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Gall midges (Diptera: Cecidomyiidae) of Sardinia: second contribution to the gall midge fauna of Italy

ABSTRACT

The present gall midge fauna of Sardinia includes 44 species. During investigations in 1997 at 15 localities, situated from the seaside up to the altitude of 700 m a.s.l., 35 species were found of which 31 are new records for Sardinia. Of them, four species (*Cystiphora schmidti*, *Dasineura papaveris*, *Giraudiella inclusa* and *Lasioptera arundinis*) are new records of Italian fauna. The present fauna of Italy now includes 385 species. During investigations in Sardinia 2-15 gall midge species were found at individual localities, on average 6.5 species per locality. The highest number (15 species) were found at the locality San Pantaleo in the most northern part of Sardinia. The gall midge fauna is formed of 52% Mediterranean, 14% European, 30% Euro-Siberian and 4% Holarctic species. *Asphondylia calycotomae*, *Braueriella phillyreae*, *Dasineura turionum* and *Myricomyia mediterranea* are typical representatives of the Mediterranean element. At present, *Lasioptera carophila*, *Dasineura plicatrix* and *Dasineura turionum* are the most abundant gall midge species in Sardinia. *Apiomyia bergenstammi* and *Contarinia pyrivora*, both associated with *Pyrus communis*, are potential pests of pear in Sardinia. An annotated list of gall midge species and a list of host plant species attacked by gall midges is given. Morphological characters of adults of *Myricomyia mediterranea* are shown in scanning electron micrographs.

Key words: Cecidomyiidae, faunistics, zoogeography, Mediterranean, Italy, Sardinia, distribution, economic importance, pests.

INTRODUCTION

In 1995 when the extensive project check-listing the fauna of Italy was finished and published (MINELLI *et al.*, 1995), only twelve gall midge species were known to occur in Sardinia, in contrast to the relatively abundant gall midge fauna of Italy, including 324 gall midge species (SKUHRAVÁ, 1995; SKUHRAVÁ & SKUHRAVY, 1994). Much more is now known of the gall midge fauna of Sicily, the largest island in the Mediterranean Sea, where 49 species

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have been found.

MASSALONGO (1895) first reported several galls occurring in Sardinia. CECCONI (1901a, b and 1903) determined galls which were collected in the southern part of Sardinia near Cagliari by Prof. F. Cavara. He found several galls of insects (including gall midges) and of mites. BARNES (1934) described two gall midge species, *Silvestriola asphodeli* and *Lestodiplosis asphodeli*, based on material, originating from Sardinia. MÖHN (1966-1971) included in his morphological studies larvae of *Lasioptera carophila* which were found at Cagliari in 1863 (collector not given). RIZZO and MASSA (1998) found during their investigations galls of *Cystiphora sonchi* in Sardinia.

The relatively low number of gall midge species known to occur in Sardinia was the reason why we in May 1997 decided to undertake an expedition to collect gall midge galls at 15 localities in the northeastern part of Sardinia.

These investigations of the gall midge fauna in Sardinia were carried out with financial help and sponsoring by the Grant Agency of the Academy of Sciences of the Czech Republic, Praha (Project Nr. A 6007503).

STUDY AREA

Sardinia is an island in the Mediterranean Sea, situated to the west of the Apennines Peninsula, belonging to Italy, including 23 813 square kilometers. It is about 270 km long from north to south and its width from west to east is about 145 km. A distance of about 180 km separates it from Italy and a similar distance separates it from Tunis on the African coast. The island of Sardinia is dominated by mountains of granite and schist. The interior is formed by a mountain complex, the Gennargent Massif, with the highest point, the mountain La Marmora, 1834 m a.s.l. In the south-western part is the lowland Campidano. The climate is subtropical and the weather is dry and hot which influences the composition of vegetation cover of the island. The evergreen and deciduous forests have been largely cut down and now occupy only 4 percent of the area of Sardinia. Scrub formations predominate, with maquis in the north and garrigue in the south. Natural pastures cover more than one half of the area of Sardinia. The main agricultural plants are wheat, barley, grapes, olives, cork and tobacco.

From the phytogeographical point of view, Sardinia belongs to the Mesomediterranean zone with sclerophyllous cork oakwoods, i. e. natural forests with cork oak (*Quercus suber*), and with holm oak (*Quercus ilex*) (NOIRFALAISE, 1987). According to the classification of UDVARDY (1975), Sardinia

belongs to the Mediterranean Sclerophyll Biogeographic Province.

MATERIAL AND METHODS

We collected gall midge galls at 15 localities in the northern part of Sardinia during 18-31 May, 1997 by a uniform method - by slowly walking through various biotopes in the course of several hours, searching and collecting galls on various plants, or plants inhabited by mites, aphids or coccids, or rusts and fungi in which gall midge larvae may develop. Attacked plants with galls were put into polyethylene bags (each plant species separately) and then processed as described in earlier papers (e.g. SKUHRAVÁ & SKUHRAVY, 1997).

