northern occurrence of this species in Europe.

DISTRIBUTION. European.

### ***Cystiphora sanguinea* (Bremi, 1847)**

*Cecidomyia hieracii* Löw, 1874

*Cecidomyia pilosellae* Kieffer, 1892

Whitish yellow larvae cause circular pustule galls on leaves of *Hieracium murorum* L. (Asteraceae). One or two generations develop a year. Larvae overwinter in the soil.

OCCURRENCE. Hardangerfjord (Trail 1889).

REFERENCE. Leatherdale (1959).

DISTRIBUTION. European.

### ***Dasineura alpestris* (Kieffer, 1909)**

*Dasyneura schneideri* Rübsaamen, 1917

*Dasyneura arabis* Barnes, 1927

Red larvae cause galls on *Arabis alpina* L. and *A. hirsuta* (L.) Scop. (Brassicaceae). The bases of attacked leaves are swollen, enlarged and drawn together, forming a compact open gall. Several generations may develop a year. Larvae pupate in white cocoon in the gall. It is a pest of cultivated plants in garden and parks. Galls were first recorded in Norway (in Oslo) in 1956 (Fjelddalen 1963).

OCCURRENCE. NT: Øverby (2003).

REFERENCES. Barnes (1948b), Fjelddalen (1957, 1963, 1994).

DISTRIBUTION. European.

### ***Dasineura auritae* (Rübsaamen, 1915)**

Yellow larvae cause marginal leaf rolls on *Salix aurita* L. and *S. cinerea* L. (Salicaceae). Two generations develop a year. Larvae pupate and hibernate in the soil.

OCCURRENCE. Ljosnes (Leatherdale 1959). – New records: NT: Flornes, Storlien (*Salix glauca*), Værnes. ST: Tydal (2003).

DISTRIBUTION. European.

### ***Dasineura berti* Sylvén, 1993**

Trail (1889) first found the galls on *Astragalus alpinus* L. (at that time: *Phaca astragalina* DC.) (Fabaceae) at Oifiord, Norway, in 1878. He described galls as inflated, conduplicate, yellowish green leaflets or terminal swellings on young stems. Sylvén (in Sylvén & Tastás-Duque 1993) described this species based on adults reared from galls collected at the type locality Kongsvold, Norway.

DISTRIBUTION. European.

***Dasineura crataegi* (Winnertz, 1853)**

Firstly whitish, later yellow and at last red-yellowish coloured larvae live gregariously among deformed leaves in terminal rosette galls on *Crataegus laevigata* (Poiret) DC (= *C. oxyacantha* L.) (Rosaceae). Two generations develop a year. Some larvae pupate in galls, some larvae leave galls and pupate in the soil.

OCCURRENCE. Oslo (Leatherdale 1959).

DISTRIBUTION. European.

**\**Dasineura engstfeldi* (Rübsaamen, 1889)**

Single, at first whitish, later slightly red coloured larvae live in depressions on the lower surface of the leaf of *Filipendula ulmaria* (L.) Maxim. (Rosaceae) with wrinkled swellings on corresponding part of the upper leaf side. One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian.

***Dasineura epilobii* (Löw, 1889)**

Pale red larvae live in swollen unopened flower buds of *Epilobium angustifolium* (L.) Scop. (Onagraceae) (Fig. 17). Two generations develop a year. Larvae pupate in the soil.

OCCURRENCE. Bergen (Leatherdale 1959). New records: TR: Harstad (1995). NT: Flornes, Stjørdal; ST: Sveberg, Tømra (2003).

DISTRIBUTION. Euro-Siberian.

***Dasineura fastidiosa* Roskam, 1979**

Yellowish larvae live between swollen and normal fruits in the catkins of *Betula pendula* Roth. and *B. pubescens* Ehrh. (Betulaceae). Roskam (1979) described this species based on material found in the Netherlands. He also collected larvae in Norway, at Vest Agder, Åseral, in 1977.

DISTRIBUTION. European.

***Dasineura fraxinea* (Kieffer, 1907)**

Whitish larvae cause flattened circular pustule-like swellings on upper surface of the leaflets of *Fraxinus excelsior* L. (Oleaceae). One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Moss, Onsøy, Bærum, Ringsaker, Modum, Hurum, Borre, Kragerø, Solum, Froland, Lillesand, Vindafjord, Hjelmeland, Ølen, Ullensvang, Årdal (Fjelddalen 1963, 1994).

DISTRIBUTION. European.

***Dasineura fraxini* (Bremi, 1847)**

Orange larvae cause longitudinal swellings on the mid-vein or of the petiole on the leaflets of *Fraxinus excelsior* L. (Oleaceae). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Oslo (Trotter 1923); Bærum, Froland, Årdal (Fjelddalen (1963); Børve, Oslo, Stavanger (Leatherdale 1959).

REFERENCE. Fjelddalen (1994).

DISTRIBUTION. European.

***Dasineura galiicola* (Löw, 1880)**

Orange-yellow larvae form artichoke-shaped, spongy galls at the vegetative tip of *Galium boreale* L. (Rubiaceae). One generation develop a year. Larvae hibernate in the soil.

OCCURRENCE. Bodö (Löw 1888). – New record: TR: Harstad (1995).

REFERENCE. Leatherdale (1959).

DISTRIBUTION. Euro-Siberian.

**\**Dasineura geranii* (Kieffer, 1907)**

Orange larvae live in unopened flower buds of *Geranium* sp. (Geraniaceae). Attacked flower buds turn black and fall off. One generation develop a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Storlien (2003).

DISTRIBUTION. Euro-Siberian.

***Dasineura interbracta* Roskam, 1979**

Pinkish larvae live asinquilines of *Semudobia betulae* (Winnertz) between fruits of the catkins of *Betula pubescens* Ehrh. (Betulaceae). One generation develop a year. Larvae hibernate in the soil.

OCCURRENCE. Roskam (1979) described this species based on material collected in the Netherland and also found larvae in Norway, at Vest Agder, Åseral, in 1977.

DISTRIBUTION. European.

**\**Dasineura kellneri* (Henschel, 1875)**

*Cecidomyia laricis* Löw, 1878

Solitary orange larva develops in a gall formed by lateral or flower bud of *Larix decidua* L. (Pinaceae). The attacked bud is swollen, capped with resin and inside is a large chamber where the larva develops and where it pupates in the spring of the following year. One generation develops a year. It is a major pest of larch in Central Europe; locally and occasionally it may cause harm to larch trees but attack does not lead to death (Skuhrová & Roques 2000).

OCCURRENCE. NT: Åsen (2003).

REFERENCE. Barnes (1951).

DISTRIBUTION. It is a European species and its occurrence at Åsen near Trondheim is evaluated as alien (Skuhrová et al. 2010).

**\**Dasineura kiefferiana* (Rübsaamen, 1891)**

Pale yellow larvae cause leaf margin rolls on *Epilobium angustifolium* L. (Onagraceae). One or two generations develop a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Øverby, Stjørdal; ST: Sveberg, Tømra (2003).

DISTRIBUTION. Euro-Siberian.

***Dasineura leguminicola* (Lintner, 1879)**

Salmon yellow larvae develop in flowers of *Trifolium pratense* L. (Fabaceae) and prevent the development of seed. One or two generations may develop a year. It is a minor pest of clover in central and northern Europe, which may cause considerable loss of seed, but it sometimes remains unrecognised because of the hidden lifestyle of the larvae (Darvas et al. 2000). This species was first recorded in Norway at Jaren in 1914 (Schøyen 1926).

REFERENCE. Barnes (1946b).

DISTRIBUTION. Primarily European, secondarily Holarctic.

***Dasineura mali* (Kieffer, 1894)**

At first white, later red larvae develop in rolled leaf margins of *Malus sylvestris* Mill. (Rosaceae). It is a potential pest of young trees in forest nurseries. Infested leaves drop prematurely. Two or more generations develop a year. Some larvae pupate in galls and others drop to the ground and

pupate in the soil. Larvae hibernate in the soil. It is a serious pest of young apple trees and scions in orchards and in nurseries (Darvas et al. 2000). In Norway first reported from Sauherad in 1991 (Edland 1991).

REFERENCES. Barnes (1948a), Fjelddalen (1994).

DISTRIBUTION. European, secondarily Holarctic.

***Dasineura napi* (Loew, 1850)**

*Cecidomyia brassicae* Winnertz, 1853

Whitish orange coloured larvae live gregariously in swollen and prematurely ripening and yellowing siliques of *Brassica napus* L. ssp. *napus*, *B. oleracea* L. and other host plant species of the family Brassicaceae. Normal development of seed is disturbed. Several generations develop a year. Pupation takes place in the soil. It is a serious pest of rape in rape-growing areas, but a minor pest in north to southern Sweden (Darvas et al. 2000). Females usually use the puncture holes made by weevils *Ceutorhynchus obstrictus* (Marsham) (= *C. assimilis* (Paykull)) (Coleoptera: Curculionidae) for egg-lying. In Norway it was first recorded by Schøyen (1916).

REFERENCE. Barnes (1946a).

DISTRIBUTION. European.

**\**Dasineura periclymeni* (Rübsaamen, 1889)**

Whitish larvae live in fleshy, thickened leaf rolls at vegetative tip of *Lonicera* sp. (Caprifoliaceae). One or two generations develop a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European.

***Dasineura plicatrix* (Loew, 1850)**

White larvae live gregariously in contorted and twisted leaves on growing shoots of *Rubus caesius* L., *R. fruticosus* L. and other *Rubus*-species (Rosaceae). Several generations develop a year. Pupation takes place in the soil. It is evaluated as a minor pest of blackberry, loganberry and raspberry in northern Europe (Darvas et al. 2000).

OCCURRENCE. Granvin (Leatherdale 1959, on *Rubus idaeus*).

REFERENCE. Barnes (1948a, 1951).

DISTRIBUTION. European. This species has recently been accidentally introduced into Canada (Sinclair et al. 2009).

**\**Dasineura populeti* (Rübsaamen, 1889)**

White larvae live gregariously in leaf galls on *Populus tremula* L. (Salicaceae). The galls are formed by upwardly rolled leaf margins with a pilose surface. Several generations develop a year. Pupation takes place in the soil.

OCCURRENCE. TR: Harstad (1995); NT: Skatval, Stjørdal; ST: Sveberg (2003).

DISTRIBUTION. Euro-Siberian.

***Dasineura pteridis* (Müller, 1871)**

*Cecidomyia filicina* Kieffer, 1889

Solitary orange-yellow larva develops in swollen rolled leaf margin of *Pteridium aquilinum* (L.) Kuhn. (Dennstaedtiaceae). Only one generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. Eide (Leatherdale 1959).

DISTRIBUTION. Euro-Siberian.

***Dasineura pustulans* (Rübsaamen, 1889)**

White larvae develop in small circular depressions on the lower surface of the leaves of *Filipendula ulmaria* (L.) Maxim. (Rosaceae). The gall is surrounded by a bright yellow patch. Usually two generations develop a year. Larvae pupate in the soil.

