

Gall midges (Diptera: Cecidomyiidae) of the Olympos Mountains (northern Greece)

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Abstract. In June 2007 65 species of the family Cecidomyiidae were found during investigations at ten localities in the Olympos Mountain area along an altitudinal transect from sea level up to 950 m a. s. l. *Arthrocnodax coryligallarum* (Targioni-Tozzetti, 1887), *Contarinia merceri* Barnes, 1930, *Dasineura fraxinea* (Kieffer, 1907), *Dasineura fraxini* (Bremi, 1847), *Dasineura gleditchiae* (Osten Sacken, 1866), *Dichodiplosis langeni* Rübsaamen, 1910, *Jaapiella schmidt* (Rübsaamen, 1912), *Rhopalomyia tripleurospermi* Skuhravá, 2000, *Trotteria bochkarevi* Fedotova, 2004, and *Zeuxidiplosis giardi* (Kieffer, 1896) are reported from Greece for the first time. Biology: 92% species are phytophagous, 5% zoophagous and 3% phytosaprophagous. These gall midges were associated with 46 host plant species belonging to 21 host plant families. The average species number found at one locality is 10.2. *Dasineura plicatrix* (Loew, 1850) causing leaf galls on *Rubus caesius* is the most abundant species. Virgin forest near Neoi Poroi at the seaside was the richest locality in number of species where galls of 16 gall midge species were found. Zoogeography: 43% are Mediterranean species, 34% European, 12% Eurosiberian, 3% Euroasian, 6% Holarctic. *Dasineura gleditchiae* (Osten Sacken, 1866) causing leaflet galls of *Gleditsia triacanthos* is a Nearctic species and an alien species in Greece. Beneficial species: *Aphidoletes aphidimyza* (Rondani, 1847) for biological control of aphids, *Cystiphora schmidt* (Rübsaamen, 1914) for biological control of *Chondrilla juncea*, *Rhopalomyia tripleurospermi* Skuhravá, 2000 for biological control of *Tripleurospermum perforatum* and *Zeuxidiplosis giardi* (Kieffer, 1896) for biological control of *Hypericum perforatum*. The known gall midge fauna of Greece includes at present 211 species. Annotated lists of gall midge species and a list of host plants attacked by gall midges are given.

Distribution, zoogeography, Cecidomyiidae, Diptera, Greece, Olympos Mountains, Palaearctic region, plant-insect interactions

INTRODUCTION

Up to 1993 only twenty gall midge species were known to occur in the large territory of Greece. In the framework of our investigations in Europe that we have carried out at about 1800 localities in the period of 1955–1997 (Skuhravá & Skuhravý 1998), we collected gall midge galls at 67 localities in Greece during three expeditions in 1994, 1995 and 1996. We found a total of 147 gall midge species. Together with twenty gall midge species found by earlier authors, the known gall midge fauna included 167 gall midge species (Skuhravá & Skuhravý 1997). Jaschhof (1998) contributed to the fauna with nine gall midge species of the subfamily Lestremiinae.

We enriched the Greek fauna during our investigations in Corfu in 2004 and in Samos in 2005 with other 20 gall midge species (Skuhravá & Skuhravý 2006). In June 2007 we continued our investigations in the northern part of Greece in the area of the Olympos Mountains where few investigations have been done. Only Rübsaamen (1900) reported three galls caused by gall midge species, viz. *Hartigiola annulipes* (Hartig, 1839), *Myricomyia mediterranea* (F. Löw, 1885) and *Wachtliella ericina* (F. Löw, 1885).

Olympos is a large mountain complex in northern Greece with the highest point – Mount Olympos (or: Ólympos), 2919 m a. s. l. Its base is located at sea level. This area is noted for its

very rich flora with several endemic plant species. In 1938 the first national park in Greece was established, the Mount Olympus National Park. It includes an area of about 4000 ha.

From the biogeographical point of view, according to Udvardy (1975), this area belongs to the Mediterranean Sclerophyll Province. According to Noirfalise (1987), five zones of natural vegetation may be found there: (1) the thermomediterranean zone with dominant trees of *Olea europea*; (2) the mesomediterranean zone with sclerophyllous oakwoods, *Quercus ilex* and *Q. coccifera*; (3) the supramediterranean zone with deciduous oakwoods with dominant tree of *Quercus pubescens* at altitudes of about 600 m a. s. l.; (4) the oromediterranean or montane zone with conifers; (5) the altimediterranean and supra-forest zone.

MATERIAL AND METHODS

The investigations of occurrence and distribution of gall midges have been investigated by means of a uniform method, by collecting galls on host plants at each locality. The method is described in detail in article of Skuhrová & Skuhrový (1997).

Identification of galls is based on the keys of Houard (1908–1909), Buhr (1964–1965), Redfern et al. (2002), identification of larvae on Möhn (1955), of adults on Skuhrová (1997a), nomenclature of gall midge species is based on Skuhrová (1986, 1989) and Gagné (2004). 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 Skuhrová (1987, 1991, 1994a, b, 1997b) and Skuhrová et al. (1984).

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

Localities examined

Localities are arranged alphabetically. The following data are given for each locality: the name of locality, its altitude, short ecological characteristics, the dates of investigations and, at the end in parentheses, the number of the locality, indicating its position on the map (Fig.1).

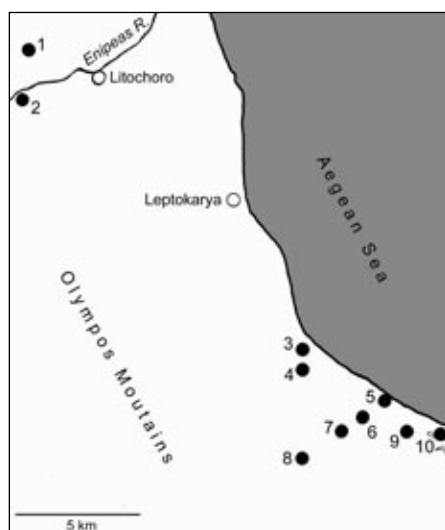


Fig. 1. Part of northern Greece with localities where investigations of the family Cecidomyiidae were carried out in 2007: 1 – Stavros, 2 – Enipeas river near Litochoro, 3 – Pandeimonas, castle, 4 – Neos Pandeimonas, 5 – Platamonas, lower part, 6 – Platamonas, middle part, 7 – Platamonas, upper part, 8 – Poroi, 9 – Neoi Poroi, 10 – Salt Lake near Neoi Poroi.

Enipeas river near Litochoro (canyon), 600–650 m a. s. l.: deep valley with hill-sides that are overgrown with various shrubs and trees, mainly *Quercus coccifera*, *Q. ilex*, *Ostrya carpinifolia*, *Buxus sempervirens*; 11. 6. 2007 (2) (Fig. 2).

Neos Pandeimonas, 300 m a. s. l.: shrubs and trees round the village; 10. 6. 2007 (4).

Neoi Poroi, 5–20 m a. s. l.: virgin forest near the village with trees about 300 years old; 6. 6. 2007 (9).

