INTRODUCTION

My husband, Václav, and I intended to write this book for many years. We have extensively discussed its content and what should be included. We were aware of the immense amount of work which still needs to be done in the coming years. However, we felt that it is necessary first, and above all, to publish all the results of our investigations in Europe which we have done and then to start summarizing the results in a book, this book. For sixty-two years we have investigated the occurrence and distribution of gall midges and their galls in 31 countries of Europe, in Siberia and in 14 islands in the Mediterranean Sea, as well as in the Faroe Islands in the North Atlantic Ocean. Unfortunately, Václav passed away two years ago and therefore the writing of the publication fell to me. While I, Marcela, am doing the writing, Václav is, most definitely, a co-author.

Gall midges are small flies, minute to medium-sized (0.5–3.0 mm), rarely 8 mm, very fine with holoptic eyes in both sexes. The antennae with 6 to 40, usually 12 or 14, flagellomeres are covered with microtrichia or whorls of long setae or circumfila or sensoria. Wing veins are reduced in number; usually only three or four long veins are present. Legs are usually long, the first tarsomere (metatarsus) being much shorter than the second tarsomere. Tibial spurs are absent. The larvae have a sclerotized organ - spatula sternalis - on the ventral side of the prothoracic segment which is unique to the family and important for the identification at the species level. The larvae are phytophagous, mycophagous, saprophagous, zoophagous or xylophagous. Many phytophagous larvae are gall makers, inducing galls on various plants (in Latin: cecidium, hence the name of the family), whilst some live freely in the 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 and therefore, some of them are also used in the biological control of pests. Mycophagous and saprophaguos larvae are associated with fungi. The life span of adults is very short, mostly only few hours and five days at the maximum.

Gall midges forming the family Cecidomyiidae are in the biological kingdom of Animalia and are divided into three subfamilies: Lestremiinae, Porricondylinae and Cecidomyiinae (Gagné, Jaschhof 2017). Only the members of the subfamily Cecidomyiinae are able to initiate the development of galls on host plants. The members of the other two subfamilies are associated with mildews and rusts and decaying plant tissues during their development.

Gall midges are a large family of the order Diptera which presently contains numbers 6590 described species and 812 genera (Gagné & Jaschhof 2017). About 3200 species occur in the Palaearctic Region and 1800 in Europe (Skuhravá 2005a, Skuhravá 2006, Skuhravá & Skuhravý 2010). Gall midges are the most abundant group of gall-inducing animals in Europe. Houard (1908–1909) included 6239 galls that are induced by 1450 species of animals belonging to various taxonomical groups in his two-volume book on plant galls of Europe and the Mediterranean. Gall midges (Diptera: Cecidomyiidae) with their 420 species are the richest group of all gall-inducing animals – representing 29 % of all gall midge species. Buhr (1964–1965) recorded gall midges as the richest Diptera group, including 580 species, i.e. 36% of all insect species inducing galls in his "*Identification Key for Galls on*

the Plants of Central and Northern Europe". Kolomoets et al. (1989) recorded 328 gall--inducing species of Diptera associated with plants in the European part of the USSR. Of those, 301 species (92%) belong to Cecidomyiidae and 25 species to another six dipteran families. In Japan, situated in the Eastern Palaearctic, the gall midges with 628 species (44%) are the largest group of gall-inducing arthropods (Yukawa & Masuda 1996) including both described and undescribed species. Of those, only 176 species are described species.

Europe is one of seven continents of the earth. It is the northwestern part of the Eurasia. It occupies an area of 9.97 million square kilometers. The highest point is Mont Blanc, 4810 m, a. s. l. in the Alps. In the north, Europe is bounded by the Arctic Ocean, in the west by the Atlantic Ocean; in the east, the boundary between Europe and Asia is formed by the Ural Mountains, the Caspian Sea, the Greater Caucasus, the Black Sea, the Turkish Strait and the Aegean Sea. In the south, Europe is separated by the Mediterranean Sea from Africa. According to Wikipedia there are fifty seven countries in Europe. Five countries - Turkey, Russia, Kazakhstan, Georgia and Azerbaijan - belong to the transcontinental countries: each of them has territory on two continents, one part into Europe, the other part to Asia. The climate of Europe is largely influenced by warm Atlantic currents which temper winters and summers on most of the continent, even at latitudes in which the climate in Asia and North America is more severe.

The geographic boundaries of Europe for the project *Fauna Europaea* are defined as follows: European mainland plus the Macaronesian islands, i.e. Azores, Madeira and Canary Islands (excluding the Cape Verde Islands), Cyprus, Franz Josef Land and Novaya Zemlya, Western Kazakhstan is excluded.

The most prevalent vegetation in Europe is forest. In temperate Europe, mixed forests with both broadleaved and coniferous trees dominate. The most common species in central and western Europe are broadleaved trees of *Fagus sylvatica, Quercus robur* and *Q. petraea*. In the North, the taiga is a mixed forest with dominant trees of *Picea abies, Pinus sylvestris* and *Betula* spp.; the taiga transitions to tundra farther north within Russia and extreme northern Scandinavia. In the Mediterranean areas the dominant tree is *Olea europaea* which is well-adapted to drier climates. In the semi-arid Mediterranean region scrub forests occur. A narrow east-west oriented strip of Eurasian grassland, the steppe, extends westward from Ukraine and southern Russia to Hungary. In Europe the animals and plants have been substantially affected by the presence and activities of man since ancient times. With the exception of northern Scandinavia and northern Russia, few areas of untouched wilderness can be found, except for various national parks in other regions. Long ago, most (about 90%) of Europe was covered with forests. They extended from the Mediterranean to the Arctic Ocean. Unfortunately, about half of these forests were lost due to deforestation through the centuries.