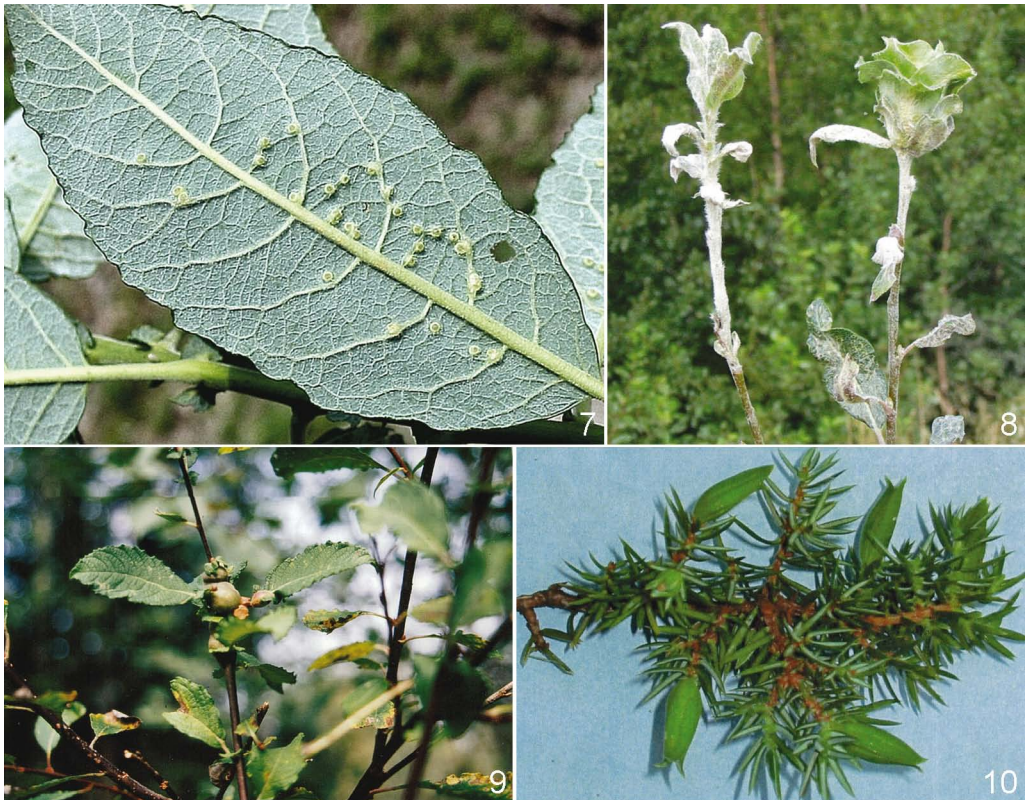
OCCURRENCE. Hvaler (Leatherdale 1959); Bærum, Bamle, Ullensvang (Fjelddalen (1994). – New records: TR: Harstad (1995). NT: Åsen, Flornes, Øverby, Stjørdal, Værnes (2003).

DISTRIBUTION. European.

***Dasineura pyri* (Bouché, 1847)**

White larvae develop in curled and rolled leaf margins of *Pyrus communis* L. (Rosaceae). Two or more generations develop a year. Pupation takes place in the galls or in the soil. *D. pyri* may occasionally be a serious pest of pears, especially on young trees (Darvas et al. 2000).

OCCURRENCE. this species occurs in southern part of Norway and first recorded as pest in 1914 by Schøyen (1916), and since 1950 frequently found in nurseries.



Figs 7–10. Galls of gall midges found in Norway. 7 – Small galls of *Iteomyia capreae* (Winnertz, 1853) on the leaf of *Salix* sp., the most frequent gall midge species in Norway. 8 – Rosette galls caused by *Rabdophaga rosaria* (Loew, 1850) on terminal branches of *Salix glauca* L., on the peat bog at Storlien, August 2003. 9 – Swellings on branches of *Salix* sp. caused by *Rabdophaga salicis* (Schrank, 1803). 10 – Bud galls of *Oligotrophus juniperinus* (Linnaeus, 1758) on branches of *Juniperus communis* L.

REFERENCES. Barnes (1948a), Leatherdale (1959), Fjelddalen (1954, 1994), Stenseth (1966).

DISTRIBUTION. European, secondarily Holarctic.

***Dasineura rosae* (Bremi, 1847)**

*Cecidomyia rosarum* Hardy, 1850

*Wachtliella rosarum* (Hardy, 1850)

Orange coloured larvae live gregariously in swollen, pod-like folded leaflets of *Rosa canina* L. and other species of the genus *Rosa* (Rosaceae). Several generations develop a year. Full-grown larvae leave galls and fall to the soil where they pupate.

OCCURRENCE. Ulvik, Trondheim (Löw 1888, on *Rosa carelica*); Oslo (Trotter 1923); Oslo (Leatherdale 1959, on *Rosa* sp.); Oslo, Vestby, Ringsaker, Ås, Vestby, Hurum, Lier, Hole, Tønsberg, Drangedal (Fjelddalen 1994, on *Rosa dumalis* and cultivated rose). – New records: NT: Skatval, Stjørdal (2003).

DISTRIBUTION. Euro-Siberian.

**\**Dasineura saussureae* Fedotova, 1996**

Orange coloured larvae develop in flower-heads of *Saussurea alpina* (L.) DC. (Asteraceae). Fedotova (1996) described this species from the flower-heads of *Saussurea latifolia* found in Kazakhstan. Sylvén & Lindberg (1998) found larvae of this species in flower-heads of *Saussurea alpina* in Sweden.

OCCURRENCE. NT: Storlien (2003).

DISTRIBUTION. Euro-Asian.

***Dasineura tetensi* (Rübsaamen, 1891)**

At first white, later yellowish larvae live in folded and twisted leaves on terminal shoots of *Ribes nigrum* L. (Grossulariaceae). Three or four generations develop a year. Pupation takes place in the soil. Occasionally *D. tetensi* may be a serious pest of black currant (Darvas et al. 2000). *D. tetensi* was first recorded in Norway in 1948 (Fjelddalen 1954) and since then it is a serious pest in southern part of Norway.

REFERENCES. Barnes (1948a), Fjelddalen (1963, 1994), Leatherdale (1959).

DISTRIBUTION. Euro-Siberian.

***Dasineura tiliae* (Schrank, 1803)**

*Cecidomyia tiliamvolvans* Rübsaamen, 1889

Red-yellow or orange larvae live in upwardly rolled swollen leaf margins of *Tilia platyphyllos* Scop. and *T. cordata* Mill. (Tiliaceae) (Fig. 14). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. Eide (Trail 1889); Råde, Ås, Frogn, Vestby, Ringsaker, Toten (Fjelddalen 1963, 1994).

DISTRIBUTION. Euro-Siberian.

**\**Dasineura tortilis* (Bremi, 1847)**

*Cecidomyia alni* F. Löw, 1877

At first yellowish, later orange red larvae live gregariously in leaf galls on *Alnus incana* (L.) Moench (Betulaceae). The attacked leaf is folded upwards and its veins become thickened and swollen basally. One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Åsen, Flornes, Øverby, Skatval, Stjørdal, Storlien, Værnes; ST: Sveberg, Tømra, Tydal (2003).

DISTRIBUTION. European.

**\**Dasineura trifolii* (Löw, 1874)**

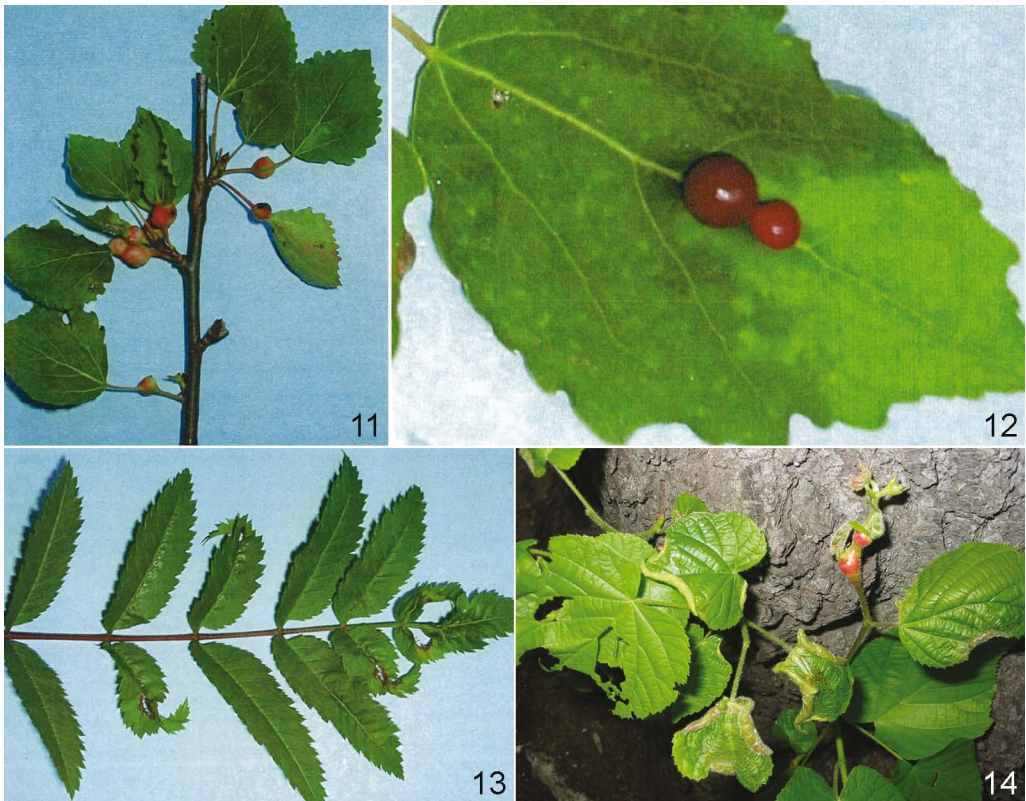
Reddish-yellow larvae live in folded leaflets of *Trifolium repens* L. (Fabaceae). Several generations develop a year. Larvae of the summer generations pupate in the galls in white cocoons. In autumn larvae leave galls and hibernate in the soil.

OCCURRENCE. NT: Skatval, Stjørdal (2003).

DISTRIBUTION. Euro-Siberian, secondarily Holarctic.

***Dasineura ulmaria* (Bremi, 1847)**

Solitary yellowish white larvae develop in galls on leaves of *Filipendula ulmaria* (L.) Maxim. (Rosaceae). The gall is hemispherical on the upper and conical on the lower side, with the opening at the apex of the cone. Each gall contains one chamber where the larva develops and pupates. Two or three generations develop a year.