Pandeimonas, castro (castle), 100 m a. s. l.: shrubs and trees round the castle on hill above the sea with xerotherm vegetation; 7. 6. 2007 (3) (Fig. 4).

Platamonas, lower part, 10–20 m a. s. l.: Seaside and shrubs and trees along paths through village and garden; 2. 6. 2007 (5) (Fig. 3).

Platamonas, middle part, 20–30 m a. s. l.: shrubs and trees around the pumping site and growth in the valley of the dried small river; 3. 6. 2007, 12. 6. 2007 (6).

Platamonas, upper part, 30–40 m a. s. l.: shrubs and trees on the hill-side; 4. 6. 2007 (7).

Poroi, 500 m a. s. l.: shrubs and trees round the village situated on the hill-side of the Olympus-complex; 8. 6. 2007 (8).

Salt Lake near Neoi Poroi, 5–10 m a. s. l.: extensive lake joined with sea, with salt-marshes and with sand banks; 9. 6. 2007 (10).

Stavros, 950 m a. s. l.: shrubs and trees at the border of the forest with *Pinus halepensis*, *Picea abies*, *Fagus sylvatica*, *Juniperus oxycedrus*; 11. 6. 2007 (1).

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 in the Olympos area and character of distribution in the Palaearctic region. An asterisk (*) before the species name indicates a new record for Greece.

Aphidoletes aphidimyza (Rondani, 1847)

Larvae feed predaciously on various species of aphids. They are used in biological control. Several generations develop per year. Occurrence: Platamonas, middle part. Larvae were found feeding among aphids on the shoot of *Rosa centifolia* (Rosaceae). Distribution: Holarctic.

Apiomyia bergenstammi (Wachtl, 1882)

Larvae cause woody, plurilocular galls on twigs of *Pyrus communis* L. (Rosaceae) (Fig. 5). Wachtl (1882) described this species based on material collected by Bergenstamm at Corfu. Only one generation develops a year. Larvae pupate in galls. It may cause dying off of attached branches. Occurrence: Platamonas, lower part. Distribution: Mediterranean.

Arnoldioli tymanifex (Kieffer, 1909)

Larvae cause small round parenchymous galls on the leaves of *Quercus ilex* L. (Fagaceae). Only one generation develops a year. Hibernation takes place in the soil. Occurrence: Enipeas river canyon, Pandeimonas. Distribution: Mediterranean.

*** *Arthrocnodax coryligallarum*** (Targioni-Tozzetti, 1887)

Larvae develop in big bud galls caused by *Phytoptus avellanae* (Nalepa, 1889) (Eryophyoidea, Acarina) on *Corylus avellana* L. (Corylaceae) and are predators on eriophyid mites (Fig. 6). One generation develops a year. Occurrence: Platamonas, lower part. Distribution: European.

Asphondylia calycotomae Kieffer, 1912

A solitary larva develops in swollen leaf bud (hibernation generation) or in swollen fruit (summer generation) of *Calicotome villosa* (Poiret) Link (Fabaceae). Two generations develop per year. Occurrence: Platamonas, lower part. Distribution: Mediterranean.

Asphondylia coronillae (Vallot, 1829)

Larvae cause leaf bud galls and pod galls on *Coronilla emerus* L. (Fabaceae) (Fig. 7). Two generations develop per year. Occurrence: Platamonas, Poroi. Distribution: Mediterranean.

Asphondylia scrophulariae (Schiner, 1856)

A solitary larva develops inside swollen flower bud of *Scrophularia canina* L. (Scrophulariaceae) (Fig. 8). Two generations develop per year. Occurrence: Enipeas river canyon, Neoi Poroi, Pandeimonas, Poroi. Distribution: Mediterranean.

Asphondylia verbasci (Vallot, 1827)

Larvae produce galls (swollen flower buds) of *Verbascum sinuatum* L. (Scrophulariaceae) (Fig. 9). Two generations develop per year. Occurrence: Platamonas, middle part, Pandeimonas, Salt Lake near Neoi Poroi, Stavros. Distribution: Mediterranean.

Bayeriola thymicola (Kieffer, 1888)

Larva produce rosette leaf galls on *Thymus* sp. (Lamiaceae) (Fig. 10). Leaves forming the galls are densely covered with white hairs. Two generations develop per year. Occurrence: Platamonas. Distribution: European, spread up to northern Africa.

Braueriella phillyreae (F. Löw, 1877)

Larvae cause pustule galls on leaves of *Phillyrea media* L. (Oleaceae) (Fig. 11). One generation develops per year. Pupation takes place in galls. Occurrence: Neos Pandeimonas, Platamonas, middle part, Pandeimonas. Distribution: Mediterranean.

Clinodiplosis cilicrus (Kieffer, 1889)

Phytosaprophagous and mycophagous larvae develop in decaying plant matter. Larvae were found in decaying leaf bud galls of *Phytoptus avellanae* (Eriophyoidea, Acarina) on *Corylus avellana* L. (Corylaceae), together with larvae of *Arthrocnodax* sp. Two generations develop per year. Occurrence: Platamonas, lower part. Distribution: Eurosiberian.

Contarinia ballotae Kieffer, 1898

Larvae live among leaves of the vegetative tip of *Ballota nigra* L. (Lamiaceae). One or two generations develop per year. Occurrence: Neos Pandeimonas. Distribution: Mediterranean.

Contarinia coronillae Janežič, 1978

Larvae develop in pod-like swollen leaflets of *Coronilla emerus* L. (Fabaceae). Only one generation develops per year. Occurrence: Platamonas, middle part. Distribution: Mediterranean.

Contarinia craccae (Loew, 1850)

Contarinia craccae Kieffer, 1897

Larvae develop in swollen unopened flower buds of *Vicia cracca* L. (Fabaceae). One or two generations develop per year. Occurrence: Platamonas, lower part. Distribution: Eurosiberian.

* ***Contarinia merceri*** Barnes, 1930

Several golden-yellow larvae develop gregariously in florets of *Alopecurus pratensis* L. (Poaceae) and may cause blind and empty florets. Larvae feed on the reproductive organs and prevent forming the seed. Usually only one generation develops a year. Occurrence: Platamonas, lower part. Distribution: European.

Contarinia nasturtii (Kieffer, 1888)

Larvae live in swollen flower buds of an undetermined species of the family Brassicaceae. Two generations develop per year. Occurrence: Neoi Poroi. Distribution: European.

Contarinia pyrivora (Riley, 1886)

Larvae develop inside deformed fruits of *Pyrus communis* L. (Rosaceae). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Platamonas, lower part. Distribution: Holarctic.

Contarinia quercina (Rübsaamen, 1890)

Larvae develop among small young leaves of terminal leaf bud of *Quercus pubescens* Willd. (Fagaceae). Two generations develop per year. Occurrence: Poroi. Distribution: European.

* ***Contarinia*** sp.

Larvae develop in the flower heads of *Achillea* sp. (Asteraceae). Occurrence: Stavros. Distribution: Mediterranean.