The Southern parts of Europe, forming a zoogeographic subunit called the Mediterranean sub-region partly borders on the Mediterranean Sea and also includes the northern part of Africa and part of western Asia. The climate of this area is mild; winters there are rainy and summers are hot and dry. The landscape is covered with forests, woodlands and scrub shrubs. This area is one of the world's most endangered biogeographic regions. Only about 4% of the original vegetation still remains. Man and his impact, including overgrazing, deforestation and conversion of lands for pasture, agriculture, and urbanization, have degraded much of the flora in this region. Formerly, this area was mostly covered with forests

and woodlands but extensive human activity has changed much of the region to sclerophyll shrub lands known as chaparral, matorral, maquis and garrigue.

At present, 57 countries of various sizes constitute Europe. Of them, the European part of Russia is the largest both in area and population. The level of knowledge about the galls on plants and about gall-inducing organisms is very uneven in Europe. Some countries have a long tradition and many researchers contributed to the body of knowledge which resulted in the high number of species of the family Cecidomyiidae – Europe being the most explored area of the world.

The Latin name of this interesting group of small flies – Cecidomyiidae – is derived from the ability of larvae to initiate the formation of galls. The gall (in Latin „cecidium") is defined as any deviation from the normal pattern of the plant growth induced by a specific reaction to the presence and activity of a foreign organism (animal or plant) (Bloch, 1965). Cecidology is the interdisciplinary scientific discipline at the border between botany and zoology, aimed at the study of plant galls at all levels. The galls caused by the animals are called zoocecidia and animals causing galls are cecidozoa; the galls caused by plants are phytocecidia and such plants are called cecidophyta. The ability of organisms to induce galls on plants has evolved independently many times during the evolution of insects as well as other groups (Roskam, 1992).

At the beginning of the 20th century one thousand and five hundred gall-inducing animals were known in Europe, associated with about four thousand host plants (Houard, 1908–1909). Cecidology quickly developed and about three thousand gall-causing and associated organisms were known to occur in Central and Northern Europe (Buhr, 1964–1965) in the second half of the 20th century. They belong to various groups of organisms: about one--third to bacteria and fungi, two-thirds to animals. Three groups of animals are the species causing galls on various plants most frequently: the gall midges (Cecidomyiidae, Diptera) with about 600 species, eriophyid mites (Eriophyoidea, Acarina) with about 350 species and aphids (Aphidoidea, Hemiptera) with about 370 species. Since that time many new species of gall-causing organisms have been discovered and described and thus the number of species is much higher now.

The knowledge of galls has a long history. The famous Italian physician and researcher Marcello Malpighi (1628–1694), the founder of microscopy anatomy, is also considered to be the founder of cecidology. In 1679 he published the comprehensive work „Anatomes Plantarum", in which he included the chapter called „De Gallis"(in English: About galls). This chapter is the first scientific approach to the study of galls on plants and, therefore, Malpighi is recognized as a father of cecidology. Redfern et al. (2008) translated this fundamental work on galls from Latin into English.

The literature on galls is very extensive. Houard (1908–1909) gave a rich bibliography including about 1000 references, Mani (1964) included 1300 references that referred to the problem of galls in his comprehensive book „The ecology of plant galls"; Buhr (1964–1965) in his two-volume book provided 2700 references with the identification key to the plant galls. Useful data on biology and ecology of gall causing organisms can also be found in books published by Ananthakrishnan (1984), Shorthouse and Rohfritsch (1992), Dauphin and Aniotsbehere (1993), Redfern et al. (2002), Raman et al. (2005), Ozaki et al. (2006) and Roskam (2019).

METHODS

During our faunistic investigations we used the time and area unit collection method at each locality. This involved the surveying of each locality visually by walking slowly through the area over a period of one to three hours. Two persons walked through the various biotopes and searched for gall midge galls and collected them on herbs, shrubs and trees as well as visually examining buds, leaves, flowers, fruits and stems of herbaceous plants, shrubs and trees. The altitude and short characteristics of biotopes were noted. All findings were recorded, including notes about the local abundance of species. Each locality was investigated only once. During the excursion, several specimens of each host plant with galls were put into separate, small, plastic bags. All species that were found were recorded in the protocol. Several specimens of each host plant with galls were observed as herbarium items; several plants with galls were kept in plastic bags to obtain living mature larvae; several parts of plants with galls were placed in small emergence cages to obtain adults and finally several galls with larvae were put into vials containing 75% alcohol for identification and future morphological studies.

All data obtained during our investigations of gall midge faunas were compared with the data of earlier authors and evaluated and analyzed from two points of view: from the geographic and from the zoological. From the geographic point of view, the horizontal occurrence was analyzed as various species numbers (absolute species numbers found) and also by the average species numbers in countries of Europe; or by the numbers of species related to the area unit of 100 km^2. The vertical occurrence was calculated as the average species numbers in the respective altitudinal zones. From the zoological point of view, it was possible to elaborate the characterization of a particular species as the zoogeographic diagnosis and elaborate maps of the distribution areas of a particular species which then may be compared with the distribution areas of pertinent host plant species.