For scanning-electron-microscope (SEM) examination, specimens were removed from 75% alcohol, transferred into 80%, 96% and 100% alcohol, then dehydrated in 100% acetone, critical point CO₂ dried (Pelco CPD2) and subsequently each specimen was mounted on a small metal stub. After sputter coating with gold (SEM coating unit Polaron E 5100) they were examined in a JEOL JSM 6300 scanning electron microscope (Japan, 1992).

Determination of galls is based on HOUARD (1908-1909), of larvae on MÖHN (1955), of adults on SKUHRAVÁ (1997a), nomenclature of gall midge species is based on SKUHRAVÁ (1986). Nomenclature of host plants is based on TUTIN *et al.* (1964-1980) and PIGNATTI (1982).

Data gathered by these investigations were analysed from the zoogeographical point of view using methods described by SKUHRAVÁ (1987, 1994a, b, 1997b).

Host plants with galls of gall midges (voucher specimens) are deposited in the gall-midge-galls-collection of Marcela Skuhrová in Praha, Czech Republic.

LOCALITIES EXAMINED

The following data are given for each locality: the name of the locality, its altitude, short ecological characteristic together with important plant species or genera, and the date of our investigation. At the end, the number in parentheses indicates the position of the locality in the map (Fig. 1).

Arzachena, 80 m a.s.l.: archaeological site with pre-historical findings; rocks with sparse vegetation; *Pistacia*, *Olea europaea*, *Rhamnus alaternus*, *Myrtus*, *Rubus*, *Pyrus pyraeaster*, *Quercus ilex* (abundant), *Quercus coccifera* (scarce); 20.5.1997 (5).

Berchidda, 150-300 m a.s.l.: stands on a hill near the small town; in lowland

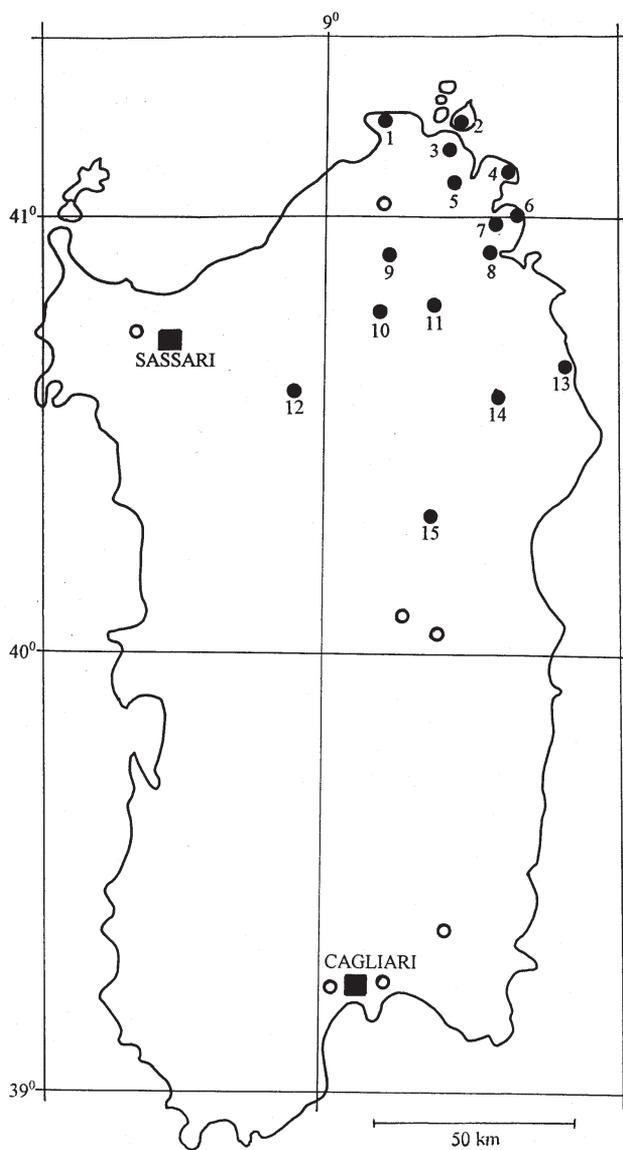


Fig. 1 - Map of Sardinia with localities where previous researchers collected galls (white circles) and localities where investigations of gall midge fauna were carried out in 1997 (black circles): 1 - Santa Teresa di Gallura; 2 - La Maddalena; 3 - San Pantaleo; 4 - Costa Smeralda; 5 - Arzachena; 6 - Golfo Aranci; 7 - Rudolza; 8 - Olbia; 9 - Calangianus; 10 - Berchidda; 11 - Monti; 12 - Chilivani; 13 - Budoni; 14 - Lodé; 15 - Núoro.

pastures; *Pistacia* spp., *Tamarix* spp., *Rhamnus alaternus*, *Crataegus*, *Quercus ilex*; plantations of *Quercus suber*; 21.5.1997 (10).

Budoni, 50 m a.s.l.: stands along a path up to a hill; extensive stands of *Cistus* sp.; *Euphorbia dendroides*, *Ruta*, *Myrtus*, *Verbascum*; *Eucalyptus globosus*, *Olea europaea*, *Quercus suber*, *Ficus carica*; 22.5.1997 (13).