* ***Contarinia*** sp.

Larvae develop in the pods of *Calicotome villosa* (Poir.) Link. (Fabaceae). Occurrence: Platamonas. Distribution: Mediterranean.

Cystiphora schmidtii (Rübsaamen, 1914)

Larvae cause pustule galls on leaves and stems of *Chondrilla juncea* L. (Asteraceae) (Fig. 12). Up to six generations may develop in southern Greece (Caresche & Wapshere 1975). This species is used as biological control against the weed *Chondrilla juncea*. Occurrence: Neoi Poroi, Salt Lake near Neoi Poroi. Distribution: Primarily Mediterranean species, occurring up to Middle East. It was introduced for biological control of this weed in North America (Oregon, Idaho, California) and Australia (New South Wales, Victoria).

Dasineura acrophila (Winnertz, 1853)

Larvae cause pod-like galls on leaflets of *Fraxinus ornus* L. (Oleaceae). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Neoi Poroi. Distribution: European.

Dasineura aparines (Kieffer, 1889)

Larvae live inside large terminal galls on the shoots of *Galium aparine* L. (Rubiaceae). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Platamonas, lower part. Distribution: European, it occurs up to northern Africa.



Figs. 2–5. 2 – Enipeas river valley ca. 6 km west of Litochoro, the site where bud galls of *Phyllodiplosis cocciferae* on *Quercus coccifera* were found. 3 – Seaside of the village Platamonas with typical vegetation. 4 – The castro Pan-deleimonas built on the hill over the sea, strongly fortified, at an altitude of about 100 m a. s. l., and its neighbourhood characterised by xerotherm vegetation. 5 – Plurilocular woody galls of *Apiomyia bergenstammi* (Wachtl, 1882) on twigs of *Pyrus communis*.

Dasineura crataegi (Winnertz, 1853)

Larvae live gregariously among deformed leaves in terminal rosette galls on *Crataegus laevigata* (Poiret) DC (= *C. oxy-cantha*) (Rosaceae). Two generations develop per year. Some larvae pupate in galls, some larvae leave galls and pupate in the soil. Occurrence: Pandeimonas (*Crataegus* sp.), Salt Lake near Neoi Poroi. Distribution: European.

Dasineura ericaescopariae (Dufour, 1837)

Larvae cause large galls at tips of shoots of *Erica scoparia* L. and *E. arborea* L. (Ericaceae) (Fig. 13). Many larvae live together inside one gall. Only one generation develops a year. Larvae overwinter in galls. Adults emerge in the spring. Occurrence: Platamonas. Distribution: Mediterranean.

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

White larvae produce pustule galls on the leaflets of *Fraxinus excelsior* L. (Oleaceae). Only one larva develops in the gall. One generation per year. Larvae hibernate in the soil. Occurrence: Neoi Poroi. Distribution: European.

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

Orange larvae cause swellings of the mid-vein on the leaflets of *Fraxinus excelsior* L. (Oleaceae) (Fig. 14). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Neoi Poroi. Distribution: European.

* ***Dasineura gleditschiae*** (Osten Sacken, 1866)

White larvae cause galls on leaflets of *Gleditsia triacanthos* L. (Caesalpiniaceae). Several generations develop per year (Fig. 15). Larvae pupate in galls. In autumn they leave galls and hibernate in the soil. Occurrence: Platamonas, lower part. Distribution: Nearctic species, alien to Europe, immigrant from North America.

Dasineura hyperici (Bremi, 1847)

Larvae cause terminal leaf bud gall on stems of *Hypericum* sp. (Hypericaceae). Two generations develop per year. Larvae pupate in the soil. Occurrence: Neoi Poroi, Platamonas, lower part, Poroi. Distribution: European.

Dasineura mali (Kieffer, 1904)

Larvae live in rolled leaf margins of *Malus sylvestris* Mill. (Rosaceae). Two generations develop per year. Larvae hibernate in the soil. Occurrence: Pandeimonas. Distribution: Holarctic.

Dasineura oleae (F. Löw, 1885)

Larvae cause slight, indefinite, elongate swellings on the leaves of *Olea europaea* L. (Oleaceae) (Fig. 16). Only one generation develops per year. Larvae hibernate in the galls. Occurrence: Platamonas, lower part, Neoi Poroi. Distribution: Mediterranean.

Dasineura papaveris (Winnertz, 1853)

Larvae live in large numbers in seed capsules of *Papaver rhoeas* L. (Papaveraceae). Two generations develop per year. Larvae pupate in the galls. Occurrence: Platamonas, lower part, Neoi Poroi. Distribution: Euro-Asian species, occurring up to Israel.

Dasineura plicatrix (Loew, 1850)

Larvae cause galls formed by contorted and twisted young leaves of *Rubus caesius* L. and related species (Rosaceae) (Fig. 17). Two or more generations develop per year. Larvae leave galls and pupate in the soil. Occurrence: Enipeas river canyon, Neos Pandeimonas, Neoi Poroi, Pandeimonas, Platamonas, lower part, Poroi, Salt Lake near Neoi Poroi. It is the most abundant species in this area. Distribution: European species, occurring up to North Africa.

Dasineura pteridis (Müller, 1871)

Syn. *Cecidomyia filicina* Kieffer, 1889

Larvae develop in rolled and swollen leaflet margins of *Pteridium aquilinum* (L.) Kuhn (Hypolepidiaceae). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Poroi, Stavros. Distribution: Eurosiberian.

Dasineura pyri (Bouché, 1847)

Larvae develop in rolled leaf margins of *Pyrus communis* L. (Rosaceae) (Fig. 19). Two generations develop per year. Larvae pupate in the soil. Occurrence: Platamonas, lower part. Distribution: Holarctic.