The most distant localities in Europe where we searched for the gall midges were Faroe Islands in the Atlantic Ocean situated between latitude 61^0 20´N and 62^0 24´N and longitude 6^0 15´W and 7^0 41´ W. In continental Europe the most northern locality was Harstadt in northern Norway; the most southern locality was the island of Cyprus which is a so-called transcontinental country: the northern part of this island belongs to Europe, the southern part to Asia. In addition, we investigated gall midges on two other islands, Crete and Malta, situated in the Mediterranean Sea. The most western locality of our investigations was near the village Ripley in Surrey County in England. The most eastern locality was in Georgia which is another so-called transcontinental country: the boundary between Europe and Asia run through this country. In addition, we obtained useful data on the distribution of European gall midges during our research journey to Russia, which extended up to the southern part of Central Siberia - starting from the city of Krasnojarsk and continuing up to the Sayan Mountains (Skuhravá, Skuhravý 1993).

During the expedition, it was necessary to write all the data and related information into the expedition book in the evening of each day and to process all the host plants with galls which were collected during the excursion. One part of the host plants with galls was put between papers as herbarium items for further identification, the other part was put into the vials containing 75% ethanol and the remaining part was put into the rearing cages for

rearing the adults. In all of our articles in which we presented the results of the investigations in the pertinent country, we always considered the investigations made earlier by local researchers, to present a picture and summary of the investigations of gall midge fauna for that country as completely and accurately as possible.

The differences in the occurrence and the distribution of gall midge species in various countries of Europe are influenced by several factors, above all by the intensity of scientific research, by the diversity of plants and plant communities, and also by geographical position and altitude (Skuhravá, Skuhravý 1994).

Gall midges occurring in Europe are classified into seven zoogeographical types based on geographic distribution:

1. The European species which have their centers of distribution in Europe.
2. The Euro-Siberian species occurring abundantly in Europe and extending at least to Western Siberia; some species may reach the Far East.
3. The Euro-Asian species occurring in Europe, reaching to the Mediterranean Sea and western Asia, Turkey, Armenia and Kazakhstan.
4. The Mediterranean and Sub-Mediterranean species: the south-European species occurring mainly around the Mediterranean Sea and (or) associated with the species of host plants whose centers of origin are in the Mediterranean area.
5. The holarctic species: some of them are primarily European or Euro-Siberian, according to their origin, but they occur secondarily in the Nearctic Region; usually they were transferred or introduced into the Nearctic Region.
6. The cosmopolitan species: originally distributed in the Palearctic region but introduced into many parts of the world.
7. The alien species: non-native to Europe; they were introduced to Europe probably with plant seedlings or seeds from other parts of the world.

In this publication we included also the results of the identifications of gall midges which were sent to me from various countries of Europe in the context of the ecological studies. These materials included gall midges obtained by various collecting methods: pitfall traps, Moericke color traps and light traps of various types. Unfortunately, the small gall midge adults were usually heavily damaged in these samples and the identification of such material was very difficult and in many cases impossible. On the other hand, there were some species identified which would not have been discovered by any other method.

We also included the data on fossil gall midges. Not too much is known about them. Evenhuis (1994) reported on 78 species of gall midges in his „*Catalogue of the Fossil Flies of the world* ", the remnants of which were discovered in the geologic periods - Pleistocene, Oligocene, and Miocene in the Baltic amber in the Baltic Region. These adults belonged mainly to the mycophagous gall midges of the subfamilies Lestremiinae and Porricondylinae. Evenhuis found only one phytophagous species – *Mikiola fagi* – the remnants of which were found in France and are dated to the Pliocene period. Möhn (1960) described the remnants of fossil larvae and pupae of the gall midge *Sequoiomyia kraeuseli* which were discovered in Pliocene coal in Rheinland, Germany. Diéguez, Nieves-Aldrey, Barrón (1996) reported on the occurrence of the remnants of two gall midge species – *Mikiola pontensis* on *Fagus pristina* and *Contarinia* spp. on *Quercus drymeja* from the Upper Miocene sub--epoch and found in the La Cerdaña region of Spain.

Gall midges and their galls occur in Europe from the sea up to the mountains just as they do on other continents. There are nine phytogeographical zones of distribution based on the

altitude: planar, colline, sub-montane, montane, boreal, sub-alpine, alpine, sub-nivale, and nivale. The highest zone where galls of *Rhopalomyia luetkemuelleri* on *Artemisia spicata* and galls of *Jaapiella alpina* on *Silene acaulis* were found was the subnivale zone in the Alps at the altitudes of 2700 m a. s. l. (Skuhravá and Skuhravý 2010).

We summarized knowledge of gall midges in the countries and islands of Europe, and also of adjacent countries and islands, from various points of view, including:
- a review of the history of research,
- the contributions of earlier researchers to the progress of studies,
- the biology, zoogeography, and relationship of gall midges to host plants,
- the economic importance of gall midges.

The review of the summarizing articles is given in the Table 1.

We published surveys on the following countries: Slovak Republic (Skuhravá 1991), Czech Republic (Skuhravá 1994a, 1994b), Greece (Skuhravá, Skuhravý 1997), France (Skuhravá et al. 2005), Denmark (Skuhravá et al. 2006), Iberian Peninsula (Skuhravá et al. 2006), Poland (Skuhravá et al. 2008), Austria (Skuhravá, Skuhravý 2009), Norway (Skuhravá, Skuhravý 2012), Germany (Skuhravá et al. 2014), Greece (Skuhravá, Skuhravý 2016), Belarus (Skuhravá et al. 2017), Egypt (Skuhravá et al. 2014), Iran (Skuhravá et al. 2014), Morocco (Skuhravá et al. 2017) and Algeria (Skuhravá et al. 2018).