Calangianus, 600 m a.s.l.: mountain landscape with sparse shrubs and trees; *Quercus ilex*, *Rhamnus alaternus*, *Crataegus*, *Prunus spinosa*, *Arbutus unedo*, *Myrtus*, *Erica* spp.; plantations of *Quercus suber*; 23.5.1997 (9).

Chilivani, 150 m a.s.l.: locality situated in the interior of Sardinia; stands along a path in the fields with poor shrubs and trees; *Rhamnus alaternus*, *Robinia*, *Crataegus*, *Pyrus*, solitary *Pinus pinea*; vineyards (*Vitis vinifera*), plantations with *Quercus suber*; 26.5.1997 (12).

Costa Smeralda, 0-50 m a.s.l.: stands on the sea-side with stands of *Salicornia europaea* and *Salsola kali*; 29.5.1997 (4).

Golfo Aranci, 0-100 m a.s.l.: shrub stands on rocks near the harbour, formed by granite rocks and cliffs; the main stands are formed by *Pistacia* sp., *Juniperus phoenicea*, *Olea europaea*, *Myrtus comminis*, *Cistus monspessulanum*, *Calicotome spinosa*, *Asphodelus* spp., *Rosmarinus* sp., *Mesembryanthemum*, on the rocks *Genista corsica* (6).

La Maddalena, 0-50 m a.s.l.: a small island northwards of northern Sardinia; hill-side covered with sclerophyllous macchia, with *Calicotome*, *Cistus*; *Rhamnus alaternus*, *Ficus carica*, *Rubus*; 28.5.1997 (2).

Lodé, 700 m a.s.l.: surroundings of a small town in mountains; hill-sides with vineyards and gardens with various vegetables; scattered trees and shrubs; *Quercus ilex*, *Pistacia*, *Myrtus*, *Ficus*, *Opuntia*; 30.5.1997 (14).

Monti, 380 m a.s.l.: stands along the path through vineyard with *Vitis vinifera*; plantations of *Quercus suber*, heavily damaged by caterpillars; orchards with *Olea europaea*; *Erica arborea*, *Rubus*, *Rosa*, *Cytisus* sp.; 25.5.1997 (11).

Núoro, 553-600 m a.s.l.: locality in the interior of Sardinia; hill-side of mountains covered with stands of *Cistus* sp., sparsely *Pistacia*, *Quercus pubescens*, *Rubus* and wild *Ficus*-trees; orchards with various sorts of *Citrus* (orange, lemon), plantations of *Olea europaea* and *Quercus suber*; 24.5.1997 (15).

Olbia, 20-50 m a.s.l.: stands on the small hill behind the town and pasture, sclerophyllous shrubs, *Olea europaea*, *Pistacia*, *Rhamnus alaternus*, *Phillyrea*, *Asparagus albus*, *Asphodelus*, *Calicotome*; 18.5.1997 (8).

Rudolza, 0-5 m a.s.l.: stands near a small town situated about 15 km from Olbia, near the bay; forest with sparse trees of *Eucalyptus globulosus*; *Rhamnus alaternus*, *Olea europaea*, *Prunus spinosa*, *Cistus monspessulanum*, *Pistacia* spp. and *Rubus* spp.; 19.5.1997 (7).

San Pantaleo, 100 m a.s.l.: rocks formed by granite, covered with poor vegetation; *Pistacia*, *Quercus ilex*, *Rhamnus alaternus*, *Rubus*, *Cotoneaster*, *Calicotome*, *Erica*

arborea; near a brook were stands of *Arundo donax*; 29.5.1997 (3).

Santa Teresa di Gallura, 0-50 m a.s.l.: the most northern part of Sardinia with poor vegetation along the path with low stands of *Cistus*; solitary trees of *Rhamnus alaternus*; *Rubus*, *Quercus ilex*, *Calicotome*, *Genista*; 27.5.1997 (1).

RESULTS

ANNOTATED LIST OF SPECIES

For each species the following data are given: description of gall, host plant species and plant family; life history (number of generations, place of pupation); locality or localities where the species was found; if need be the date of emergence of adults from material collected during our investigations; distribution in the Palaearctic region. New records for Italy are indicated by two asterisks (**), for Sardinia with one asterisk (*).

****Aphidoletes aphidimyza*** (Rondani, 1847)

Orange larvae live among various species of aphids and feed on them. Larvae of summer generations pupate among aphids, larvae of hibernating generation in the soil. This species is used for biological control of aphids. Locality: Olbia, La Maddalena, at both localities among aphids on the stem of *Chondrilla juncea* L. (Asteraceae). - Distribution: Holarctic.

****Apiomyia bergenstammi*** (Wachtl, 1882)

Larvae cause woody plurilocular galls on branches of *Pyrus pyraeaster* Burgsd. and *P. communis* L. (Rosaceae). One generation develops a year. Pupation takes place in galls. Localities: Arzachena, Calangianus. - Distribution: Submediterranean.