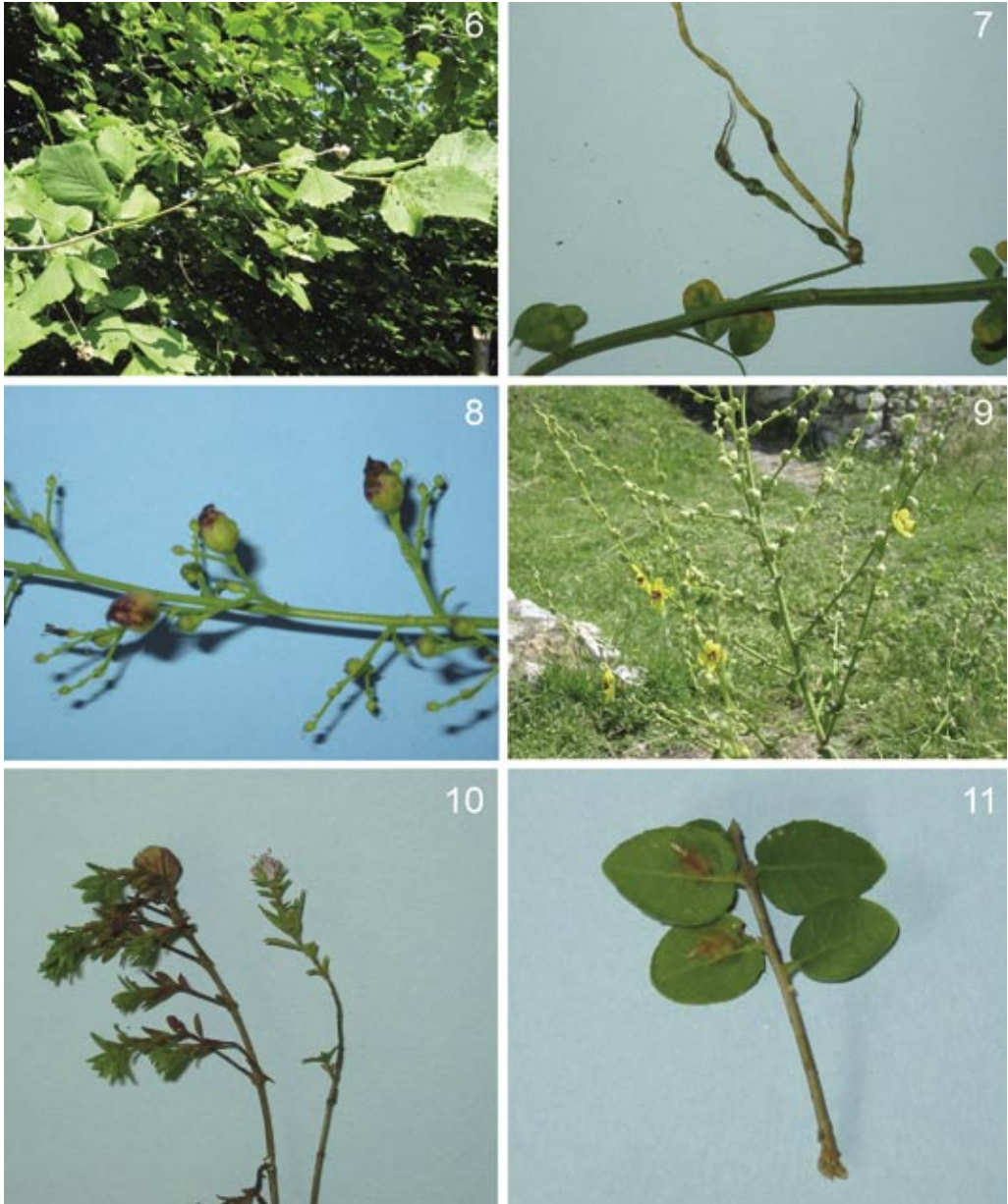
Dasineura rosae (Bremi, 1847)

Syn. *Cecidomyia rosarum* Hardy, 1850; *Wachtliella rosarum* (Hardy, 1985)

Larvae develop in pod-like folded leaflets of *Rosa* sp. (Rosaceae) (Fig. 18). Two generations develop per year. Larvae pupate in the soil. Occurrence: Platamonas, upper part. Distribution: Eurosiberian.

Dasineura rufescens (De Stefani, 1898)

Larvae cause swellings on branches of *Phillyrea media* L. (Oleaceae) (Fig. 20). Only one generation develops per year. Larvae hibernate in the soil. Occurrence: Neos Pandeimonas, Platamonas, middle part, Pandeimonas, Poroi. Distribution: Mediterranean.



Figs. 6–11. 6 – Gall of the eriophyid mite *Phytoptus avellanae* (Nalepa, 1889) on terminal bud of *Corylus avellana*, where zoophagous larvae of *Arthrocnodax coryligallarum* (Targioni-Tozzetti, 1887) and larvae of *Lestodiplosis* sp. were found. 7 – Galls of *Asphondylia coronillae* (Vallot, 1829) on pods of *Coronilla emerus*. 8 – Galls of *Asphondylia scrophulariae* (Schiner, 1856) on flower buds of *Scrophularia canina*. 9 – Galls of *Asphondylia verbasci* (Vallot, 1827) on flower buds of *Verbascum sinuatum*. 10 – The gall of *Bayeriola thymicola* (Kieffer, 1888) on the terminal bud of *Thymus* sp. (on left) and unattacked plant (on right). 11 - Galls of *Braueriella phillyreae* (F. Löw, 1877) on leaves of *Phillyrea media* with pupal exuviae protruding from openings of galls that remain after gall midge adults have emerged.

Dasineura turionum (Kieffer & Trotter, 1904)

Larvae live under the scale-shaped and swollen young leaves on very young just growing shoots of *Asparagus aphyllus* L. (Liliaceae) (Fig. 21). Attacked plants are later irregularly deformed forming a cluster. Usually two generations develop per year. Larvae pupate in the soil. Occurrence: Platamonas, lower part, Neoi Poroi, Neos Pandeimonas. Distribution: Mediterranean.

Dasineura urticae (Perris, 1840)

Whitish-orange larvae cause irregular galls on leaves, stems and flower stalks of *Urtica dioica* L. (Urticaceae). Two or more generations develop per year. Larvae pupate in the soil. Occurrence: Pandeimonas. Distribution: Eurosiberian.

Dasineura viciae (Kieffer, 1888)

Larvae cause pod-like galls on leaflets of *Vicia* sp. (Fabaceae). Two or more generations develop per year. Larvae pupate in the soil. Occurrence: Platamonas, lower part, Neos Pandeimonas. Distribution: Eurosiberian.

* ***Dichodiplosis langeni*** Rübsaamen, 1910

Red larvae develop inside dry fruits of *Prunus domestica* L. (Rosaceae). One generation develops per year. Occurrence: Neos Pandeimonas. Distribution: European.

Geocrypta galii (Loew, 1850)

Reddish-yellow larvae cause round bladder swellings on stems and flower stalks of *Galium verum* L. and other species (Rubiaceae). Usually two generations develop per year. Larvae pupate in the soil. Occurrence: Salt Lake near Neoi Poroi. Distribution: Eurosiberian.

Giraudiella inclusa (Frauenfeld, 1862)

Larvae live in corn-like galls inside stems of shoots of *Phragmites australis* (Cav.) Steudel (Poaceae). Two generations develop per year: one generation develops inside the stem, the second generation in the side shoots. Larvae pupate in the galls (Skuhřavá & Skuhřavý 1981). Occurrence: Neoi Poroi, Salt Lake near Neoi Poroi. Distribution: European.

Hartigiola annulipes (Hartig, 1839)

Solitary white larva produces a cylindrical gall on the upper side of the leaf of *Fagus sylvatica* L. (Fagaceae). Only one generation develops per year. Larvae hibernate inside the galls among fallen leaves on the soil surface. Occurrence: Rübsaamen (1900) reported occurrence of galls from Olymp without giving the name of the locality. Distribution: European.

* ***Jaapiella schmidti*** (Rübsaamen, 1912)

Reddish larvae develop in seed capsules of *Plantago lanceolata* L. (Plantaginaceae) and feed by sucking the seed. One or two generations develop per year. Occurrence: Poroi. Distribution: European.