Table 1 The countries and islands of Europe (see the note following the table) and the number of gall midge species found there

Country	Number of species	References
Andorra	30	Skuhravá, Blasco-Zumeta, Pujade-Villar 2002
Albania	11	Skuhravá 1986
Austria	396	Skuhravá, Skuhravý 2009
Azores (Portugal)		without data
Belarus	73	Skuhravá, Skuhravý, Carbonelle 2017
Belgium	251	Roskam, 2015
Bosnia, Herzegovina	169	Simova-Tošič, Skuhravá, Skuhravý 2007
Bulgaria	240	Skuhravá, Skuhravý, Dončev, Dimitrovov 1991
Canary Islands (Spain)	3	Skuhravá, Blasco-Zumeta, Pujade 2002
Corfu (Greece)	49	Skuhravá, Skuhravý 2006
Corsica (France)	60	Skuhravá, Skuhravý 2011
Crete (Greece)	38	Skuhravá, Skuhravý 1997
Croatia	232	Simova-Tošič, Skuhravá, Skuhravý 2004
Cyprus	32	Skuhravá, Skuhravý 2004
Czech Republic	590	Skuhravá 1994, 2006
Denmark	307	Skuhravá, Skuhravý, Jörgensen 2006, Haarder, Bruun, Harris, Skuhravá 2016

Estonia	93	Spungis, Jaschhof 2000
Faroe Islands (Denmark)	5	Skuhravá, Skuhravý 2009
Finland	356	Jaschhof, Skuhravá, Penttinen 2014
France	668	Skuhravá, Skuhravý, Dauphin, Coutin 2005
Germany	686	Skuhravá, Skuhravý, Meyer 2014
Greece	211	Skuhravá, Skuhravý 1997, Skuhravá, Skuhravý 2016
Hungary	332	Skuhravá, Skuhravý 1999
Iceland (Denmark)		without data
Ireland	87	Chandler 2008
Italy	508	Skuhravá, Skuhravý 1995 (324 species) Skuhravá, Skuhravý 2010 (South Tyrol) (311 species)
Latvia	506	Spungis 2002, 2003, Spungis, Jaschhof 2000
Liechtenstein	65	Skuhravá, Skuhravý 1993
Lithuania	224	Pakalniškis et al. 2000, Spungis, Jaschhof 2000
Luxembourg	96	Roskam, Carbonelle 2015
Macedonia	148	Simova-Tošič, Skuhravá, Skuhravý, Pstolovski 2007
Madeira (Portugal)	18	Skuhravá 2008
Mallorca (Spain)	33	Skuhravá, Skuhravý 2004
Montenegro	85	Simova-Tošič, Skuhravá 2001
Malta	36	Skuhravá, Skuhravý, Ebejer 2002
Moldova	2	Gagné, Jaschhof 2017
Netherlands	356	Roskam, Carbonelle 2015
Norway	170	Skuhravá, Skuhravý 2012
Poland	463	Skuhravá, Skuhravý, Skrzypezynska, Szadziewski 2008
Portugal	122	Skuhravá et al. 1996, 2002, 2006
Romania	315	Skuhravá, Skuhravý, Neacsu 1972
Russia	797	Skuhravá, Skuhravý (in preparation)
Samos (Greece)	34	Skuhravá, Skuhravý 2006
Sardinia (Italy)	44	Skuhravá, Skuhravý 2002

Serbia	283	Simova-Tošič et al. 2000
Sicily (Italy)	89	Skuhravá, Skuhravý, Massa 2007
Slovakia	362	Skuhravá 1991, 2006
Slovenia	219	Simova-Tošič, Skuhravá, Skuhravý 1996
Spain	261	Skuhravá et al. 1996, 2002, 2006, Sánchez et al. 2012
Sweden	662	Skuhravá, Skuhravý (in preparation)
Switzerland	237 (255)	Skuhravá, Skuhravý 1997; Skuhravá, Jaschhof, Roskam 2020
Turkey	70	Skuhravá, Skuhravý, Dauphin, Coutin 2005,
Ukraine	294	Skuhravá, Skuhravý (in preparation)
United Kingdom (GB)	650	Harris 1976, Chandler 1998, Chandler 2018

Note: The list of countries was compiled according to the Fauna Europaea (2004) where 50 countries plus islands are given. Five countries – Turkey, Russia, Kazakhstan, Georgia and Azerbaijan – belong to the so--called transcontinental countries: each of them falls into two continents, one part to Europe, the other part to Asia. Islands belonging to Europe are here considered to be the independent geographical units although some of them are parts of continental countries.

In addition, we included results of investigations done outside Europe, where European gall midges have also their distribution, i. e. 123 species were found in Georgia (Skuhravá et al. 2013), 48 species in Egypt (Skuhravá et al. 2014), 61 species in Iran (Skuhravá et al. 2014), 61 species in Morocco (Skuhravá et al. 2017), 95 species in Algeria (Skuhravá et al. 2018) and 96 species in Armenia (Mirumjan 2011).