Figs 11–14. Galls of gall midges found in Norway. Fig. 11 – Swellings on leaf petioles of *Populus tremula* L. caused by *Contarinia petioli* (Kieffer, 1898). 12 – Large globular galls on upper leaf side of aspen caused by *Harmandiola tremulae* (Winnertz, 1853). 13 – Folded leaflets on *Sorbus aucuparia* caused by *Contarinia sorbi* Kieffer, 1896. 14 – Rolled leaf margins caused by *Dasineura tiliae* (Schrank, 1803) and swellings on young shoots of *Tilia* sp. caused by *Contarinia tiliarum* (Kieffer, 1890).

OCCURRENCE. Lyngseidet, Trondheim (Löw 1888); Eide (Trail 1889); Ulfbakk, Issorvann, Liset, Hjelle, Rosett, Bulken, Eide, Bordalen, Granvin, Skjervet, Aldalen, Nordgulen, Lyngseidet (Leatherdale 1959); Moss, Ås, Oppegård, Hurum, Uvdal, Lillesand, Ullensvang, Aurland, Leikanger, Oppdal, Sørfold (Fjelddalen 1994). – New records: TR: Harstad (1995). NT: Åsen, Flornes, Stjørdal, Storlien, Værnes (2003).

DISTRIBUTION. Euro-Siberian.

***Dasineura urticae* (Perris, 1840)**

Whitish-orange larvae cause galls on leaves, stems or flower peduncles of *Urtica dioica* L. (Urticaceae). The gall is rounded, pouch-like, containing one or more larvae and with a mouth-like opening on the upper surface of the leaf. Two or more generations develop a year. Pupation takes place in the soil.

OCCURRENCE. Bergen (Leatherdale 1959). – New records: NT: Flornes, Skatval, Stjørdal, Værnes (2003).

DISTRIBUTION. Euro-Siberian-Asian.

***Dasineura viciae* (Kieffer, 1888)**

Whitish larvae live gregariously in pod-like folded and hypertrophied leaflets of *Vicia sepium* L. and *V. sativa* (Fabaceae). Two or three generations develop a year. Larvae pupate in the soil.

OCCURRENCE. Lyngseidet (Löw 1888); Lyngen in Troms county (Trail 1889). – New records: TR: Harstad (1995). NT: Flornes, Skatval, Stjørdal (2003). REFERENCE. Leatherdale (1959).

DISTRIBUTION. Euro-Siberian-Asian.

**\**Dasineura virgaureae* (Liebel, 1889)**

Larvae live between deformed leaves at vegetative tip of *Solidago virgaurea* L. (Asteraceae). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. NT: Øverby (2003).

DISTRIBUTION. European.

**\**Dasineura vitisidaea* (Kieffer, 1909)**

Larvae develop in leaf bud galls at vegetative tips of *Vaccinium vitis-idaea* L. (Ericaceae). Only gall and larva were described. One generation develops a year. Larvae pupate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European, Arctic-Alpine species.

***Didymomyia tiliacea* (Bremi, 1847)**

*Cecidomyia frauenfeldi* Kaltenbach, 1872

*Hormomyia reaumuriana* Löw, 1878

Solitary whitish or pale yellow larvae produce hard woody galls on the leaves of *Tilia cordata* Mill. (Tiliaceae). Each gall is visible on both sides of the leaf and contains an inner cylindrical gall containing one larva. The inner gall separates from the rest of the gall, which remains on the leaf, and falls to the ground. The larva overwinters inside the inner gall and pupates there in the spring. Only one generation develops a year.

OCCURRENCE. Eide (Trail 1889, Leatherdale (1959), Moss, Bærum, Oslo, Vestby, Ås, Hurum, Hedrum (Fjelddalen 1994).

DISTRIBUTION. Euro-Siberian.

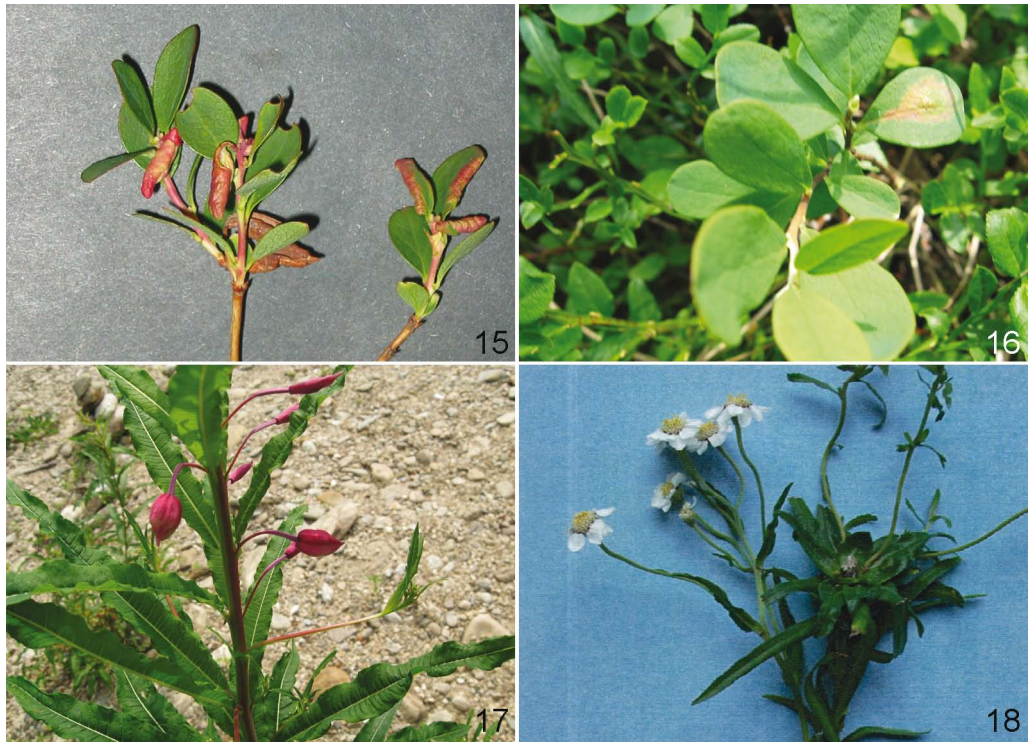
***Feltiella acarisuga* (Vallot, 1827)**

*Cedomyia acarisuga* Vallot, 1827

Larvae are predators of spider mites (Acarina: Tetranychidae). Larvae occur mainly on leaves in colonies of spider mites where they feed on eggs, nymphs and adult spider mites. It is one of the most effective and widespread natural enemies of spider mites. Several generations develop a year. Full-grown larvae spin a white cocoon either on the leaf, or drop to the soil where they pupate (Gagné 1995).

OCCURRENCE. This species has been introduced to Norway as a biological agent for control of *Tetranychus urticae* Koch in greenhouses (EPPO 2002).

DISTRIBUTION. It is probably primarily a European species, at present known to be distributed in several continents and considered therefore to be cosmopolitan. It is included among alien species in Europe (Skuhravá et al. 2010).



Figs 15–18. Galls of gall midges found in Norway. 15 – Rolled leaf margins caused by *Hydrodiplosis vaccinii* (Kieffer, 1897) on *Vaccinium uliginosum* L. 16 – Larvae of *Contarinia* sp. developing in depressions on the lower side of the leaf of *Vaccinium uliginosum* causing red or pink spots. 17 – Swollen flower buds on *Epilobium angustifolium* (L.) Scop. caused by *Dasineura epilobii* (F. Löw, 1889. 18 – Irregular gall on *Achillea ptarmica* L. caused by *Rhopalomyia ptarmicae* (Vallot, 1849).

***Geocrypta galii* (Loew, 1850)**

Reddish-yellow larvae cause round bladder swellings on stems and flower stalks of *Galium mollugo* L. and *G. boreale* L. (Rubiaceae). The galls are fleshy, glossy, with a lateral opening. Inside each gall is one chamber. Several generations develop a year. Larvae hibernate in the soil.

OCCURRENCE. Trondheim (Löw 1888, on *Galium boreale*); Myrkedalen, Trondheim (Leatherdale 1959). – New records: TR: Harstad (1995); NT: Skatval (2003).

DISTRIBUTION. Euro-Siberian.

***Harmandiola cavernosa* (Rübsaamen, 1888)**

Solitary orange red larvae produce large, thick walled galls on the leaves of *Populus tremula* L. (Salicaceae). The gall is globular on the lower surface, partly extending on the upper surface where it is a slit-like opening. Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Trondheim, Oslo (Trotter 1923); Ulfsbakk, Oslo, Trondheim (Leatherdale 1959); Ås, Stor-Elvdal, Kongsberg, Ringerike, Ål, Solum, Saltdal, Narvik, Målselv (Fjelddalen 1994). – New record: TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian-Asian.

***Harmandiola globuli* (Rübsaamen, 1889)**

A solitary red yellow larva produces a small unilocular, globular, hard but thin walled gall on the upper surface of the leaf of *Populus tremula* L. (Salicaceae). The slit-like opening is on the lower surface. One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. Arendaler Skaeren (Hieronymus 1890). – New records: TR: Harstad (1995). NT: Åsen, Øverby, Skatval, Stjørdal, Værnes (2003).

DISTRIBUTION. Euro-Siberian-Asian.

**\**Harmandiola populi* (Rübsaamen, 1917)**

A solitary yellow larva produces a small unilocular, globular, hard but thin-walled gall on the lower side of the leaf of *Populus tremula* L. (Salicaceae), with the opening on the upper leaf side. One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. TR: Harstad (1995). NT: Åsen, Øverby, Skatval, Værnes (2003).

DISTRIBUTION. Euro-Siberian.

***Harmandiola tremulae* (Winnertz, 1853)**

*Diplosis loewii* Rübsaamen, 1892

A solitary orange red larva produces a large, globular, very hard and thick walled gall on the upper surface of the leaf of *Populus tremula* L. (Salicaceae). The slit-like opening is on the lower surface of the leaf (Fig. 12). One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Trondheim (Löw 1888); Arendaler Skaeren (Hieronymus 1890); Trondheim, Levanger (Leatherdale 1959); Moss, Bærum, Asker, Frogn, Kongsberg, Ål, Kvam, Orkdal, Målselv (Fjelddalen 1994). – New records: TR: Harstad (1995). NT: Åsen, Skatval, Tømra (2003).

DISTRIBUTION. Euro-Asian (up to Kazakhstan).

***Hartigiola annulipes* (Hartig, 1839)**

A solitary white larva produces a cylindrical, hairy or bare gall on the upper surface of the leaf of *Fagus sylvatica* L. (Fagaceae). One generation develops a year. In autumn the full-grown larva closes the opening at the base of the gall by a lid. The gall separates from the leaf and falls to the soil where the larva hibernates hidden in the gall. In the spring the larva pupates inside the gall and then the adult gall midge emerges.

OCCURRENCE. Stavanger (Leatherdale 1959).

DISTRIBUTION. European.