Janetiella lemeei (Kieffer, 1904)

Solitary yellow larvae produce small galls on the leaves of *Ulmus minor* Mill. (Ulmaceae). Each swelling has a short tube on the lower side with an opening. Only one generation develops per year. Occurrence: Neoi Poroi, Poroi, Salt Lake near Neoi Poroi. Distribution: European species, occurring up to Turkey.

Lasioptera arundinis Schiner, 1854

Whitish larvae live gregariously in swollen lateral shoots of *Phragmites australis* (Cav.) Steudel (= *P. communis* Trin.) (Poaceae). Only one generation develops per year. Females lay their eggs at the base of lateral shoots that develop only in case if the vegetative tip of the stem is destroyed (Skuhřavá & Skuhřavý 1981). Occurrence: Neoi Poroi, Salt Lake near Neoi Poroi. Distribution: European.

Lasioptera eryngii (Vallot, 1829)

Orange coloured larvae cause plurilocular swellings of stems and leaf petioles of *Eryngium campestre* L. (Apiaceae). Two generations develop per year. Occurrence: Platamonas, lower part. Distribution: Mediterranean and sub-Mediterranean.

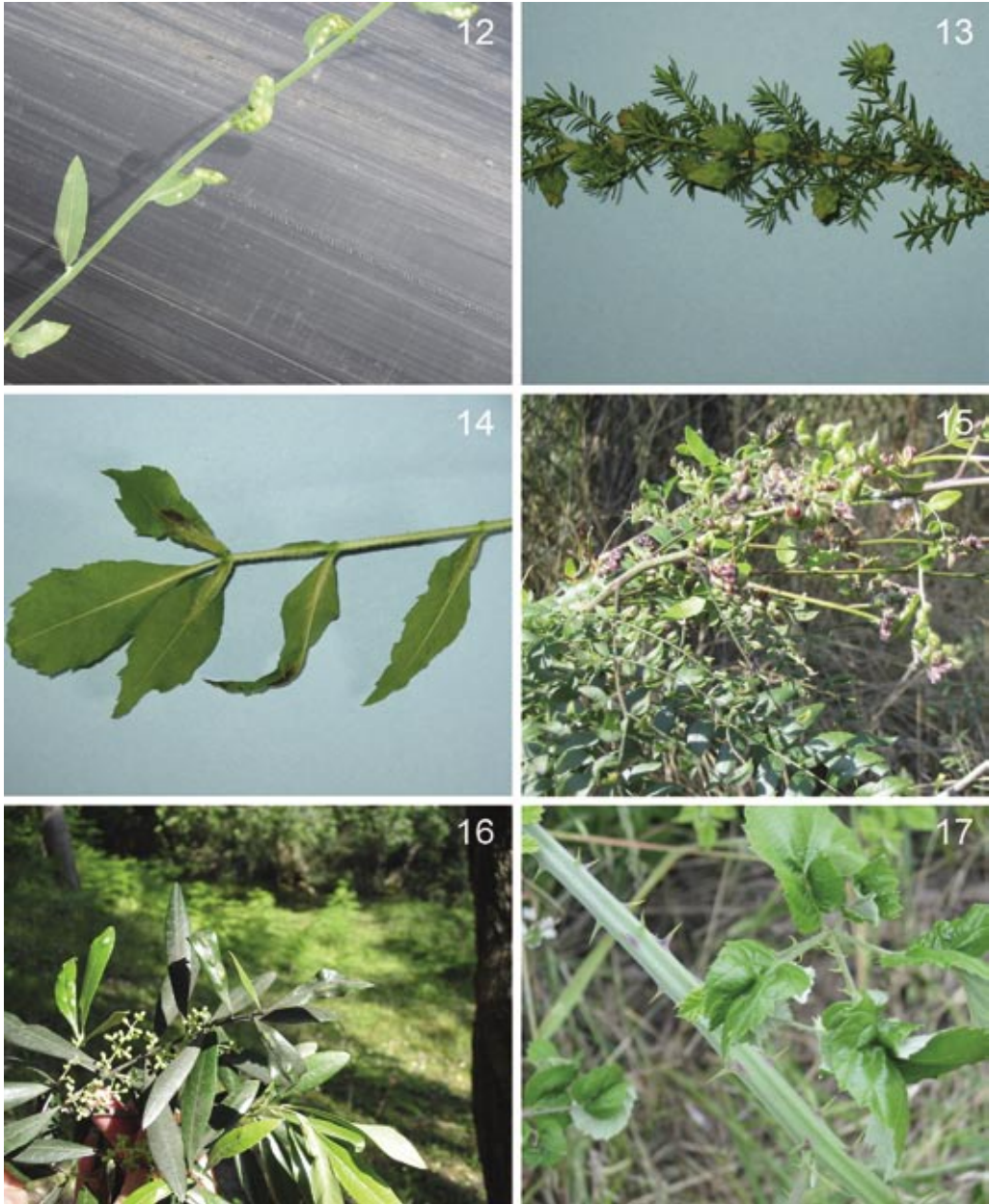
* ***Lestodiplosis*** sp.

Larvae develop in big bud galls caused by *Phytoptus avellanae* (Nalepa, 1889) (Erythrophyoidea, Acari) on *Corylus avellana* L. (Corylaceae) together with larvae of *Arthrocnodax coryligallarum* (Targioni-Tozzetti, 1887). Larvae of both species feed as predators on eriophyid mites. These larvae were found also by Sasso & Viggiani (2002) in Italy. Occurrence: Distribution: Mediterranean.

Macrodiplosis pustularis (Bremi, 1847)

Syn. *Diplosis dryobia* F. Löw, 1877; *Macrodiplosis dryobia* (F. Löw, 1877)

Larvae cause galls on leaves of *Quercus pubescens* Willd. (Fagaceae) (Fig. 22). The marginal leaf lobe is folded downwards. Only one generation develops per year. Larvae leave galls and remain in the soil up to the spring of the following year. Occurrence: Poroi. Distribution: European.



Figs. 12–17. 12 – Pustule galls on leaves of *Chondrilla juncea* caused by larvae of *Cystiphora schmidti* (Rübsaamen, 1914). 13 – Galls of *Dasineura ericaescopariae* (Dufour, 1837) on leaf buds of *Erica arborea*. 14 – Galls of *Dasineura fraxini* (Bremer, 1847) on mid-veins of leaflets of *Fraxinus excelsior*. 15 – Galls of *Dasineura gleditschiae* on leaflets of *Gleditsia triacanthos*; it is of Nearctic origin and an alien species in Greece. 16 – Galls of *Dasineura oleae* (F. Löw, 1885) in the form of small indefinite elongate swellings on leaves of *Olea europaea*. 17 – Galls of *Dasineura plicatrix* (Loew, 1850) on leaves of *Rubus caesius*, the most abundant gall midge species in the Olympus Mts area.