The faunal investigations carried out in a defined area with the use of unified methods provide data on the quantitative composition of the fauna of this area, as well as on the frequency of the various species. These data can be plotted in maps showing the ranges of the occurrence and the distribution of species, to estimate the ecological tolerance of species by analyzing its presence in various altitudinal zones, to define its pertinence to the altitudinal zones, and to define a zoogeographical characteristic of the species.

The aim of our publication is to summarize the information and data on gall midges in Europe as completely as currently possible. The fauna of gall midges inhabiting the large area of Europe has changed over the years. Some species have stable populations but the populations of many species have transitioned – the number of specimens in a population diminishes and such populations gradually die and disappear.

The fauna of the family Cecidomyiidae in the Czech Republic with its 525 species can be considered as the best explored fauna in Europe. It comprises both phytophagous as well as zoophagous and mycophagous species. Most of the phytophagous gall midges include species, whose larvae induce the development of galls (cecidia) on plants. Adult gall midges usually live very shortly, sometimes several hours only, sometimes one to four days. In contrast, the galls produced by their larvae on different organs of host plants can be found from spring to autumn, and the galls of species developing in branches of trees and shrubs can be found during the entire winter. Galls have characteristic shapes; thus the species

References: Harris 2008, Skuhravá 2009.

Acer platanoides

» ***Acumyia acericola*** Harris, 2008

Larvae develop in the malformed fruits and prevent the seed development of *Acer platanoides*. The life cycle lasts two years. Larvae lay in fruits in leaf litter and soil.
Distribution: UK, Czech Republic; Japan.
References: Harris 2008, Skuhravá 2009.

Acer pseudoplatanus

» ***Acericecis vitrina*** (Kieffer, 1909)

(*Dasineuea vitrina* Kieffer, 1909; *Harrisomyia vitrina* Kieffer, 1909)

This species was originally described very briefly by Kieffer (1909) under the name *Perrisia vitrina*. Later this species was placed in the genus *Dasyneura,* then in the genus *Harrisomyia* and at the end in the genus *Acericecis*.

A solitary larva causes a small pustule gall on the leaf of *Acer pseudoplatanus* of about 2 mm in diameter on the leaf vein. Larvae live inside these small galls. Heavily attacked leaves dry up and fall off trees prematurely. The restriction of the assimilation surface of leaves results in the reduced yields of maple wood. It is the forest pest.
Life history: Adults fly in May. Females after mating lay eggs on the lower surfaces of the young leaves, mostly along the main veins. One female has about 100 eggs in the abdomen. Larvae leave eggs, penetrate plant tissue and feed sucking liquids. Attacked plant tissues become swollen. Only one larva lives inside the gall. The development from egg to full--grown larva lasts about six weeks. The full-grown larva pierces a hole on one side of the gall, drops to the soil, spins a cocoon and overwinters in the soil until the following spring. The empty gall and the adjacent plant tissue of the leaf, an area up to 6 mm in diameter, becomes dry and attacked places are visible as lightly brown spots on the leaf.
Distribution: *Acericecis vitrina* is European species (Plate 8, Figure 49).
It is the forest pest.

The galls of *Acericecis vitrina* were registered in the following countries: Sweden, France, Germany, Switzerland, Austria, Czech Republic, Slovakia, Hungary, Yugoslavia, Greece, Bulgaria, Italy (South Tyrol); Sicily.
References: Barnes 1951, Dauphin, Aniotsbehere 1993, Kolomoets et al. 1989, Skuhravá, Skuhravý 1960, Skuhravá, Skuhravý 1963, Skuhravá, Skuhravý 1973, Skuhravá, Skuhravý, Brewer 1984, Skuhravá 1986, Skuhravá, Skuhravý 1986, Skuhravá 1987, Skuhravá 1991, Skuhravá 1994, Skuhravá, Skuhravý 1992, Skuhravá 1994, Skuhravá, Skuhravý 1998, Skuhravá, Skuhravý 1999, Skuhravá, Roques 2000, Skuhravá, Skuhravý, Dauphin, Coutin 2005, Skuhravá, Skuhravý, Skrzypczynska, Szadziewski 2008, Skuhravá, Skuhravý 2009, Skuhravá, Skuhravý 2010, Skuhravá, Skuhravý, Meyer 2014.

» *Contarinia acerplicans* (Kieffer, 1889)

Several white larvae cause galls on leaves of *Acer pseudoplatanus*. The leaf is folded, thickened, red coloured, with opening on the underside. Only one generation develops per year. Larvae hibernate in the soil.
Distribution: UK, Sweden, Denmark, Netherlands, Belgium, Luxemburg, France, Germany, Czech Republic, Poland, Hungary, Austria, Romania, Ukraine, Italy (South Tyrol), Greece; Algeria.
References: Barnes 1951, Chandler 1998, Kolomoets et al. 1989, Mamaev, Krivosheina 1993, Redfern, Shirley 2002, Roskam, Carbonelle 2015, Rübsaamen-Hedicke 1926–1939, Skuhravá, Skuhravý 1960, Skuhravá, Skuhravý 1963, Skuhravá, Skuhravý, Neacsu 1972, Skuhravá, Skuhravý 1973, Skuhravá, Skuhravý 1992, Skuhravá, Skuhravý 2009, Skuhravá, Skuhravý, Dauphin, Coutin 2005, Skuhravá, Skuhravý, Skrzypczynska, Szadziewski 2008, Skuhravá, Skuhravý 2010, Skuhravá, Skuhravý, Meyer 2014, Skuhravá, Skuhravý 2016, Skuhravá, Skuhravý, Salemkour, Tahar Chaouche 2018, Skrzypczynska, Kowalski 2016.