****Arnoldiola tympanifex*** (Kieffer, 1905)

Small pustule galls on the leaf of *Quercus ilex* L. (Fagaceae), with a round opening on the lower side. Locality: San Pantaleo. - Distribution: Mediterranean.

****Asphondylia calycotomae*** Kieffer in Houard, 1912

A solitary larva develops in a swollen pod (summer generation) or in a swollen leaf bud (hibernating generation) of *Calicotome villosa* (Poiret) Link. (Fabaceae). Localities: Budoni, Costa Smeralda, Golfo Aranci, La Maddalena,

Santa Teresa di Gallura, San Pantaleo. - Distribution: Mediterranean.

****Asphondylia cytisi*** Frauenfeld, 1873

A solitary larva develops in swollen flower buds of *Cytisus* sp. (Fabaceae). Localities: Calangianus, Monti; 1 female emerged on 25.5.1997. - Distribution: Euro-Siberian.

Asphondylia verbasci (Vallot, 1827)

A solitary larva develops in swollen flower buds of various species of *Verbascum* (Scrophulariaceae). CECCONI (1901) recorded galls on *Verbascum sinuatum* L. found by F. Cavara at Palabanda near Cagliari. Locality: Budoni. - Distribution: Mediterranean on *Verbascum sinuatum*, European on *Verbascum lychmitis*.

****Asphondylia*** sp.

Swollen bud or base of the pod of *Genista corsica* (Loisel) DC (Fabaceae). Locality: Golfo Aranci (only two galls). - Distribution: Mediterranean.

* ***Asphondylia*** sp.

Swollen bud of *Phillyrea angustifolia* L. (Oleaceae), 4 mm long, 2 mm broad, with thin walls, inside with a chamber. At the end of May the gall with an opening after emergence of adults. Locality: San Pantaleo. - Distribution: Mediterranean.

Note. We found a similar gall on *P. angustifolia* at Lido di Ostia near Roma, Italy, 16.5.1997.

****Baldratia salicorniae*** Kieffer, 1897

Larvae induce galls in internodes on stems of *Arthrocnemum (Salicornia) fruticosum* (L.) Moq. and other species and genera of Chenopodiaceae. Attacked internode is swollen and only one larva develops inside a chamber where it also pupates. Locality: Costa Smeralda. - Distribution: Mediterranean.

****Braueriella phillyreae*** (F. Löw, 1877)

Solitary larva causes a gall in the form of a pustule on the leaf of *Phillyrea angustifolia* L. (Oleaceae). Larva pupates in the gall. One generation develops a year. Localities: - Calangianus, San Pantaleo. - Distribution: Mediterranean.

Contarinia ballotae Kieffer, 1898

Larvae live gregariously among deformed leaves of the vegetative tip of *Ballota nigra* L. (Lamiaceae). Larvae leave galls and hibernate in soil. Probably only one generation develops a year. Locality: Olbia. - Distribution: European.

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

Larvae develop inside fruits of *Pyrus communis* L. (Rosaceae). The insides of fruits are blackened and hollowed out. Attacked fruits are irregular in shape, turn black, dry up and fall precociously to the ground. Larvae hibernate in the soil. One generation develops a year. Localities: Chilivani, Lodé. - Distribution: Holarctic.

****Contarinia*** sp.

Several up to 30 orange, jumping larvae live inside the pods of *Calicotome villosa* (Poiret) Link. (Fabaceae). No seed develops in attacked pods which are at first green with grey spots, then turn black, dry up and fall off precociously. Larvae leave attacked pods when they are mature. Probably only one generation develops a year. Localities: Budoni, Golfo Aranci, La Maddalena. - Distribution: Mediterranean.

*****Cystiphora schmidti*** (Rübsaamen, 1914)

Larvae cause pustule galls on leaves and stems of *Chondrilla juncea* L. (Asteraceae). Several generations develop a year. Larvae pupate in galls. This species is used for biological control in Australia and North America. Locality: La Maddalena; 4 females emerged from leaf galls on 4.6.1997. - Distribution: European; Rübsaamen described this species based on adults found at Grünberg (now: Zielena Gora in Poland). At present, *C. schmidti* occurs mainly in the Mediterranean area.

Cystiphora sonchi (Bremer, 1847)

Larvae cause pustule galls on various species of *Sonchus* L. (Asteraceae). Several generations a year. Larvae of summer generations pupate in galls, larvae of hibernating generation in the soil. This species was introduced into Canada for biological control. RIZZO and MASSA (1998) found galls during their investigations at Alghero (Sassari) on *Sonchus asper* (L.) Hill. - Distribution: Euro-Siberian.

Dasineura capsulae (Kieffer, 1901)

Hard galls on the vegetative tips of *Euphorbia pithyusa* L. (Euphorbiaceae) were found by F. Cavara at Cagliari (CECCONI, 1901; TROTTER & CECCONI, 1900-1917). - Distribution: European.