Macrodiplosis roboris (Hardy, 1854)

Syn. *Macrodiplosis volvens* Kieffer, 1895

Larvae cause galls on leaves of *Quercus pubescens* Willd. (Fagaceae) (Fig. 23). The gall is formed of a rolled leaf segment, situated between two lobes. Only one generation develops per year. Larvae leave galls and remain in the soil up to the spring of the following year. Occurrence: Enipeas river canyon, Platamonas, upper part, Poroi. Distribution: European.

Mikiola fagi (Hartig, 1839)

A solitary white larva produces a large, smooth hairless hard gall, pointed at the tip, on the leaf of *Fagus sylvatica* L. (Fagaceae) (Fig. 24). Only one generation develops per year. Full-grown larvae shut the opening at the base of the gall by a spinned lid. In autumn the galls separate from leaves and drop to the ground where they remain up to the spring of the next year. Larvae hibernate inside galls and pupate there. Occasionally it is a serious pest of young trees in submountain and mountain zones of Central Europe (Skuhrová & Roques 2000). In Greece it occurs rarely. It is known only from Kastania (Skuhrová & Skuhrový 1997). Occurrence: Stavros. Distribution: European.

Myricomyia mediterranea (F. Löw, 1885)

Larvae cause small rosette galls on twigs of *Erica arborea* L. (Ericaceae). In the middle of each gall is a small chamber including one larva. Only one generation develops per year. Larvae pupate in the galls. Occurrence: Platamonas, upper part, Poroi. Rübssaamen (1900) mentioned occurrence of galls of this species from Olympos without giving the name of the locality. Distribution: Mediterranean.

Oligotrophus juniperinus (Linné, 1758)

Orange larva lives solitary in a gall on *Juniperus communis* L. (Cupressaceae) (Fig. 25). The gall is slender, with tips of outer needles recurved. Only one generation develops per year. Larvae pupate in the galls. Occurrence: Stavros. Distribution: European.

Ozirhincus millefolii (Wachtl, 1884)

Solitary orange larva develops in achene in the flower head of *Achillea millefolium* L. (Asteraceae). Two or three generations develop per year. Larvae pupate in the galls. Occurrence: Stavros. Distribution: Eurosiberian, Holarctic.

Phyllocladiplosis cocciferae (Tavares, 1902)

Contarinia cocciferae Tavares, 1902

Larvae develop in cone-shaped leaf bud galls of *Quercus coccifera* L. (Fagaceae). Only one generation develops per year. Larvae leave galls and hibernate in the soil. Occurrence: Enipeas river canyon, Neos Pandeileimonas. Distribution: Mediterranean.

Physemocecis ulmi (Kieffer, 1909)

Physemocecis ulmi Rübssaamen, 1914

White larvae develop in small blisters on the leaf of *Ulmus minor* Mill. (= *U. campestris* L.) (Ulmaceae) (Fig. 23). Only one generation develops per year. Larvae leave galls and hibernate in the soil. Occurrence: Poroi, Salt Lake near Neoi Poroi. Distribution: European.

Piranea spartii Janezic, 1990

Orange coloured larvae live in dry flower buds of *Spartium junceum* L. (Fabaceae). Only one generation develops per year. Larvae leave flower buds and hibernate in the soil. Occurrence: Platamonas, lower part, Poroi. Distribution: Mediterranean.

Probruggmanniella phillyreae (Tavares, 1907)

Larvae develop in swollen fruits of *Phillyrea media* L. (Oleaceae) (Fig. 27). Only one generation develops per year. Larvae pupate in the galls. Occurrence: Platamonas, upper part. Distribution: Mediterranean.

Rhopalomyia artemisiae (Bouché, 1834)

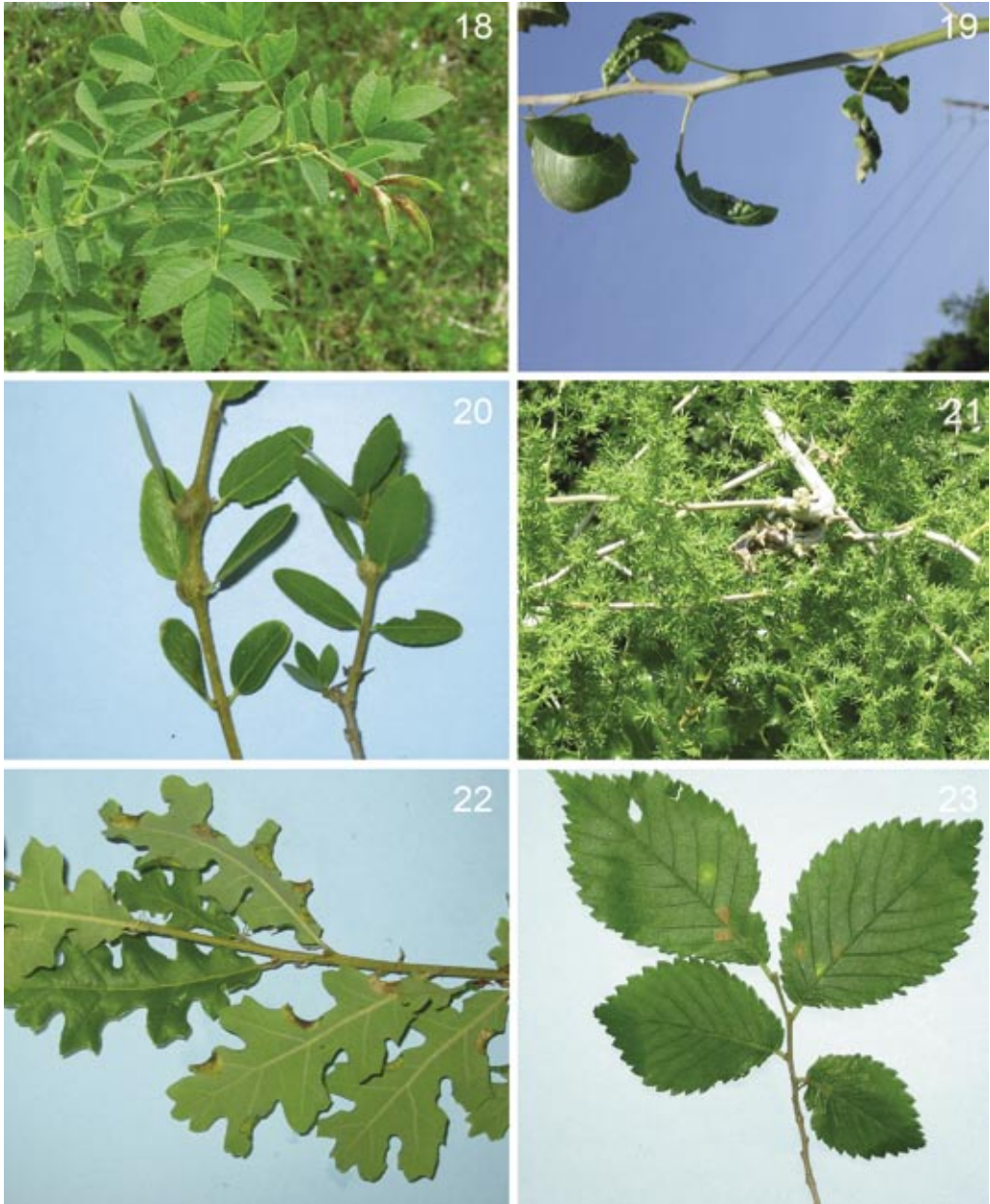
Orange coloured larvae cause large globular galls at the tip or in axils of *Artemisia campestris* L. and *A. scoparia* WK (Asteraceae). One or several chambers are inside one gall, each with only one larva. Two generations develop per year. Larvae pupate in the galls. Occurrence: Salt Lake near Neoi Poroi. Distribution: Submediterranean.