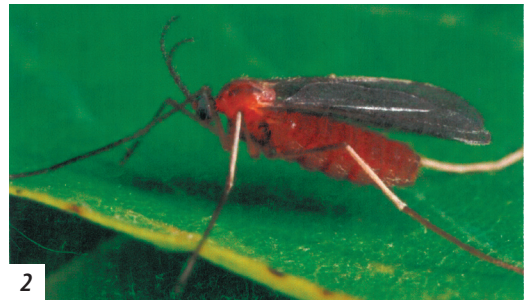
» *Dasineura irregularis (Bremi, 1847)*

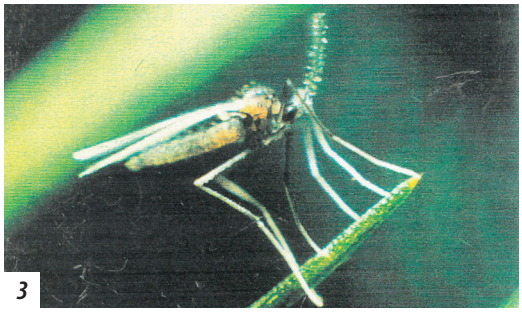
Synonym: *Dasineura acercrispans* (Kieffer, 1988)
Several white larvae cause galls on the leaves of *Acer pseudoplatanus*. The leaf is wrinkled, curled and rolled upwards, veins are hypertrophied and slightly swollen. It is the forest pest.

Two generations develop a year. Adults fly at the time of leaf extension of maples. Females lay their eggs on leaf blades and veins. Hatched larvae feed on leaves and veins. Larvae quickly grow, leave the gall after several weeks and fall to the soil where they pupate. After several days the adults of the summer generation fly and females search for suitable young leaves for egg-lying. Larvae of this generation remain in the soil where they overwinter.
Distribution: It is European species with a large distribution area spreading from Denmark in the north to northern Italy, the former Yugoslavia and Bulgaria near the Black Sea. Locally and occasionally it may be a major pest, mainly if it attacks young maple trees in forest nurseries or young maple trees grown in hedges. The galls were registered in the following countries: UK, France, Denmark, Belgium, Lucemburg, Switzerland, Netherlands, Germany, Czech Republic, Slovakia, Austria, Italy (South Tyrol), Poland, Latvia, Hungary, Romania, Ukraine, Yugoslavia, Bulgaria. This species reaches up to Georgia, Armenia and Iran.
References: Dauphin, Aniotsbehere 1993, Chandler 1998, Kolomoets et al. 1989, Lambinon, Carbonelle, Claerebout 2015, Mamaev, Krivosheina 1993, Mirumjan 2011, Redfern, Shirley 2002, Roskam, Carbonelle 2015, Simova-Tosic 2014, Skrzypczynska, Kowalski 2016, Skuhravá, Skuhravý 1960, Skuhravá, Skuhravý 1963, Skuhravá, Skuhravý 1973, Skuhravá, Skuhravý 1972, Skuhravá 1989, Skuhravá, Skuhravý 1992, Skuhravá, Skuhravý, Skrypczynska, Szadziewski 2008, Skuhravá, Skuhravý 2009, Skuhravá, Skuhravý 2010, Skuhravá, Roques 2000, Skuhravá, Skuhravý, Dauphin, Coutin 2005, Skuhravá, Skuhravý, Skrzypczynska, Szadziewski 2008, Skuhravá, Skuhravý, Meyer 2014, Skuhravá, Karimpour, Sadeghi, Ali Gol, Joghtaie 2014.

» *Drisina glutinosa* Giard, 1893

Synonym: *Massalongia aceris* (Rübsaamen, 1921)
A solitary white larva develops in a liquid in a small depression in the lower surface of the leaf. It is a forest pest, in Central Europe a major pest of *A. pseudoplatanus*. Only one generation develops per year. Adults emerge in the spring at the time when leaf buds of maple





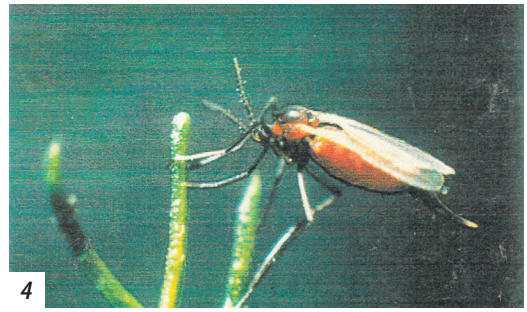


PLATE 1. ADULTS OF GALL MIDGES. **1.** Female of *Contarinia pyrivora* sitting on the flower bud of Pyrus communis as she is laying eggs (photo by Remi Coutin). **2.** Female of *Obolodiplosis robiniae* sitting on the leaf of *Robinia pseudo-acacia*. (photo by G. Csóka). **3.** Male of *Rhopalomyia tripleurospermi* (photo by H. Hinz). **4.** Female of *Rhopalomyia tripleurospermi* (photo by H. Hinz). **5.** A group of researchers examining the stems of wheatand searching for galls of *Haplodiplosis marginata*. From the left: Václav Skuhravý, Marcela Skuhravá, a technician, and Jaroslav Mentberger. **6.** A field lecture: Václav Skuhravý informs the leaders of plant protection committee presenting the results of experiments with new chemicals for protecting plants against the saddle gall midge, *Haplodiplosis marginata*. **7.** Václav Skuhravý installing a nylon cloth (isolator) on a Pinus shrub for the planned experiments. **8.** A field laboratory with soil samples placed in black isolators; each of which has a small opening connected to a flask containing water. Adults emerging in the dark search for the light and are caught in the water in which several drops of detergent are instilled.