**\**Hygrodiplosis vaccinii* (Kieffer, 1897)**

Yellow or reddish larvae cause galls – rolled leaf margins of *Vaccinium uliginosum* L. (Ericaceae) (Fig.15). Only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995), ST: Tydal (2003).

DISTRIBUTION. European, Arctic-Alpine species and sub-nivale species (Skuhravá & Skuhravý 2010b).

***Iteomyia capreae* (Winnertz, 1853)**

At first white, then orange, at maturity red larvae produce small hemispherical galls on the leaves of *Salix caprea* L., *S. aurita* L. and its relatives (Salicaceae) (Fig.7). The circular opening is on the lower surface of the leaf. Each gall contains one larva. When full-grown, larvae leave the galls and drop to the soil where they hibernate. One generation develops a year.

OCCURRENCE. Tromsø (Löw 1888); Oslo, Odde (Trail 1889); Tana (Andersson 1958); Bergen, Guddal, Ljosnes, Rondalsvann, Grønliseter, Solberg, Sauatræ, Nordgulen, Skeie, Bordalen, Bulken, Eide, Skjervan, Haugland, Oslo, Odda, Tromsdal (Leatherdale 1959, on *Salix caprea* L., *S. aurita* L., *S. phylicifolia* L.); Oslo, Vestby (Fjelddalen 1994). – New records: TR: Harstad (1995); NT: Øverby, Skatval, Stjørdal, Værnes, ST: Tydal (2003). *Iteomyia capreae* is the most frequent species in Norway.

DISTRIBUTION. Euro-Siberian-Asian.

***Iteomyia major* (Kieffer, 1889)**

Orange-red larvae cause larger, hard, irregular swellings usually on the midvein of the leaf of *Salix caprea* L. and *S. cinerea* L. (Salicaceae). The gall has many chambers with openings on the lower side. One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. Skjervet (Leatherdale 1959, on *Salix caprea*). – New record: ST: Tydal (2003).

DISTRIBUTION. Euro-Siberian.

**\**Jaapiella knautiae* Rübсаamen, 1917**

Whitish larvae live in leaf bud galls at the vegetative tip of *Knautia* sp. (Dipsacaceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. NT: Øverby (2003).

DISTRIBUTION. European.

***Jaapiella loticola* (Rübсаamen, 1889)**

Reddish or orange larvae develop in leaf bud galls on shoots of *Lotus corniculatus* L. (Fabaceae). Two generations develop a year. Larvae overwinter in the soil.

OCCURRENCE. Lagerheim (1905) on the Coast of the Baltic. – New record: TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian-Asian.

**\**Jaapiella vacciniorum* (Kieffer, 1913)**

*Dichelomyia vaccinii* Rübсаamen, 1895, non Smith, 1890

*Perrisia vacciniorum* Kieffer 1913: new name for *Dichelomyia vaccinii* Rübсаamen, 1895

Red larvae develop among deformed leaves at the vegetative tip of *Vaccinium myrtillus* L. (Ericaceae). Two generations develop a year. Larvae hibernate in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European, Arctic-Alpine species, boreal and mountain species (Skuhravá 1987).

***Jaapiella veronicae* (Vallot, 1827)**

Several orange coloured larvae develop in galls on vegetative tips of *Veronica chamaedrys* L. (Scrophulariaceae). The two terminal leaves are shell-like, thickened, densely covered with white hair, pressed together, forming a cavity in which the larvae live and pupate in white cocoons. Several overlapping generations develop a year. Larvae overwinter in the soil where they pupate in the spring.

OCCURRENCE. Oslo (Trail 1888); Bergen, Oslo (Leatherdale 1959); Oslo (Fjeldalen 1994).

DISTRIBUTION. European.

***Kaltenbachiola strobi* (Winnertz, 1853)**

Solitary orange larva develops in slight swelling on the scale in the cones of *Picea abies* (L.) Karsten (Pinaceae). One generation develops a year. Larvae pupate in a white cocoon in the cones.

REFERENCES. Bakke (1955, 1963), Eide (1927), Skrzypczyńska (1987).

DISTRIBUTION. European.

***Karshomyia oklandi* Mamaev et Krivosheina, 1998**

Biology unknown. One male was caught at Tappenberg in 1991 by B. Okland.

DISTRIBUTION. European.

**\**Lasioptera carophila* Löw, 1874**

A solitary orange coloured larva produces a swelling at the point of insertion of the umbellules in inflorescence of *Pimpinella saxifraga* L., *Daucus carota* L. and other species of Apiaceae. One or two generations develop a year. Larvae pupate and also overwinter in galls.

OCCURRENCE. NT: Stjørdal (2003).

DISTRIBUTION. European.

***Lasioptera populnea* Wachtl, 1883**

Orange larvae live as inquiline in galls of *Contarinia populi* on leaves of *Populus tremula* L. (Salicaceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. Lakselv (Andersson 1958).

REFERENCES. Fjeldalen (1954), Leatherdale (1959), Stenseth (1978).

DISTRIBUTION. European.

***Lasioptera rubi* (Schrank, 1803)**

Orange larvae develop gregariously in hard woody swellings on stems of *Rubus idaeus* L., *R. caesius* L. and other species of *Rubus* (Rosaceae). One generation develops a year. Pupation takes place in the gall. It is a minor but widespread pest of *Rubus* species (Darvas et al. 2000). In Norway it is a horticultural pest (Schøyen & Jørstad 1942).

OCCURRENCE. Hen (Fjeldalen 1954, on *Rubus idaeus*). – New record: NT: Værnes (2003).

REFERENCES. Barnes (1948a), Fjeldalen (1994), Leatherdale (1959), Schøyen (1919), Stenseth (1978).

DISTRIBUTION. Euro-Siberian-Asian.

***Lathyromyza schlechtendali* (Kieffer, 1886)**

White larvae live gregariously in rolled leaflets of *Lathyrus linifolius* Reich. (Bassl.) (= *Orobuchus montanus* Bernh. (Fabaceae) without swelling and coloration. Two generations develop a year. Larvae pupate and overwinter in the soil. Sylvén (1975) recorded this species without giving locality name.

DISTRIBUTION. Euro-Siberian.

***Lestodiplosis holstei* Kieffer, 1920**

Larvae are zoophagous and live as predators between scales in cones of *Picea abies* (L.) Karst. (Pinaceae). Skrzypczyńska (1987) obtained larvae from cones collected at Arendal in Southern Norway.

DISTRIBUTION. European.

***Lestodiplosis polypori* (Loew, 1850)**

Larvae are zoophagous and live as predators in various species of the genus *Polyporus* (Fungi: Polyporaceae). Økland & Hågvar (1994) and Økland (1995) reared adults from dead fruiting bodies of *Fomitopsis pinicola*, *Fomes fomentarius* and *Piptoporus betulinus* (Fungi: Polyporaceae).

DISTRIBUTION. European.

***Macrodiplosis pustularis* (Bremer, 1847)**

*Diplosis dryobia* F. Löw, 1877

Two to six white, later red yellow larvae cause galls on leaf margins of *Quercus robur* L. and *Q. petraea* (Matt.) Liebl. (Fagaceae). The gall is formed by a thickened leaf marginal lobe folded downwards. One generation develops a year. Full-grown larvae drop to the soil where they hibernate.

OCCURRENCE. Skeie (Leatherdale 1959), Onsøy (Fjelddalen 1994).

DISTRIBUTION. European-Siberian-Asian (Kazakhstan).

***Macrodiplosis roboris* Hardy, 1854)**

*Macrodiplosis volvens* Kieffer, 1895

Whitish, later orange-yellow larvae cause leaf marginal galls on *Quercus robur* L. and *Q. petraea* (Matt.) Liebl. (Fagaceae). The leaf margin segment between two lobes is rolled upwards forming a chamber for development of larvae. One generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Ås (Fjelddalen 1994).

DISTRIBUTION. European-Asian (Kazakhstan).

**\**Macrolabis achilleae* Rübsaamen, 1893**

Larvae develop in flower-heads of *Achillea millefolium* L. (Asteraceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European.

**\**Macrolabis luceti* Kieffer, 1899**

Whitish larvae live asinquilines in galls of *Dasineura rosae* (= *Wachtliella rosarum*) which are formed of folded leaflets of *Rosa canina* L. and related species (Rosaceae). One or two generations develop a year. Larvae overwinter in the soil.

OCCURRENCE. NT: Skatval (2003).

DISTRIBUTION. European.

**\**Macrolabis saliceti* (Loew, 1850)**

Whitish larvae live asinquilines among leaves in large rosette galls caused by *Rabdophaga rosaria* (Loew) on *Salix glauca* L. (Salicaceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. ST: Tydal (2003).

DISTRIBUTION. European.

**\**Massalongia betulifolia* Harris, 1974**

Larvae cause shallow circular blisters in leaf blade of *Betula pendula* L. (= *B. verrucosa* L.) (Betulaceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. ST: Tydal (2003).

DISTRIBUTION. European.

NOTE. This species was described by Harris (1974) who found galls in England. It is the second finding of galls caused by this species in Europe.

**\**Massalongia rubra* (Kieffer, 1890)**

At first white, later red larvae cause swellings on the midrib and bases of lateral veins on leaves of *Betula pendula* L. (= *B. verrucosa* L.) (Betulaceae). One generation develops a year. Larvae overwinter in the soil.

OCCURRENCE. TR: Harstad (1995). NT: Storlien (2003).

DISTRIBUTION. European-Asian (up to Kazakhstan).

***Mayetiola destructor* (Say, 1817)**

*Mayetiola mimeuri* Mesnil, 1934

*Mayetiola secalis* Bollow, 1950

White larvae (so called "Hessian fly") cause swellings on the lower part of the stems, mainly on wheat *Triticum aestivum* L. (= *T. vulgare* Vill.), on rye *Secale cereale* L. and occasionally also on various species of weed grasses (Poaceae). Larvae feed by sucking the sap from the tissues of the stem. Several generations develop a year. When the young plants are attacked, they frequently die. When older plants are attacked, injured stems break and fall over. Full-grown larvae form a brown puparium in which they pupate on the stem during summer and where they also overwinter. At present, it is a minor pest of cereals in Europe, but the main pest of cereals in North America. In the past, it was a serious pest in Ukraine, Hungary and Poland (Darvas et al. 2000). Sporadic occurrence has been recorded in southern Norway since 1893 (Schøyen 1922, Fjelddalen 1994).

REFERENCES. Barnes (1956), Gagné (1989), Skuhrová et al. (1984b).

DISTRIBUTION. Primarily European, secondarily Holarctic and nearly cosmopolitan.

**\**Mycodiplosis melampsorae* (Rübsaamen, 1889)**

Larvae are mycophagous and feed on the uredospores of *Melampsora salicina* Wint. (Uredinales, Fungi) on leaves of *Salix caprea* L. (Salicaceae). One or two generation develop a year. Larvae overwinter in the soil.

OCCURRENCE. NT: Værnes (2003).