****Dasineura filicina*** (Kieffer, 1889)

Larvae live in rolled and thickened margins of leaflets of *Pteridium aquilinum* (L.) Kuhn (Hypolepidiaceae). When mature, larvae leave galls and fall off to the soil, where they hibernate. Probably only one generation develops a year. Locality: San Pantaleo. - Distribution: Euro-Siberian.

*****Dasineura papaveris*** (Winnertz, 1853)

Numerous larvae develop inside one capsule of *Papaver rhoeas* L. (Papaveraceae). Attacked capsules are slightly swollen or deformed. Larvae pupate inside capsules. Several generations develop a year. Localities: Berchidda, Chilivani, Lodé, Núoro, Olbia, Santa Teresa di Gallura. - Distribution: Euro-Siberian.

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

White, gregarious larvae induce galls on leaves of *Rubus* sp. (Rosaceae). Leaves are distorted, midrib swollen and bent. Mature larvae leave galls, fall to the soil where they pupate. Two generations develop a year. Localities: Arzachena, Berchidda, Budoni, Calangianus, Chilivani, La Maddalena, Lodé, Monti, Núoro, Olbia, Rudolza, Santa Teresa di Gallura, San Pantaleo. - Distribution: Euro-Siberian.

****Dasineura turionum*** (Kieffer & Trotter, 1904)

Very young, just budding stems of *Asparagus acutifolius* L. (Liliaceae) are deformed and swollen. Larvae leave galls and pupate in soil. Two generations develop a year. Localities: Arzachena, Berchidda, Budoni, Calangianus, Chilivani, Golfo Aranci, La Maddalena, Lodé, Monti, Núoro, Olbia, Rudolza, San Pantaleo, Santa Teresa di Gallura. - Distribution: Mediterranean.

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

Larvae cause galls on leaves on the vegetative tip of *Urtica dioica* L. (Urticaceae). Basal part of the leaf is swollen, fleshy, forming two galls along the midvein; inside each gall two to three larvae develop in a chamber. Larvae leave galls when mature and fall to the soil where they pupate. Two

generations develop a year. Locality: Monti (on *Urtica atrovirens* Req.). - Distribution: Euro-Siberian.

****Dasineura vagans*** (Kieffer, 1909)

Swollen flower bud of *Erica arborea* L. (Ericaceae). Locality: San Pantaleo. - Distribution: Mediterranean.

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

Larvae induce galls on leaflets of *Vicia cracca* L. (Fabaceae). Galls are formed of pod-like deformed and swollen leaflets. Mature larvae leave galls, fall to the soil where they pupate. Two generations develop a year. Localities: Monti, La Maddalena, San Pantaleo. - Distribution: Euro-Siberian.

Dictyomyia setubalensis (Tavares, 1902)

MASSALONGO (1895) and CECCONI (1901) recorded small galls on *Santolina chamaecyparissus* L. (Asteraceae) under the name „*Cecidomyidarum* sp.“ which were found by M. Martelli on Monte Gennargentu in 1894. - Distribution: Mediterranean.

Dryomyia lichtensteini (F. Löw, 1878)

Larvae cause galls on the leaves of *Quercus ilex* L. (Fagaceae). Each gall has a hemispherical part on the lower side and a lengthwise slot opening on the upper side of the leaf. A single larva develops in the central chamber where it hibernates and pupates in the spring of the following year. Only one generation develops a year. CECCONI (1901) recorded galls in the southern part of Sardinia. Localities: Calangianus, San Pantaleo. - Distribution: Mediterranean.

Geocrypta galii (H. Loew, 1850)

Larvae cause swellings on stems and flower stalks of various species of *Galium* L. (Rubiaceae). CECCONI (1901) recorded galls on *Galium saccharatum* All. at Cagliari. Larvae leave galls and pupate in the soil. Two generations develop a year. - Distribution: Euro-Siberian.

*****Giraudiella inclusa*** (Frauenfeld, 1862)

Solitary larva causes a corn-like, woody gall inside the stem of *Phragmites*

australis (Cav.) Trin. (*P. communis* Trin.) (Poaceae). Larva pupates in the gall. Two generations develop a year. Locality: San Pantaleo. - Distribution: Euro-Siberian.

****Jaapiella floriperda*** (F. Löw, 1888)

Larvae induce galls in flower buds of *Silene vulgaris* (Moench) Garcke (*S. inflata* Sm.) (Caryophyllaceae). Larvae leave galls and pupate in the soil. Two generations develop a year. Locality: Lodé. - Distribution: Euro-Siberian.

****Jaapiella*** sp.

Larvae occur in dried black mass inside the sheaths of *Foeniculum vulgare* Mill. (Apiaceae). Localities: Chilivani, La Maddalena. - Distribution: Mediterranean.

****Jaapiella*** sp.

Four adults (males) were reared from deformed capsules of *Papaver rhoeas* L. (Papaveraceae) 22.5.1997. Locality: Arzachena. - Distribution: Mediterranean.

****Kiefferia pericarpiicola*** (Bremer, 1847)

Larvae induce galls in the fruits of various species and genera of the family Apiaceae. The fruit is swollen, much enlarged, inside with a large chamber containing a single red larva. When mature, the larva makes an opening and falls to the soil where it hibernates. Only one generation develops a year. Locality: Chilivani (on *Foeniculum vulgare* Mill.). - Distribution: Euro-Siberian.