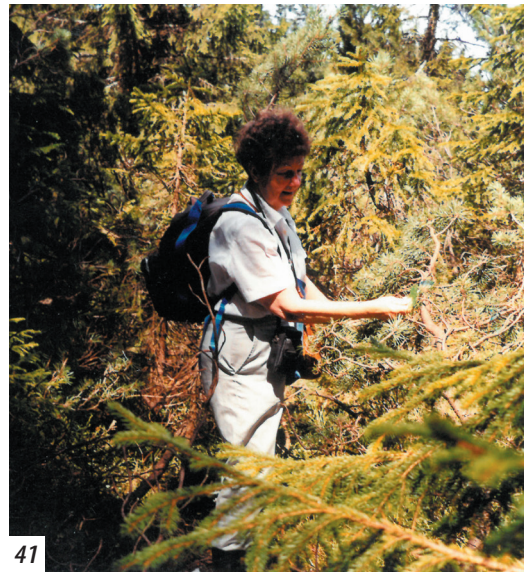


PLATE 6. CZECH REPUBLIC. THE LOCALITIES WHERE MARCELA AND VÁCLAV SKUHRAVÝ INVESTIGATED THE OCCURENCE OF GALL MIDGES WERE MAINLY IN THE AREAS WHERE THE *CODIPLOSIS BRACHYNTERA* IS FOUND. *THECODIPLOSIS BRACHYNTERA* BECAME A VERY SERIOUS PEST IN PINE FORESTS IN THE SECOND PART OF THE 20TH CENTURY. 34. Krkonoše Mts., mount Zlaté Návrší, 1411 m a. s. l. In September 2003, the shrubs of *Pinus mugo* were heavily attacked by the gall midge *Thecodiplosis brachyntera*. **35.** Krkonoše Mts., the same locality. The detail of shrubs of *Pinus mugo* with unattacked, green-coloured shoots (on the left) and dry brownish-coloured, shortened needles heavily damaged by the gall midge *Thecodiplosis brachyntera* (in May 1967). **36.** South Bohemia. Václav examining the attacked parts of pine shrubs in the forest near the town of Třeboň (May 1971). **37.** The peat bog „Pod Lipkou", situated on the boundary between the Czech Republic and Germany, with the warning sign: „Achtung, Staatsgrenze". At that time it was not possible to move freely in that area. Václav is shown collecting samples of branches attacked by *Thecodiplosis brachyntera*; he was accompanied by a soldier, a member of the Army of the State Boundary Protection (April 1981). **38.** A small lake in the central part of the Blatenská slať (Blatná Moor) near the village of Modrava in South Bohemia where pine shrubs were heavily attacked by *Thecodiplosis brachyntera* (March 1991). **39.** Václav in the central part of the peatbog, Radostínské rašeliniště, near the town of Žďár nad Sázavou where he collected pine samples for determining the degree of infestation (May 1991). **40.** A group of dry and dead shrubs in the peatbog, Chalupská slať in the Šumava National Park, near the village of Borová Lada. Among the dead branches, there are small, young pines beginning to grow, contributing to the restoration of the forest (May 1991). **41.** Marcela examining pine shrubs in the heavily damaged forest near the town of Třeboň in South Bohemia (April 1990).

PLATE 9. Distribution of gall midges in europe

Fig. 54: Distribution of *Oligotrophus juniperinus* on *Juniperus communis*

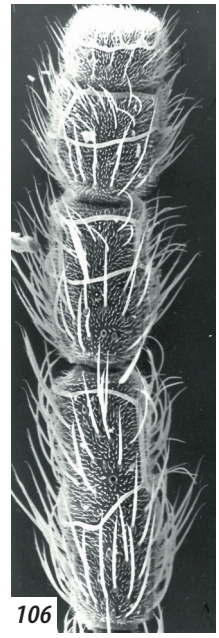
Fig. 55: Distribution of *Asphondylia satrothamni* on *Sarothamnus scoparius*

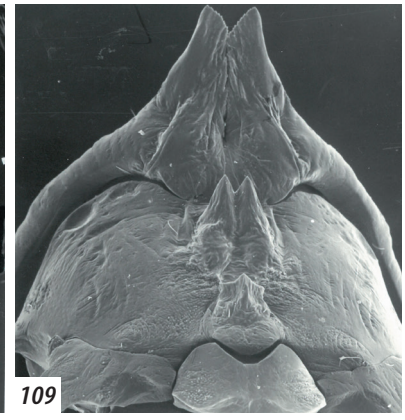
Fig. 56: Distribution of *Dasineura kellneri* on *Larix decidua*