DISTRIBUTION. Euro-Siberian.

**\**Mycodiplosis saundersi* Barnes, 1927**

Larvae are mycophagous and live in colonies of *Puccinia suaveolens* (Pers.) Rostr. (Basidiomycetes, Fungi) on the leaves of *Cirsium arvense* (L.) Scop. (Asteraceae). One or generations develop a year. Larvae overwinter in the soil.

OCCURRENCE. NT: Åsen, Skatval, Stjørdal (2003).

DISTRIBUTION. Euro-Siberian.

***Oligotrophus juniperinus* (Linnaeus, 1758)**

Single orange coloured larvae cause galls on *Juniperus communis* L. (Cupressaceae). The galls are slender, about 12 mm long, involving more than two verticils of needles. Outer needles of the fully developed gall have recurved tips (Fig. 10). One generation develops a year. Pupation takes place

in the gall. Harris et al. (2006) suggest that this species has a 24-month life cycle, with oviposition in June/July of first year, most development in second year and adult emergence in third year. OCCURRENCE. Ulvik, Falejde (Löw 1888); Oifjord in Hardanger (Trail 1889); Trondheim (Trotter 1923); Ulvik, Øyfjord (Leatherdale (1959). – New records: TR: Harstad (1995). NT: Åsen, Skatval, Stjørdal, Storlien; ST: Sveberg, Tydal (2003).

REFERENCES: Barnes (1951), Harris et al. (2006).

DISTRIBUTION. European, boreal and Alpine species (Skuhrová 1987).

**\**Oligotrophus panteli* Kieffer, 1898**

Single orange coloured larvae cause galls on *Juniperus communis* L. (Cupressaceae). The galls are bulbous at the base and have a pointed apex. One generation develops a year. Pupation takes place in galls.

OCCURRENCE. NT: Skatval, Stjørdal, Storlien; ST: Tydal (2003).

DISTRIBUTION. European.

**\**Ozirhincus millefolii* (Wachtl, 1884)**

A solitary orange coloured larva develops in slightly swollen achene in the flowerhead of *Achillea millefolium* L. (Asteraceae). Several generations develop a year. Pupation takes place in the gall.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. Euro-Siberian, secondarily Holarctic.

***Physemocecis hartigi* (Liebel, 1892)**

Whitish larvae cause rounded, flattened and parenchymatous galls on leaves of *Tilia platyphyllos* Scop. and *T. cordata* Mill. (Tiliaceae). Each gall contains only one larva. Usually only one generation develops a year. Larvae hibernate in the soil.

OCCURRENCE. Moss, Oslo, Asker, Ås, Kragerø, Gjerpen, Nome, Hjelmeland, Bergen (Fjelddalen 1963, 1994).

DISTRIBUTION. European-Asian (up to Turkey).

***Physemocecis ulmi* (Kieffer, 1909)**

White larvae cause small parenchymatous galls on leaves of *Ulmus glabra* Huds. (Ulmaceae). One generation develops a year. Larvae hibernate in the soil. Larvae live in parenchymatous galls on leaves of *Ulmus minor* Mill. (Ulmaceae).

OCCURRENCE. Oslo, Frogn, Åa, Gjerpen, Nome, Kristiansand (Fjelddalen 1994). – New record: NT: Stjørdal (2003).

DISTRIBUTION. European.

***Rabdophaga degeerii* (Bremi, 1847)**

*Rabdophaga ramicola* Rübsaamen, 1905

Red-yellow larvae cause swelling on young, one-year twig of *Salix purpurea* L. (Salicaceae). The gall is spindle-shaped, encircling the twig and with a number of larval chambers. One generation develops a year. Pupation takes place in the gall.

OCCURRENCE. Asker, Sandnes (Fjelddalen 1994).

DISTRIBUTION. European.

**\**Rabdophaga exsiccans* (Rübsaamen, 1915)**

Larvae develop under the bark of slightly swollen one-year branch of *Salix repens* L. (Salicaceae). Attacked branch dries up and dies. Only one generation develops a year.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European.

**\**Rabdophaga iteobia* (Kieffer, 1890)**

Orange larvae live gregariously among the leaves, densely covered with white hairs, forming a loose rosette gall at the top of the branch of *Salix caprea* L. (Salicaceae). Probably only one generation develops a year. Pupation takes place in the soil.

OCCURRENCE. TR: Harstad (1995); ST: Tømra (2003).

DISTRIBUTION. Euro-Siberian.

**\**Rabdophaga jaapi* Rübisaamen, 1915**

A single reddish-yellow larva causes a small spindle-shaped gall at the branch tip of *Salix repens* L. (Salicaceae). Only one generation develops a year. Larva hibernates in the gall where it pupates in the spring.

OCCURRENCE. TR: Harstad (1995).

DISTRIBUTION. European.

***Rabdophaga marginemtorquens* (Bremi, 1847)**

Orange-yellow larvae live in tightly rolled leaf margins of *Salix viminalis* L. (Salicaceae). The rolled part is usually continuous, swollen and discoloured white or red. Two or three generations develop a year. Pupation takes place in the gall. Larvae overwinter in the soil.

OCCURRENCE. Kuhammeren (Leatherdale 1959). He identified this species on the basis of galls on leaves of *Salix lapponum* L. It may be another species.

DISTRIBUTION. Euro-Siberian.

**\**Rabdophaga repenticola* Stelter, 1964**

A solitary orange or orange-red larva causes a small leaf bud gall on *Salix repens* L. (Salicaceae). The bud is enlarged, about 6 mm long, covered with scales and small leaves. One generation develops a year. Pupation takes place in the gall.

OCCURRENCE. NT: Storlien (2003).

DISTRIBUTION. European.

***Rabdophaga rosaria* (Loew, 1850)**

A single orange red larva causes a large rosette leaf gall on terminal or lateral buds of *Salix alba* L. and related species of *Salix* (Salicaceae) (Fig. 8). Only one generation develops a year. Pupation takes place in the gall.

OCCURRENCE. Drivstuen, Dovrefjeld (Hieronymus 1890, on *Salix nigricans*); Prestvatnet, Skeie, Liset, Granvin (Leatherdale 1959, on *Salix glauca*); Vestby, Grimstad, Lom, Hurum, Ås, Vestre Slidre, Aurland, Harstad, Tromsø, Bærum, Hjartdal (Fjelddalen 1994, on *S. caprea*, *S. myrsinites*, *S. nigricans*, *S. cinerea*, *S. glauca*). – New records: TR: Harstad (on *Salix repens*) (1995). NT: Storlien; ST: Sveberg, Tømra (*S. glauca*), Tydal (*S. alba*) (2003).

DISTRIBUTION. Euro-Siberian-Asian (up to Kazakhstan).

**\**Rabdophaga rosariella* (Kieffer, 1897)**

A small single larva causes a very small rosette gall on *Salix aurita* L. and *S. cinerea* L. (Salicaceae), as it was described by Kieffer (1897). This species was synonymized in the past with *Rabdophaga rosaria* but Harris (2009) demonstrated and documented that it is a valid species.

OCCURRENCE. NT: Storlien (2003).

DISTRIBUTION. European.

***Rabdophaga salicis* (Schrank, 1803)**

Gregarious orange coloured larvae cause obvious, woody, fusiform or spherical, plurilocular swellings on the branches of *Salix cinerea* L., *S. aurita* L. and *S. caprea* L. (Salicaceae) (Fig. 9). One generation develops a year. Larvae overwinter and in the spring pupation takes place in the gall. OCCURRENCE. Tromsø (Löw 1888, on *Salix hastata*); Malmangernuten, Andersfjell, Nystøl, Lussand (on *Salix lapponum* L.), Tromsdal (on *Salix hastata* L.), Guddal (on *Salix aurita* L.), Bodø (Leatherdale 1959). – New record: TR: Harstad (1995). DISTRIBUTION. Euro-Siberia-Asian (up to Kazakhstan).

**\**Rabdophaga schicki* Stelter, 1982**

A solitary larva develops in a large spindle-shaped swelling on the branch of *Salix repens* L. (Salicaceae). A single larva develops inside a large chamber where it also pupates in the summer of the following year. OCCURRENCE. TR: Harstad (1995). DISTRIBUTION. European.

**\**Rabdophaga schreiteri* Stelter, 1982**

Larvae live asinquilines in the galls of *Rabdophaga rosaria* on *Salix repens* L. (Salicaceae). Probably only one generation develops a year. OCCURRENCE. TR: Harstad (1995). DISTRIBUTION. European.

***Rabdophaga terminalis* (Loew, 1850)**

Orange or reddish larvae live gregariously in galls formed by deformed and shortened terminal leaves of *Salix fragilis* L. and *S. alba* L. (Salicaceae). Two or more generations develop a year. Pupation takes place partly in the gall, partly in the soil. OCCURRENCE. Roset (Leatherdale 1959, on *Salix lanata* L.). – New record: ST: Tydal (2003), on *S. glauca*. REFERENCE. Barnes (1949, 1951). DISTRIBUTION. Euro-Siberian-Asian (up to Kazakhstan).

**\**Resseliella betulicola* (Kieffer, 1889)**

*Plemeliella betulicola* Kieffer, 1889

Yellowish-white larvae develop among youngest terminal leaves on the vegetative tip of *Betula pubescens* Ehrh. and *B. pendula* Roth. (Betulaceae). One generation develops a year. Larvae hibernate in the soil. OCCURRENCE. TR: Harstad (1995). NT: Flornes, Øverby, Storlien; ST: Sveberg, Tømra, Tydal (2003). DISTRIBUTION. Euro-Siberian.

***Resseliella theobaldi* (Barnes, 1927)**

*Thomasiniana theobaldi* Barnes, 1927

Salmon-pink to red larvae live under the rind of stems of *Rubus idaeus* L. (Rosaceae). The rind of attacked parts peels off. Several generations may develop a year. Larvae leave attacked parts and drop to the soil where they pupate. Occasionally may be a serious pest of raspberry (Darvas et al., 2000). In Norway first recorded in 1959 (Valset 1960). OCCURRENCE. Asker, Toten, Tønsberg (Fjelddalen (1963). References: Barnes (1948a), Fjelddalen (1994), Stenseth (1972, 1977). DISTRIBUTION. European.

***Rhopalomyia chrysanthemi* (Ahlberg, 1939)**

A single larva develops inside a small gall occurring on leaves, stems, buds or flowerheads of autumn commercial chrysanthemums (*Chrysanthemum*) (Asteraceae). Several overlapping generations develop in one year. Larvae pupate in the galls. It is primarily a glasshouse pest, but it may survive also in out-of-door conditions (Barnes 1948). In Norway first recorded in Oslo in 1949 (Gjærun 1949). It is a serious pest of cultivated chrysanthemum in greenhouses (Fjelddalen 1963, 1994).

REFERENCE. Barnes (1948b).

DISTRIBUTION. Europe and North America (pest in greenhouses). It probably originates from south-eastern Asia and is evaluated as alien in Europe (Skuhrová et al. 2010).