*****Lasioptera arundinis*** Schiner, 1854

Larvae develop in black mass inside thickened and shortened side shoots of *Phragmites australis* (Cav.) Trin. (Poaceae). Larvae pupate in galls. Only one generation develops a year. Locality: San Pantaleo. - Distribution: European.

Lasioptera carophila F. Löw, 1874

Larvae induce galls in bases of umbellules in inflorescences of various species of the family Apiaceae. A single larva develops inside a chamber where it also pupates. Two generations a year. MÖHN (1966-1971) studied galls caused by this species on *Carum ammoides* Benth. & Hook. which were found near Cagliari on 27 May, 1863 (collector is not given). Localities: Arzachena, Berchidda, Calangianus, Chilivani, La Maddalena, Lodé, Monti,

Núoro, Rudolza, Santa Teresa di Gallura, San Pantaleo (at all localities on *Foeniculum vulgare* Mill.). - Distribution: European.

****Lasioptera eryngii*** (Vallot, 1829)

Larvae cause swellings on stems and flower stalks of *Eryngium campestre* L. and its relatives (Apiaceae). Each gall usually contains several to many chambers, each with one larva. Pupation takes place in the gall. Several generations develop a year. Locality: Arzachena (on *Eryngium maritimum* L.); 16 adults emerged from one gall on 4.6.1997. - Distribution: Sub-Mediterranean.

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

Larvae cause swellings on stems and flower and leaf stalks of various species of *Rubus* L. (Rosaceae). Larvae hibernate in galls where they also pupate in the spring of the following year. Only one generation develops a year. Locality: Budoni. - Distribution: Euro-Siberian.

Lestodiplosis asphodeli Barnes, 1934

Zoophagous larvae were found by Prof. Silvestri preying on larvae of *Silvestrina asphodeli* Barnes on *Asphodelus* sp. (Liliaceae) at Cagliari. Larvae and adults were sent to H. F. Barnes and he described a new species (BARNES, 1934). - Distribution: Mediterranean.

Myricomyia mediterranea (F. Löw, 1875)

Single larvae cause small rosette galls on the twigs of *Erica arborea* L. and *E. scoparia* L. (Ericaceae). Each gall consists of several deformed leaves and has a central chamber containing only one larva. Pupation takes place in the gall. Only one generation develops a year. CECCONI (1901) recorded galls found in the southern part of Sardinia. Localities: Calangianus, Monti, San Pantaleo; 1 male and 3 females emerged from galls between 23.-30.5.1997. - Distribution: Mediterranean. - Morphological characters of this gall midge species, a typical representative of the Mediterranean fauna, are shown in scanning electron micrographs (Figs 2-10).

****Ozirhincus longicollis*** Rondani, 1840

Larvae develop in swollen achenes in inflorescence of *Chrysanthemum* sp. (Asteraceae). Only a single larva lives in central chamber. Two generations develop a year. Locality: Lodé. - Distribution: European.

****Placochela nigripes*** (F. Löw, 1877)

Larvae induce galls in flower buds of *Sambucus nigra* L. (Caprifoliaceae). Several larvae develop in one gall. Pupation takes place in the soil. One generation develops a year. Localities: Calangianus, Núoro. - Distribution: European.

****Probruggmanniella phillyreae*** (Tavares, 1907)

Larvae develop in swollen fruits of *Phillyrea angustifolia* L. (Oleaceae) where they pupate. Only one generation develops a year. Locality: San Pantaleo. - Distribution: Mediterranean.

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

Larvae cause spindle terminal leaf bud galls on *Salix fragilis* L., *S. alba* L. and on related willow species and their hybrids (Salicaceae). Larvae are gregarious, in one gall up to 40 larvae may develop. There are several generations a year. Larvae of summer generations pupate either in galls or in the soil, larvae of overwintering generation pupate in the soil. Locality: Berchidda (on *Salix alba*). - Distribution: Euro-Siberian.

Silvestriola asphodeli (Barnes, 1934)