* ***Rhopalomyia tripleurospermi*** Skuhrová, 2000

Larvae cause galls in different meristematic tissues of *Tripleurospermum perforatum* (Mérat) Lainz. (= *Matricaria perforata* Mérat) (Asteraceae): at apical meristems of rosettes and bolting plants, leaf axils, buds and flower heads. Several generations develop per year. Larvae pupate in plant tissues where they developed. Occurrence: Platamonas, middle part. Distribution: European, used in the biological control of its host plant in Canada (Skuhrová & Hinz 2000).

Schizomyia galiorum Kieffer, 1889

Larvae develop in swollen flower buds of *Galium* sp. (Rubiaceae). Two generations develop per year. Larvae leave galls and pupate in the soil. Occurrence: Enipeas river canyon. Distribution: Eurosiberian.



Figs. 18–23. 18 – Galls of *Dasineura rosae* (Bremi, 1847) on leaflets of *Rosa* sp. 19 – Galls of *Dasineura pyri* (Bouché, 1847) on leaf margins of *Pyrus communis*. 20 – Galls of *Dasineura rufescens* (De Stefani, 1898) on branches of *Phillyrea media*. 21 – Galls of *Dasineura turionum* (Kieffer & Trotter, 1904) causing cluster deformation of the main axis on *Asparagus aphyllus*. 22 – Galls of *Macrodiplosis pustularis* (Bremi, 1847) on leaf margins of *Quercus pubescens*. 23 – Blister galls of *Physemocercis ulmi* (Kieffer, 1909) on the leaves of *Ulmus minor*.

* *Trotteria bochkarevi* Fedotova, 2004

Larvae develop in galls of *Asphondylia verbasci* (Vallot) (Scrophulariaceae). Occurrence: Pandeileimonas. Distribution: European.

Wachtliella ericina (F. Löw, 1885)

Larvae cause large rosette galls on branches of *Erica arborea* L. (Ericaceae). Only one larva develops in the central chamber. Only one generation develops per year. Larvae pupate in the galls. Occurrence: Neoi Poroï, Platamonas, upper part, Poroï. Rübssaamen (1900) mentioned occurrence of galls of this species from Olympos without giving the name of the locality. Distribution: Submediterranean, Subatlantic.

* *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 or three generations develop per year. Larvae pupate in the galls. This species is used for biological control of weed *Hypericum perforatum*. Occurrence: Neoi Poroï, Platamonas. Distribution: primarily European species which was introduced in North America (California), Australia, New Zealand for biological control; immigrant in South Africa.

List of host plants attacked by gall midges

Host plant species

Achillea millefolium
Achillea sp.
Alopecurus pratensis
Artemisia campestris
Asparagus aphyllus
Brassicaceae
Ballota nigra
Calicotome villosa

Chondrilla juncea
Coronilla emerus

Corylus avellana

Crataegus laevigata
Erica arborea

Eryngium campestre
Fagus sylvatica

Fraxinus ornus

Galium aparine
Galium verum
Galium sp.
Gleditsia triacanthos
Hypericum perforatum

Juniperus communis
Malus sylvestris
Olea europaea
Papaver rhoeas
Phillyrea media

Gall midge species

Ozirhincus millefolii
Contarinia sp.
Contarinia merceri
Rhopalomyia artemisiae
Dasineura turionum
Contarinia nasturtii
Contarinia ballotae
Asphondylia calycotomae
Contarinia sp.
Cystiphora schmidti
Asphondylia coronillae
Contarinia coronillae
Arthrocodax coryligallarum
Clinodiplosis cilicrus
Lestodiplosis sp.
Dasineura crataegi
Dasineura ericaescopariae
Myricomyia mediterranea
Wachtliella ericina
Lasioptera eryngii
Hartigiola annulipes
Mikiola fagi
Dasineura acrophila
Dasineura fraxinea
Dasineura fraxini
Dasineura aparines
Geocrypta galii
Schizomyia galiorum
Dasineura gleditschiae
Dasineura hyperici
Zeuxidiplosis giardi
Oligotrophus juniperinus
Dasineura mali
Dasineura oleae
Dasineura papaveris
Braueriella phillyreae
Dasineura rufescens
Probruggmanniella phillyreae

Phragmites australis

Plantago lanceolata

Pteridium aquilinum

Prunus domestica

Pyrus communis

Quercus coccifera

Quercus ilex

Quercus pubescens

Rosa centifolia

Rosa sp.

Rubus sp.

Scrophularia canina

Spartium junceum

Thymus sp.

Tripleurospermum perforatum

Ulmus minor

Urtica dioica

Verbascum sinuatum

Vicia cracca

Vicia sp.

Giraudiella inclusa

Lasioptera arundinis

Jaapiella schmidti

Dasineura pteridis

Dichodiplosis langeni

Apiomyia bergenstammi

Contarinia pyrivora

Dasineura pyri

Phylloiplosis cocciferae

Arnoldiella tympanifex

Contarinia quercina

Macroiplosis pustularis

Macroiplosis roboris

Aphidoletes aphidimyza

Dasineura rosae

Dasineura plicatrix

Asphondylia scrophulariae

Piranea spartii

Bayeriella thymicola

Rhopalomyia tripleurospermi

Janetiella lemeei

Physemocoecis ulmi

Dasineura urticae

Asphondylia verbasci

Trotteria bochkarevi

Contarinia craccae

Dasineura viciae

RESULTS

In the course of our investigations in the area of the Olympos Mountains carried out in June 2007 we found 65 gall midge species at eight localities situated along an altitudinal transect from sea level up 950 m a. s. l. at Stavros. Thirteen gall midge species are new records for Greece, viz. *Arthrocnodax coryligallarum*, *Contarinia merceri*, *Dasineura fraxinea*, *Dasineura fraxini*, *Dasineura gleditchiae*, *Dichodiplosis langeni*, *Jaapiella schmidti*, *Rhopalomyia tripleurospermi*, *Trotteria bochkarevi*, *Zeuxidiplosis giardi* and three species identified to the genus level, viz. *Contarinia* sp. from flowers of *Achillea* sp., *Contarinia* sp. from pods of *Calicotome villosa* and *Lestodiplosis* sp., larvae of which develop in galls of *Phytoptus avellanae* on *Corylus avellana*. The fauna of gall midges of the area of Olympos Mts. may be considered as rich in comparison with gall midge fauna of other parts of Greece that have been investigated (Skuhravá & Skuhravý 1997, 2006). The known gall midge fauna of Greece now includes 211 species.