**\**Rhopalomyia hypogaea* (F. Löw, 1885)**

Larvae cause irregular globular galls on stems of *Chrysanthemum coronarium* L. (Asteraceae) situated near the soil or on underground parts. One generation develops a year. Larvae overwinter in the gall.

OCCURRENCE. NT: Øverby (2003, on *Chrysanthemum* sp.).

DISTRIBUTION. European.

***Rhopalomyia ptarmicae* (Vallot, 1849)**

Whitish larvae cause galls on flower heads of *Achillea ptarmica* L. (Asteraceae). The inflorescence is changed into spongy, irregular, round galls with many larval chambers. Each chamber contains only one larva (Fig. 18). Two generations develop a year. Pupation takes place in the gall.

OCCURRENCE. Oslo, Bergen (Trail 1889). – New records: NT: Skatval, ST: Tydal (2003).

REFERENCE. Leatherdale (1959).

DISTRIBUTION. European.

***Rondaniola bursaria* (Bremer, 1847)**

White or slightly yellow larvae cause cylindrical galls on the upper surface of the leaf of *Glechoma hederacea* L. (Lamiaceae). The gall is up 4 mm high, densely covered with white hairs; each contains one larva. Two or more generations develop a year. Pupation takes place in the gall or in the soil.

OCCURRENCE. Trondheim (Trail 1889).

REFERENCE. Leatherdale (1959).

DISTRIBUTION. European.

**\**Schizomyia galiorum* Kieffer, 1889**

Dirty yellow larvae induce galls in the flower buds of *Galium mollugo* L., *Galium verum* L. and other *Galium*-species (Rubiaceae). Inside each galled flower bud is a chamber with one, two or three larvae. When full-grown, they leave the gall and pupate in the soil. Two generations develop a year.

OCCURRENCE. NT: Stjørdal (2003).

DISTRIBUTION. Euro-Siberian-Asian (up to Kazakhstan).

**\**Semudobia betulae* (Winnertz, 1853)**

A single orange coloured larva develops in swollen fruit in catkins of *Betula pubescens* Ehrh. and *B. pendula* Roth. (Betulaceae). The attacked seed is swollen, with a small window-pit (for future emergence), and the wings of fruit are reduced. One generation develops a year. Larvae overwinter in the gall where they pupate in the spring.

OCCURRENCE. TR: Harstad (1995). NT: Øverby, Stjørdal, Værnes (2003).

DISTRIBUTION. Euro-Siberian and Holarctic.

**\**Semudobia skuhravae* Roskam, 1977**

A single orange larva causes a small ovoid gall situated between the spindle and the scales in catkins of *Betula pendula* Roth. (Betulaceae). One generation develops a year. Pupation takes place in the gall.

OCCURRENCE. TR: Harstad (1995). NT: Øverby (2003).

DISTRIBUTION. Euro-Siberian.

***Sitodiplosis mosellana* (Géhin, 1856)**

Orange larvae feed on the developing grains in the ears of *Triticum vulgare* L. (Poaceae). One to five larvae usually develop on one grain, but one larva is able to totally destroy one grain. One generation develops a year. Pupation takes place in the soil. At present it is a minor pest, but in the past it was a serious pest in Germany, England and Sweden (Darvas et al. 2000, Skuhravá et al. 1984). In Norway first reported by Schøyen (1917) and as a pest in 1960 by Fjelddalen (1963).

OCCURRENCE. Mysen, Ås, Stange, Inderøy (Fjelddalen 1963, 1994).

REFERENCES. Barnes (1956), Gagné (1989), Skuhravá et al. (1984b).

DISTRIBUTION. Primarily European, secondarily Holarctic and nearly cosmopolitan.

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

A solitary orange red larva causes an artichoke-shaped gall on the shoots of *Taxus baccata* L. (Taxaceae). It has one-year and two-year developmental life cycles. Usually one larva develops inside a gall where it pupates in the spring of the second year.

OCCURRENCE. Stavanger (Leatherdale 1959).

REFERENCE. Barnes (1951).

DISTRIBUTION. European.

***Wachtliella caricis* (Loew, 1850)**

*Cecidomyia riparia* Winnertz, 1853

*Cecidomyia muricatae* Meade, 1886

A solitary orange coloured larva develops in swollen fruits (utricles) in the inflorescences of *Carex riparia* L. and *C. muricata* L. (Cyperaceae). Pupation takes place in a white cocoon in the gall. One generation develops a year.

REFERENCE. Lagerheim (1893).

DISTRIBUTION. European.

**\**Zeuxidiplosis giardi* (Kieffer, 1896)**

Reddish larvae cause leaf bud galls on *Hypericum perforatum* L. (Hypericaceae). The leaf pair at the vegetative tip or in stem axils forms a globular gall with large chamber inside where one or two larvae develop and pupate. Two generations develop a year. This species is used for biological control of the weed *Hypericum perforatum* in North America, Australia and New Zealand.

OCCURRENCE. NT: Stjørdal (2003).

DISTRIBUTION. European, secondarily cosmopolitan.

## EVALUATION OF RESULTS

### Number of species forming present fauna

At present (2012) the known fauna of gall midges of Norway includes a total of 238 species, of which 119 belong to Cecidomyiinae, 109 species to Lestremiinae (Jaschhof & Jaschhof 2009), four species to Porricondyliinae, viz. *Asynapta strobi* (Kieffer, 1920), *Camptomyia maxima* Mamaev,

Table 1. List of host plants and associated gall midges

host plant species	gall midge species
<i>Achillea millefolium</i>	<i>Macrolabis achilleae</i> <i>Ozrhincus millefolii</i>
<i>Achillea ptarmica</i>	<i>Rhopalomyia ptarmicae</i>
<i>Alnus incana</i>	<i>Dasineura tortilis</i>
Apiaceae	<i>Lasioptera carophila</i>
<i>Arabis alpina</i> , <i>A. hirsuta</i>	<i>Dasineura alpestris</i>
<i>Astragalus alpinus</i>	<i>Dasineura berti</i>
<i>Betula pendula</i>	<i>Anisostephus betulinus</i> <i>Massalongia betulifolia</i> <i>Massalongia rubra</i> <i>Semudobia betulae</i> <i>Semudobia skuhravae</i> <i>Anisostephus betulinus</i> <i>Dasineura fastidiosa</i> <i>Dasineura interbracta</i> <i>Semudobia betulae</i> <i>Resseliella betulicola</i>
<i>Betula pubescens</i>	<i>Dasineura napi</i> <i>Wachtliella caricis</i> <i>Contarinia campanulae</i> <i>Rhopalomyia chrysanthemi</i> <i>Rhopalomyia hypogaea</i> <i>Mycodiplosis saundersi</i> <i>Craneiobia corni</i> <i>Dasineura crataegi</i> <i>Dasineura epilobii</i> <i>Dasineura kiefferiana</i> <i>Hartigiola annulipes</i> <i>Dasineura engstfeldi</i> <i>Dasineura ulmaria</i> <i>Dasineura pustulans</i> <i>Lestodiplosis polypori</i> <i>Contarinia rhamni</i> <i>Dasineura fraxinea</i> <i>Dasineura fraxini</i> <i>Dasineura galiicola</i> <i>Geocrypta gali</i> <i>Contarinia molluginis</i> <i>Geocrypta gali</i> <i>Schizomyia galiorum</i> <i>Dasineura geranii</i> <i>Rondaniola bursaria</i> <i>Contarinia quinquenotata</i> <i>Cystiphora sanguinea</i> <i>Zeuxidiplosis giardi</i> <i>Oligotrophus juniperinus</i> <i>Oligotrophus panteli</i> <i>Jaapiella knautiae</i> <i>Dasineura kellneri</i> <i>Lathronymza schlechtendali</i> <i>Dasineura periclymeni</i> <i>Contarinia loti</i> <i>Jaapiella loticola</i> <i>Dasineura mali</i>
<i>Brassica napus</i>	
<i>Carex riparia</i> , <i>C. muricata</i>	
<i>Campanula rapunculooides</i>	
<i>Chrysanthemum</i> , cultivated	
<i>Chrysanthemum</i> sp.	
<i>Cirsium arvense</i>	
<i>Cornus sanguinea</i>	
<i>Crataegus laevigata</i>	
<i>Epilobium angustifolium</i>	
<i>Fagus sylvatica</i>	
<i>Filipendula ulmaria</i>	
<i>Fomes fomentarius</i>	
<i>Frangula alnus</i>	
<i>Fraxinus excelsior</i>	
<i>Galium boreale</i>	
<i>Galium mollugo</i>	
<i>Geranium</i> sp.	
<i>Glechoma hederacea</i>	
<i>Hemerocallis fulva</i>	
<i>Hieracium murorum</i>	
<i>Hypericum perforatum</i>	
<i>Juniperus communis</i>	
<i>Knautia</i> sp.	
<i>Larix decidua</i>	
<i>Lathyrus linifolius</i>	
<i>Lonicera</i> sp.	
<i>Lotus corniculatus</i>	
<i>Malus sylvestris</i>	

host plant species	gall midge species
<i>Picea abies</i>	<i>Kaltenbachiola strobi</i>
	<i>Lestodiplosis holstei</i>
<i>Pisum sativum</i>	<i>Contarinia pisi</i>
<i>Polyporus</i> sp.	<i>Lestodiplosis polypori</i>
<i>Populus tremula</i>	<i>Contarinia petioli</i>
	<i>Contarinia populi</i>
	<i>Dasineura populeti</i>
	<i>Harmandiola cavernosa</i>
	<i>Harmandiola globuli</i>
	<i>Harmandiola populi</i>
	<i>Harmandiola tremulae</i>
	<i>Lasioptera populnea</i>
<i>Pteridium aquilinum</i>	<i>Dasineura pteridis</i>
<i>Pyrus communis</i>	<i>Contarinia pyrivora</i>
	<i>Dasineura pyri</i>
<i>Quercus robur</i> , <i>Q. petraea</i>	<i>Macrodiplosis pustularis</i>
<i>Quercus petraea</i>	<i>Macrodiplosis roboris</i>
<i>Raphanus raphanistrum</i>	<i>Contarinia nasturtii</i>
<i>Ribes nigrum</i>	<i>Dasineura tetensi</i>
<i>Rosa canina</i>	<i>Dasineura rosae</i>
	<i>Macrolabis luceti</i>
<i>Rosa carelica</i> , <i>R. dumalis</i> , <i>R. majalis</i>	<i>Dasineura rosae</i>
<i>Rubus caesius</i>	<i>Dasineura plicatrix</i>
	<i>Lasioptera rubi</i>
<i>Rubus idaeus</i>	<i>Lasioptera rubi</i>
	<i>Resseliella theobaldi</i>
<i>Salix alba</i>	<i>Rabdophaga iteobia</i>
	<i>Rabdophaga terminalis</i>
<i>Salix aurita</i>	<i>Dasineura auritae</i>
	<i>Iteomyia capreae</i>
	<i>Rabdophaga salicis</i>
	<i>Rabdophaga rosariella</i>
<i>Salix caprea</i>	<i>Iteomyia capreae</i>
	<i>Iteomyia major</i>
	<i>Mycodiplosis melampsoae</i>
	<i>Rabdophaga iteobia</i>
	<i>Rabdophaga rosaria</i>
<i>Salix cinerea</i>	<i>Rabdophaga salicis</i>
	<i>Iteomyia major</i>
	<i>Rabdophaga iteobia</i>
	<i>Rabdophaga rosaria</i>
	<i>Rabdophaga rosariella</i>
<i>Salix fragilis</i>	<i>Rabdophaga salicis</i>
<i>Salix glauca</i>	<i>Rabdophaga terminalis</i>
	<i>Dasineura auritae</i>
	<i>Rabdophaga rosaria</i>
<i>Salix hastata</i>	<i>Macrolabis saliceti</i>
<i>Salix lanata</i>	<i>Rabdophaga salicis</i>
<i>Salix lapponum</i>	<i>Rabdophaga terminalis</i>
	<i>Rabdophaga marginemtorquens</i>
	<i>Rabdophaga salicis</i>
<i>Salix myrsinites</i>	<i>Rabdophaga rosaria</i>
<i>Salix nigricans</i>	<i>Rabdophaga rosaria</i>
<i>Salix physicifolia</i>	<i>Iteomyia capreae</i>
<i>Salix purpurea</i>	<i>Rabdophaga degeerii</i>