Fig. 57: Distribution of *Dasineura mali* on *Malus sylvestris*

Fig. 58: Distribution of *Contarinia medicaginis* on *Medicago sativa*

Fig. 59: Distribution of *Dasineura oleae* on *Olea europaea*





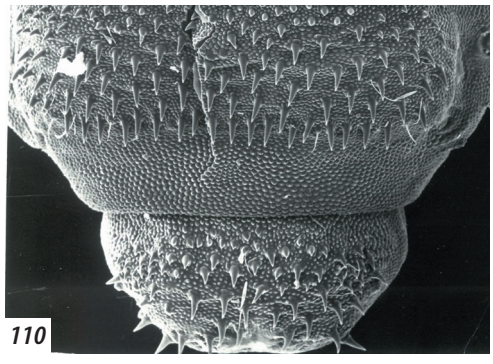
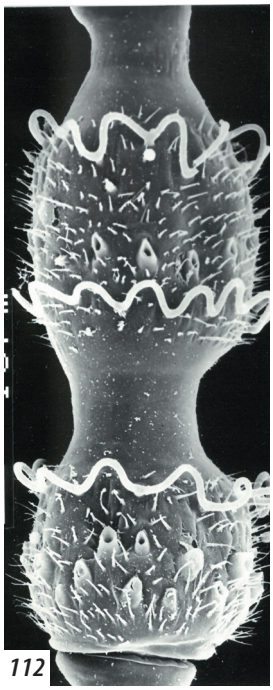
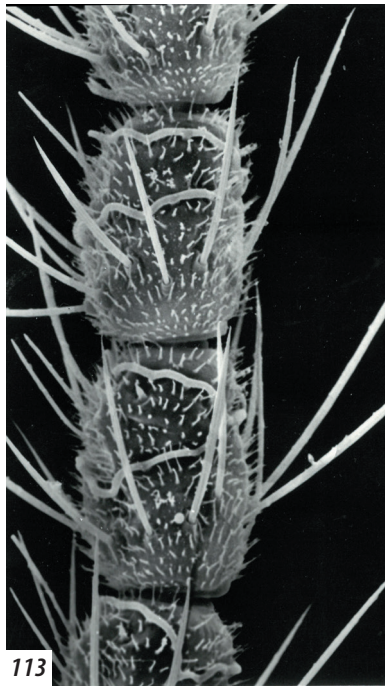
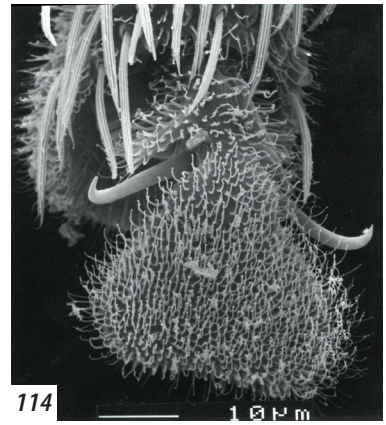
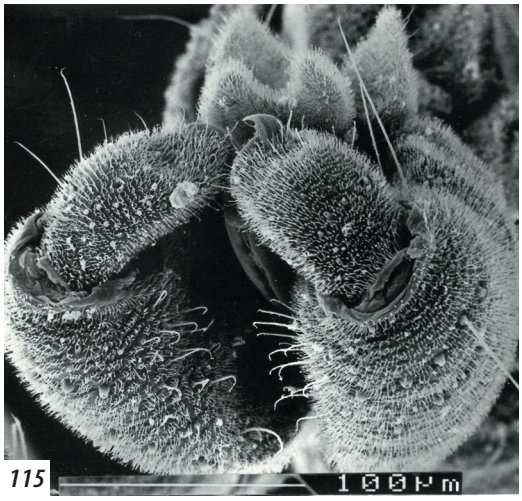


PLATE 18. MORPHOLOGICAL CHARACTERS OF THE GALL MIDGE ***ASPHONDYLIA SAROTHAMNI*** (LOEW, 1850).**105.** Head of the female in lateral view (magnification 130×). **106.** Terminal part of antenna (magnification 330×). **107.** Pupa in lateral view (magnification 19×). **108.** Female ovipositor (magnification 220×). **109.** Pupa, head part, ventral view, (magnification 90×). **110.** Pupa, terminal part of abdomen (magnification 130×). **111.** Leg of female, end part with claw and empodium (magnification 430×).









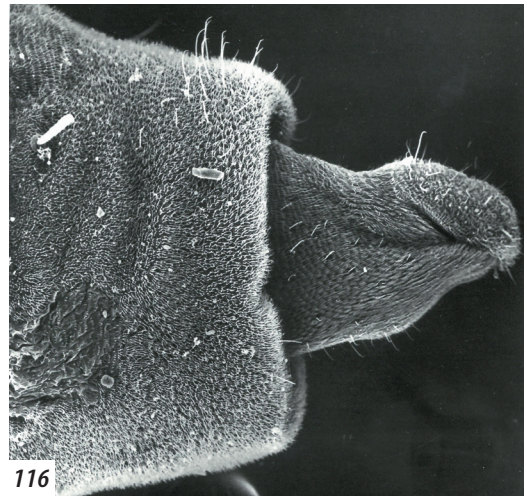


PLATE 19. MORPHOLOGICAL CHARACTERS OF GALL MIDGES OF THE ***GENUS ETSUHOA THURIFERAE*** SKUHRAVÁ, 1996. **112.** Antenna of male: one flagellomere (magnification 750×). **113.** Antenna of female: two flagellomeres (magnification 700×). **114.** Terminal part of leg with a pair of thin claws and empodium which is densely pubescent (magnification 1300×). **115.** Male hypopygium (magnification 350×). **106.** Female ovipositor (magnification 270×).