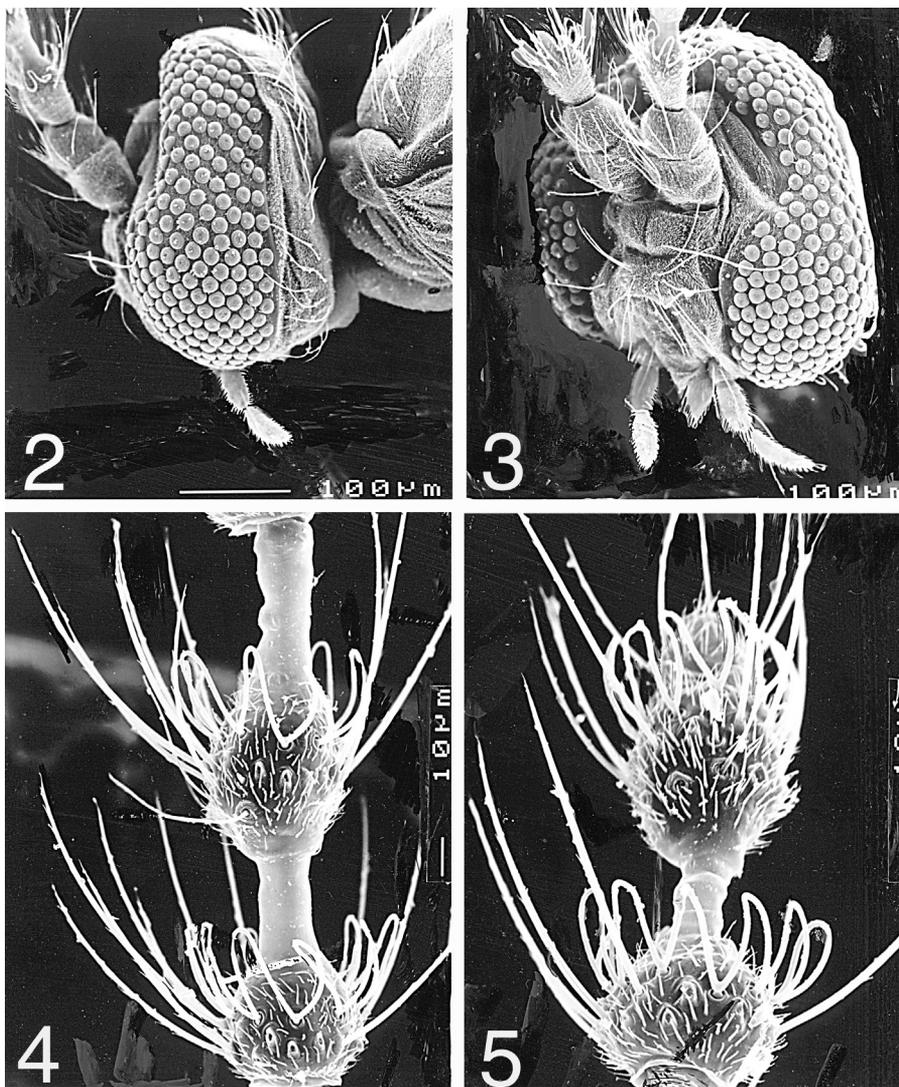
Adults of gall midges were bred from dry inflorescences of *Asphodelus* sp. (Liliaceae) collected at Cagliari by Prof. Silvestri and sent to H. F. Barnes for determination. BARNES (1934) described them as a new species. Larvae are probably zoophagous. - Distribution: Mediterranean.

Stefaniella atriplicis Kieffer, 1898

Larvae develop in swollen stem or in leaves of *Atriplex halimus* L. (Chenopodiaceae). CECCONI (1901) found galls at Cagliari and designated them as „*Cecidomyidarum* sp.“. - Distribution: Mediterranean.

Wachtliella ericina (F. Löw, 1885)

Larvae cause large conical galls on branches of various species of *Erica* L. (Ericaceae). Each gall consists of many leaves. Inside the gall only a single larva develops and pupates there in a white cocoon. Only one generation a year. Galls on *Erica arborea* L. were found by CECCONI (1903) at Tiana. Localities: Calangianus, Monti, San Pantaleo (at all localities on *Erica arborea* L.). - Distribution: Sub-Mediterranean.