Table 1. continued

host plant species	gall midge species
<i>Salix repens</i>	<i>Rabdophaga exsiccans</i> <i>Rabdophaga jaapi</i> <i>Rabdophaga repenticola</i> <i>Rabdophaga schicki</i> <i>Rabdophaga schreiteri</i> <i>Rabdophaga marginemtorquens</i>
<i>Salix viminalis</i>	<i>Dasineura saussureae</i>
<i>Saussureaea alpina</i>	<i>Contarinia steini</i>
<i>Silene pratensis</i>	<i>Dasineura virgaeaureae</i>
<i>Solidago virgaurea</i>	<i>Contarinia sorbi</i>
<i>Sorbus aucuparia</i>	<i>Taxomyia taxi</i>
<i>Taxus baccata</i>	<i>Contarinia tiliarum</i>
<i>Tilia cordata</i>	<i>Dasineura tiliae</i> <i>Physemocecis hartigi</i>
<i>Tilia platyphyllos</i>	<i>Contarinia tiliarum</i> <i>Dasineura tiliae</i> <i>Didymomyia tiliacea</i>
<i>Trifolium pratense</i>	<i>Dasineura leguminicola</i>
<i>Trifolium repens</i>	<i>Dasineura trifolii</i>
<i>Triticum vulgare</i>	<i>Contarinia tritici</i> <i>Mayetiola destructor</i> <i>Sitodiplosis mosellana</i>
<i>Ulmus glabra</i>	<i>Physemocecis ulmi</i>
<i>Urtica dioica</i>	<i>Dasineura urticae</i>
<i>Vaccinium myrtillus</i>	<i>Jaapiella vacciniorum</i>
<i>Vaccinium uliginosum</i>	<i>Contarinia</i> sp. <i>Hygrodiplosis vaccinii</i>
<i>Vaccinium vitis-idaea</i>	<i>Dasineura vitisidaea</i>
<i>Valeriana officinalis</i>	<i>Contarinia crispans</i>
<i>Veronica chamaedrys</i>	<i>Jaapiella veronicae</i>
<i>Vicia cracca</i>	<i>Contarinia craccae</i>
<i>Vicia sepium, V. sativa</i>	<i>Dasineura viciae</i>

1961, *Claspettomomyia niveitarsis* (Zetterstedt, 1850) and *Winnertzia nigripennis* Kieffer, 1896, and six species to unplaced species, viz. *Cecidomyia immunda* Zetterstedt, 1850, *Cecidomyia laeta* Zetterstedt, 1850, *Cecidomyia pallidula* Zetterstedt, 1852, *Cecidomyia palustris* Zetterstedt, 1850, *Cecidomyia rosea* Zetterstedt, 1838 and *Cecidomyia tarseolata* Zetterstedt, 1850.

If we compare these data with data given in 1986 in the *Catalogue of Palaearctic Diptera* (Skuhravá 1986) where Cecidomyiidae of Norway included only 65 species we see that the species number of the family increased in the last 26 years nearly four times (exactly 3.6 times) due to considerable increasing of species number of Lestremiinae found by M. Jaschhof and his wife Catrin mainly in the most northern part of Norway (Jaschhof & Jaschhof 2009) and quite double the number of Cecidomyiinae as a result of our investigations in the surroundings of Harstad in 1995 and in the surroundings of Trondheim in 2003.

The following 46 gall midge species of the subfamily Cecidomyiinae found during our expeditions in 1995 and 2003 are new records for Norway: *Anisostephus betulinus*, *Contarinia campanulae*, *C. craccae*, *C. crispans*, *C. molluginis*, *C. quinquenotata*, *C. sorbi*, *C. steini*, *Contarinia* sp. (*Vaccinium uliginosum*), *Dasineura engstfeldi*, *D. geranii*, *D. kellneri*, *D. kiefferiana*, *D. periclymeni*, *D. populeti*, *D. saussureae*, *D. tortilis*, *D. trifolii*, *D. virgaeaureae*, *D. vitisidaea*,

*Harmandiola populi*, *Hygrodiplosis vaccinii*, *Jaapiella knautiae*, *Jaapiella vacciniorum*, *Lasioptera carophila*, *Macrolabis achilleae*, *Macrolabis luceti*, *Massalongia betulifolia*, *M. rubra*, *Mycodiplosis melampsorae*, *M. saundersi*, *Oligotrophus panteli*, *Ozirhincus millefolii*, *Rabdophaga exsiccans*, *R. iteobia*, *R. jaapi*, *R. repenticola*, *R. rosariella*, *R. schicki*, *R. schreiteri*, *Resseliella betulicola*, *Rhopalomyia hypogaea*, *Schizomyia galiorum*, *Semudobia betulae*, *S. skuhravae*, *Zeuxidiplosis giardi*.

The gall midge fauna in the surroundings of Harstad on the island Hinnøya in northern Norway about 350 km beyond the Arctic Circle where we found galls of 38 species was surprisingly rich. Most galls occurred on plants and low shrubs in biotopes situated not far from the sea. Species number quickly reduced inland and in low forests at Kiruna in northern Sweden (at 67° 51' N) we found the galls of only one species – *Oligotrophus juniperinus* on branches of *Juniperus communis*. The species number of gall midges found at the coast of northern Norway was relatively high owing to the influence of the warm Gulf Stream which supports the development of vegetation. For example, the leaves of *Populus tremula* were conspicuously larger than leaves developing in Central Europe. Rich composition of vegetation and humid and mild climate and weather form favourable conditions for development of gall midges.

Also the gall midge fauna of the surroundings of Trondheim in the central part of Norway was rich. We found there galls of 56 species at ten localities situated from sea level (Stjørdal, Værnes) up to Storlien, 560 m a. s. l. At individual localities 10 to 22 species were found, with the average 14 species per locality. The highest number (22 species) was found at Skatval at a about 70 m a. s. l. The average species number (14 species) found in central Norway corresponds to the average species number found during our investigations in southern England (Skuhravá & Skuhravý 2007) and in Bulgaria (Skuhravá et al. 1991).

### Geographical distribution

The composition of the gall midge fauna of Norway is fundamentally influenced by its geographical position. Norway is one of the most northerly situated countries of Europe and also one of Europe's most mountainous countries with large areas covered by the Scandinavian Mountains. Average elevation is 460 m a. s. l. and about one third of the mainland is located above the tree line.

The gall midge species occurring in Norway may be divided, according to their overall distribution in the world, into four zoogeographic units: European, Euro-Siberian, Euro-Asian or Palaearctic and Holarctic. In addition, species that penetrated into Norway from other continents are designated as alien. Of 119 species of the subfamily Cecidomyiinae, forming the present fauna of Norway, 51% are European, 23% Eurosiberian, 15% Euro-Asian, 8.5% Holarctic and 2.3% alien species.

**European species** occur only in Europe and are considered to have their centres of origin in Europe. In Norway about 60 species (51%) belong in this group: 16 species of *Dasineura*, 7 species of *Rabdophaga*, 6 species of *Contarinia* and species of other genera. Typical representatives of European gall midges are *Hartigiola annulipes* galling leaves of *Fagus sylvatica* and *Taxomyia taxi* causing galls on buds of *Taxus baccata*, *Dasineura fraxinea* and *D. fraxini* causing galls on *Fraxinus excelsior*, *Dasineura kellneri* on *Larix decidua* and *Oligotrophus juniperinus* on *Juniperus communis*.

**Euro-Siberian species** inhabit the Euro-Siberian subregion of the Palaearctic region. They have centres of origin in Europe where they occur usually abundantly and extend at least to Western Siberia, with some of them reaching to Central Siberia and only a few reaching to Eastern Siberia and to the most eastern part of the Palaearctic Region, to the Far East. In Norway 28 species (23%) occur. Typical representatives of Eurosiberian species are *Harmandiola cavernosa*, *H. globuli*,

*H. populi* causing galls on leaves of *Populus tremula*, *Lasioptera rubi* inducing galls on stems of *Rubus idaeus* and its relatives and *Iteomyia capreae* on *Salix caprea*.

**Euro-Asian or Palaearctic species** are species that inhabit Europe or the Euro-Siberian subregion and at least one of the other Palaearctic subregions, i.e. in Central-Asian or East Palaearctic subregions. In Norway 18 species (15%) may be classified as Euro-Asian. *Dasineura saussureae* developing in flower heads of *Saussurea alpina* is a typical representative of this group. Some species evaluated previously as Euro-Siberian have been found during investigations in Armenia (Mirumjan 2011) and in Turkey (Skuhravá et al. 2005) and may be, therefore, designated as Euro-Asian or Palaearctic.

**Holarctic species** occur simultaneously in the Palaearctic and in the Nearctic regions. Ten gall midge species may be sorted into this group. They are associated with host plants, mainly with cereals, fruit trees and fodder crops that occur in both regions. Most of them are primarily of European origin and a number of gall midges were transported accidentally from Europe into North America with their host plants. In Norway 10 species (8.5%) may be classified as Holarctic. *Contarinia pyrivora* and *Dasineura pyri* causing galls on *Pyrus communis*; *Dasineura mali* on *Pyrus malus*; *Dasineura leguminicola* associated with *Trifolium* spp. In some cases it is not quite clear where a particular gall midge species is native and to which part it was introduced. *Contarinia* sp. developing in galls on leaves of *Vaccinium uliginosum* is a typical representative of a really Holarctic species because its host plant is a Holarctic species native to cool temperate regions of the Northern Hemisphere.