From the point of view of feeding habit, the gall midges found in 2007 in the Olympos area are composed of 92% phytophagous species, of 5% zoophagous species and 3% of phytosaprophagous species. Of zoophagous species, larvae of *Aphidoletes aphidimyza* prey on various species of aphids on many host plants and we found them during our investigation in 2007 among aphids on shoots of *Rosa centifolia*; larvae of *Arthrocnodax coryligallarum* and *Lestodiplosis* sp. were found preying on eriophyid mites in galls of *Phytoptus avellanae* on *Corylus avellana*. Larvae of *Clinodiplosis cilicrus* and *Dichodiplosis langeni* are phytosaprophagous and develop usually in decaying plant matter.

Gall midges are associated with 46 host plant species belonging to 21 host plant families. Nine gall midge species are associated with Rosaceae, eight species with Fabaceae, seven species with Fagaceae and Oleaceae and five species with Asteraceae. The remaining gall midge species are associated with 16 plant families. Each of the following host plants gives possibility for develo-

ment of at least three gall midge species, viz. *Erica arborea*, *Phillyrea media*, *Pyrus communis*, *Quercus pubescens* and *Corylus avellana*.

In the Olympus Mts. the average number per locality is 10.2 gall midge species, ranging from 6 to 16. Virgin forest near the village Neoi Poroi at an altitude of about 20 m a. s. l. with trees 300 years old, where we found 16 gall midge species, was the locality with the highest number of species. It seems that the richer gall midge species composition occurs in lower zones, viz. in thermomediterranean and mesomediterranean zones. In contrast, we found only six gall midge species at Stavros, 950 m a. s. l., the highest locality in the oromediterranean or montane zone. The number of gall midge species decreases with increasing altitude.

Geographic distribution

The gall midge fauna of the Olympus area may be divided on the basis of zoogeographical analysis, according to the occurrence of species in the Palaearctic region, into five groups. Twenty eight species (43%) have Mediterranean distribution, twenty two (34%) European, eight (12%) Euro-siberian, two (3%) Euroasian, four (6%) Holarctic and one species has Nearctic distribution.

Mediterranean species are associated with Mediterranean host plant species that have centres of origin in the Mediterranean area. In this group belong all four species of the genus *Asphondylia*, *Dasineura oleae* causing galls on leaves of olive tree, *Dasineura turionum* larvae of which induce galls on *Asparagus aphyllus*, *Dasineura ericaescopariae*, *Myricomyia mediterranea* and *Wachtliella ericina* associated with *Erica arborea*, *Braueriella phillyreae*, *Dasineura rufescens* and *Probruggmanniella phillyreae* developing on plant organs of *Phillyrea media*, *Arnoldiola tympanifex* causing galls on leaves of *Quercus ilex* and *Phyllodiplosis cocciferae* developing in bud leaf galls of *Quercus coccifera*.

European species are associated with European host plant species that have centres of origin in Europe. Some of them may extend beyond European boundaries. *Dasineura plicatrix* is a typical representative of European species. It occupies a large distribution area from Britain and Portugal in western Europe to Greece in eastern Europe and reaches to Algeria in northern Africa. It is the most abundant species in the Olympus area. In this group further belong *Contarinia quercina*, *Macrodiplosis pustularis* and *M. roboris* associated with *Quercus pubescens*, *Mikiola fagi* and *Hartigiola annulipes* causing galls on leaves of *Fagus sylvatica*, *Dasineura acrophila*, *D. fraxinea* and *D. fraxini* developing on *Fraxinus excelsior* and *F. ornus*, *Janetiella lemeei* and *Physemocecis ulmi* inducing galls on *Ulmus minor*. These gall midge species associated with *Fraxinus* spp. and *Ulmus minor* reach in the Olympus area the most southern boundary of their distribution area in Europe. Galls of *Dasineura acrophila* were recently found also in Sicily (Skuhrová et al. 2007), galls of *Janetiella lemeei* in Turkey (Skuhrová et al. 2005).

Eurosiberian species occur abundantly in Europe and extend at least to Western Siberia, some of them to central Siberia and only a few species reach to the Far East, China and Japan.

Dasineura rosae causing galls on leaflets of various *Rosa* spp. is a typical representative of Eurosiberian species. It occurs abundantly in central Europe and occupies a large distribution area from England and Portugal in western Europe to the Far East in eastern Siberia. *Contarinia craccae* galling flower buds of *Vicia cracca* and *Schizomyia galiorum* galling flower buds of various species of *Galium* occur abundantly in central Europe and their occurrence reaches to central Siberia (Skuhrová, Skuhrový 1993). *Dasineura pteridis* developing in leaf galls on *Pteridium aquilinum* and *Dasineura viciae* in leaf galls on several species of *Vicia* occur abundantly in Europe and their galls have also been found solitarily in Japan.

Dasineura papaveris developing in seed capsules of *Papaver rhoeas* and *Cystiphora schmidti* causing galls on *Chondrilla juncea* may be designated as Euroasian species although they are, according to their host plant species, of Mediterranean origin.

Aphidoletes aphidimyza, larvae of which prey on aphids and *Dasineura mali* causing galls on leaf margins of *Malus sylvestris*, *Dasineura pyri* and *Contarinia pyrivora* associated with *Pyrus communis* are Holarctic species. According to their origin, they are probably Eurosiberian species and have been transferred to North America and later to other regions of the world with their host plants.

Dasineura gleditchiae is the only Nearctic species known to occur in Greece. Larvae cause galls on leaflets of *Gleditsia triacanthos*. This species is native to North America. The galls have been unintentionally introduced into Greece probably with small plants (nursery stock) that are used in hedgerows of gardens and around hotel gardens. It is the first report of occurrence of this alien species in Greece. Galls of *D. gleditchiae* were found for the first time in 1976 in western Europe, in the Netherlands (Halstead 1992), in Serbia (Simova-Tošić & Skuhrová 1995) and then in other countries of Europe (Skuhrová 2006). In 2005 the galls were discovered in western Asia – in Turkey (Bayram et al. 2005, Skuhrová et al. 2005). *D. gleditchiae* has spread in the course of about thirty years from the place of its first import in the Netherlands to Ankara in Turkey and to Platamonas in northern Greece a distance of about 3000 km.

Four gall midge species that were found in the Olympos area may be considered to be beneficial species because they are used in some countries for biological control, viz. *Aphidoletes aphidimyza* for control of aphids, *Cystiphora schmidti* for control of the weed *Chondrilla juncea* in North America and Australia, *Rhopalomyia tripleurospermi* for control of the weed *Tripleurospermum perforatum* in Canada and *Zeuxidiplosis giardi* for control of the weed *Hypericum perforatum* in North America, Australia and New Zealand.

Two gall midge species, *Bayeriola thymicola* causing rosette galls on *Thymus* sp. and *Lasioptera eryngii* inducing stem galls on *Eryngium campestre* are in the Czech Republic included among critically endangered species (Skuhrová 2005).

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