**Alien species** (non-native, exotic, non-indigenous, foreign) are species introduced outside their normal distribution. Invasive alien species are alien species whose establishment and spread modifies ecosystems, habitats, or species (DAISIE 2009). In the gall midge fauna of Norway only four alien species (2.5%) occur from a total of 23 alien species of the family Cecidomyiidae known in Europe (Skuhravá et al. 2010): *Contarinia quinquenotata* causing galls on flower buds of *Hemerocallis fulva*, *Rhopalomyia chrysanthemi* inducing galls on leaves, stems, buds or flower-heads of autumn commercial chrysanthemums, and the zoophagous species *Feltiella acarisuga*, which has been introduced to Norway as a biological agent for control of *Tetranychus urticae* Koch in greenhouses (EPPO 2002). *Dasineura kellneri* galls on *Larix decidua* found at Asen near Trondheim, is a European species and in Norway it is evaluated as alien. It occurs here far beyond the natural distribution area of its host plant, *Larix decidua*.

From the **zoogeographical point of view**, very interesting are the findings of all 38 gall midge species in the surroundings of Harstad, about 300 km north from the Arctic Circle, which is the most northern situated known locality of their distribution area in Europe.

Also the occurrence of some other species is very interesting: *Dasineura saussureae* developing in flower heads of *Saussurea alpina* in Norway known to occur only in Sweden and in Kazakhstan; *Dasineura berti* causing galls on leaflets of *Astragalus alpinus* known only from Norway and in the Alps in South Tyrol at the Kuhberg-Hütte, 2330 m a. s. l. (Skuhravá et al. 2002); *Hygrodiplosis vaccinii* and *Contarinia* sp. associated with *Vaccinium uliginosum*, *Jaapiella vacciniorum* with *Vaccinium myrtillus* and *Dasineura vitisidaea* with *Vaccinium vitis-idaea* occurring in Scandinavia and at localities situated at high altitudes in European mountains. All these species support the mutual occurrence in Alpine zones of European mountains and in high latitudes in Scandinavia and may be evaluated as Arctic-Alpine species.

Three European gall midge species associated with broad-leaved trees reach their northern limits of distribution area in southern Norway: *Craneobia corni* causing conspicuous galls on leaves of *Cornus sanguinea* at Oslo, *Hartigiola annulipes* inducing galls on leaves of *Fagus syl-*

*vatica* at Stavenger and *Macrodiplosis pustularis* (*M. dryobia*) causing galls on *Quercus robur* at Kvinnherad. In contrast, gall midges associated with some other broad-leaved trees – *Betula pubescens*, *Sorbus aucuparia*, *Populus tremula* and various species of *Salix*, mainly *Salix repens*, extend along the seaboard up to Harstad in northern Norway.

### Frequency of occurrence

We analysed results and evaluated the frequency of gall midge species of the subfamily Cecidomyiinae occurring in Norway according to the number of findings (i. e. number of localities) at which a particular species was found during our investigations in 1995 and 2003 and included in the evaluation also the findings and records of all earlier researchers. We use the following terms: species occurring very scarcely, scarcely, medium frequently, frequently and very frequently.

In Norway fifty gall midge species (42% of all species found) belong in the first frequency group, to species occurring **very scarcely**. Each of them was found at only one locality. Many of them were recorded in Norway for the first time in the course of our investigations in 1995 and 2003.

Twenty two species (18.5%) occur **scarcely**, each of them was found at only two localities.

Thirty three species (28%) occur **medium frequently**, each of them was found at three, four or five localities.

Ten species (8.5%) occur **frequently**, each of them was found at 6–9 localities. Of them the following species are associated with trees: *Anisostephus betulinus* and *Resseliella betulicola* causing galls on *Betula pubescens*; *Harmandiola globuli*, *H. tremulae* and *Contarinia petioli* causing galls on leaves of *Populus tremula*; *Rabdophaga rosaria* producing large rosette leaf bud galls on various species of *Salix*; *Contarinia pyrivora* damaging fruits of *Pyrus communis*; and on herbaceous plants: *Dasineura viciae* causing leaf galls on *Vicia sepium*, *Dasineura epilobii* inducing flower bud galls on *Epilobium angustifolium* and *Dasineura pustulans* leaf galls on *Filipendula ulmaria*.

The following three species (3%) occur **very frequently**, each of them was found at 10 or more localities: *Dasineura tortilis* causing leaf galls on *Alnus incana*, *Dasineura ulmaria* on leaves of *Filipendula ulmaria*, *Oligotrophus juniperinus* on branches of *Juniperus communis*. *Iteomyia capreae* inducing galls on leaves of *Salix caprea* and other *Salix* species, found at 22 localities, is the most frequent species occurring in Norway. This species is also the most frequent species in the Alps in South Tyrol (Central Europe) where its galls were found at an altitude of 2138 m a. s. l. on Mount Pralongia (Skuhrová et al. 2002, Skuhrová & Skuhrový 2010b).

### Relation to host plants

In Norway 119 species of the subfamily Cecidomyiinae are associated with 87 plant species which belong to 34 plant families (Table 1). About one half of host plant species are trees and shrubs and the other half are herbaceous plants. Most gall midge species are associated with Salicaceae (24 species) and, to a lesser extent, with Rosaceae (13 species). Each of another two plant families – Betulaceae and Fabaceae – hosts 9 species, Asteraceae 8 species, each of three families – Ericaceae, Rubiaceae and Tiliaceae – 4 species, each of four plant families – Brassicaceae, Fagaceae, Pinaceae and Poaceae – 3 gall midge species. Each of the other three families – Cupressaceae, Oleaceae and Onagraceae – hosts 2 species and each of the remaining 19 plant families hosts only one gall midge species.

In Norway *Populus tremula* is the host plant with the highest number of associated gall midge species – it hosts eight species. *Betula pubescens* and *B. pendula* are in the second and third places and host together seven gall midge species. In Norway a high number – fifteen species of *Salix* were recorded as host plants of seventeen gall midge species, some of them causing galls

Table 2. Gall midges injurious to agricultural plants and forest trees in Norway

host plant	gall midge species	injured plant organ
<b>cereals</b>		
<i>Triticum vulgare</i>	<i>Contarinia tritici</i>	inflorescence
<i>Triticum</i> , <i>Secale</i> , <i>Hordeum</i>	<i>Sitodiplosis mosellana</i>	inflorescence
	<i>Mayetiola destructor</i>	stem
<b>vegetable and fodder crops</b>		
<i>Brassica napus</i>	<i>Contarinia nasturtii</i>	flower and leaf bud
<i>Pisum sativum</i>	<i>Contarinia pisi</i>	flower and leaf bud, pod
<b>fruit trees and shrubs</b>		
<i>Malus sylvestris</i>	<i>Dasineura mali</i>	leaf
<i>Pyrus communis</i>	<i>Contarinia pyrivora</i>	fruit
	<i>Dasineura pyri</i>	leaf
<i>Ribes</i>	<i>Dasineura tetensi</i>	leaf bud
<i>Rubus</i>	<i>Lasioptera rubi</i>	stem
	<i>Resseliella theobaldi</i>	stem
<b>ornamental plants and shrubs</b>		
<i>Arabis alpina</i> , <i>A. hirsuta</i>	<i>Dasineura alpestris</i>	leaf bud
<i>Chrysanthemum</i> , cultivated	<i>Rhopalomyia chrysanthemi</i>	galls on leaves, stems
<i>Rosa</i>	<i>Dasineura rosae</i>	folded leaflets
<b>coniferous trees</b>		
<i>Picea abies</i>	<i>Kaltenbachiola strobi</i>	cone
<b>broad-leaved trees</b>		
<i>Fraxinus excelsior</i>	<i>Dasineura fraxinea</i>	leaf
	<i>Dasineura fraxini</i>	leaf
<i>Populus tremula</i>	<i>Contarinia petioli</i>	leaf petiole
	<i>Harmandiola cavernosa</i>	leaf
	<i>Harmandiola tremulae</i>	leaf
<i>Quercus robur</i>	<i>Macrodiplosis pustularis</i>	leaf
	<i>Macrodiplosis roboris</i>	leaf
<i>Salix caprea</i>	<i>Iteomyia capreae</i>	leaf
<i>Salix purpurea</i>	<i>Rabdophaga ramicola</i>	stem
<i>Salix</i> spp.	<i>Rabdophaga rosaria</i>	leaf bud
<i>Tilia cordata</i>	<i>Contarinia tiliarum</i>	
	<i>Dasineura tiliae</i>	leaf
	<i>Didymomyia tiliacea</i>	leaf
	<i>Physemocecis hartigi</i>	leaf
<i>Ulmus glabra</i>	<i>Physemocecis ulmi</i>	leaf

on several related *Salix* species and some associated with only one host species, as there are five gall midge species that are specifically bound to a single host plant species – *Salix repens*.

If we compare the plant-animal relationships of the Norwegian gall midge fauna to comparable relationships of the European gall midge fauna, we see that the Norwegian gall midge fauna differs substantially in its relationships to plant families. While Fabaceae is the plant family in Europe with the highest species number of associated gall midges, in Norway the family Salicaceae is associated with the highest gall midge species number – 24 species (Skuhravá & Skuhravý 2010).

### Economic importance

The gall midges that occur on cultivated plants in fields, in gardens and fruit orchards and in forests in Norway do not have such importance as they have in central and southern Europe. Usually the

occurrence of them is not so high and their importance cannot be compared with the same gall midge species in other parts of Europe where they sometimes occur as serious pests.

Larvae of gall midges may develop in flower and leaf buds, stems, leaves, fruits and pods or other organs of host plants that are important in agriculture and in forestry. The importance of some gall midge species can fluctuate over the years from minimal up to outbreak.

During the 20th century about 30 gall midge species were reported as pests of agricultural plants and forest trees in Norway (Table 2). Some of them occurred abruptly in the past and caused harm to their host plant for a short time and then their importance decreased to a minimum. The importance of other gall midges injurious to agricultural crops decreased but their larvae may remain hidden in the soil in fields and it is necessary to be watchful. It is necessary to evaluate all these species as potential pests mainly in agriculture.

### **Possibilities of finding additional gall midge species in Norway**

The gall midge fauna of Norway is not adequately known and only a few investigations have been made in this large and interesting area. Many gall midge species are await discovery by future researchers. It will be useful to search for gall midge galls in various biotopes. Several researchers investigated galls in the southern parts of Norway but large areas in central and northern parts remain quite unexplored. If we compare the present state of knowledge of gall midges of the subfamily Cecidomyiinae in Norway (119 species) with species number of this subfamily known in Sweden (266 species) it is clear that it is necessary to do very much to improve the level of knowledge of gall midges in Norway. The authors would be very happy if this article will attract the attention of entomologists to this interesting group of insects.

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