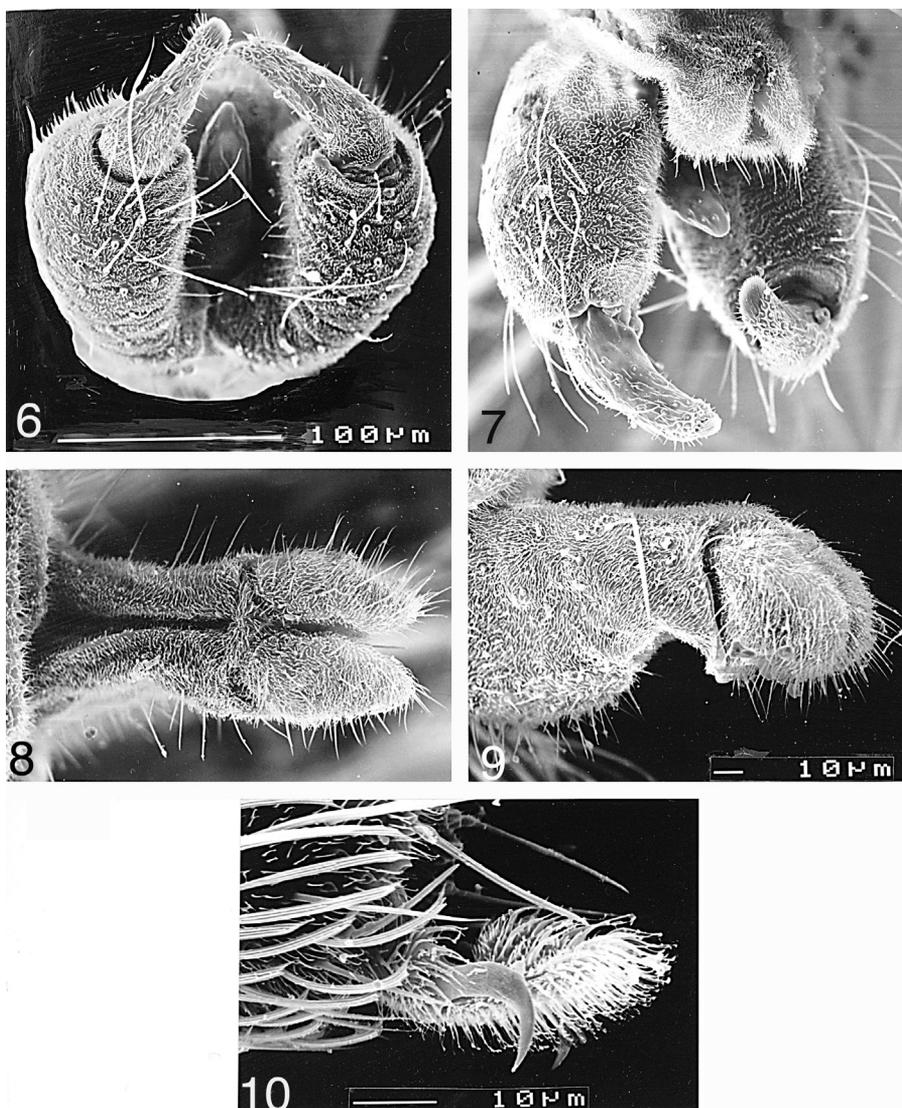


Figs 2-5 - *Myricomyia mediterranea* (F. Löw, 1875), male: 2 - head, lateral view; 3 - head, frontolateral view; 4 - 5th flagellomere; 5 - 12th flagellomere.

LIST OF HOST PLANTS ATTACKED BY GALL MIDGES

Host plant species
Arthrocnemum fruticosum
Asparagus acutifolius

Gall midge species
Baldratia salicorniae
Dasineura turionum



Figs 6-10 - *Myricomyia mediterranea* (F. Löw, 1875): 6 - male terminalia, ventral view; 7 - male terminalia, dorsal view; 8 - terminal part of ovipositor, dorsal view; 9 - terminal part of ovipositor, lateral view; 10 - terminal part of tarsus with claws and empodium.

Asphodelus sp.

Atriplex halimus

Ballota nigra

Silvestriola asphodeli (zoophagous)

Lestodiplosis asphodeli (zoophagous)

Stefaniella atriplicis

Contarinia ballotae

<i>Calicotome villosa</i>	<i>Asphondylia calycotomae</i>
<i>Carum ammoides</i>	<i>Contarinia</i> sp.
<i>Chondrilla juncea</i>	<i>Lasioptera carophila</i>
<i>Chrysanthemum</i> sp.	<i>Cystiphora schmidtii</i>
<i>Cytisus</i> sp.	<i>Aphidoletes aphidimyza</i> (zoophagous)
<i>Erica arborea</i> ,	<i>Oziorhincus longicollis</i>
<i>Erica scoparia</i>	<i>Asphondylia cytisi</i>
<i>Eryngium maritimum</i>	<i>Myricomyia mediterranea</i>
<i>Euphorbia pithyusa</i>	<i>Wachtliella ericina</i>
<i>Foeniculum vulgare</i>	<i>Dasineura vagans</i>
<i>Galium saccharatum</i>	<i>Lasioptera eryngii</i>
<i>Genista corsica</i>	<i>Dasineura capsulae</i>
<i>Papaver rhoeas</i>	<i>Jaapiella</i> sp.
<i>Phillyrea angustifolia</i>	<i>Kiefferia pericarpicola</i>
<i>Phragmites australis</i>	<i>Geocrypta galii</i>
<i>Pteridium aquilinum</i>	<i>Asphondylia</i> sp.
<i>Pyrus pyraster</i> ,	<i>Dasineura papaveris</i>
<i>Pyrus communis</i>	<i>Jaapiella</i> sp.
<i>Rubus</i> sp.	<i>Braueriella phillyreae</i>
<i>Quercus ilex</i>	<i>Probrugmanniella phillyreae</i>
<i>Salix alba</i>	<i>Asphondylia</i> sp.
<i>Sambucus nigra</i>	<i>Giraudiella inclusa</i>
<i>Santolina chamaecyparissus</i>	<i>Lasioptera arundinis</i>
<i>Silene vulgaris</i>	<i>Dasineura filicina</i>
<i>Sonchus asper</i>	<i>Aptomomyia bergenstammi</i>
<i>Urtica atrovirens</i>	<i>Contarinia pyrivora</i>
<i>Verbascum sinuatum</i>	<i>Dasineura plicatrix</i>
<i>Vicia cracca</i>	<i>Lasioptera rubi</i>
	<i>Arnoldiella tympanifex</i>
	<i>Dryomyia lichtensteini</i>
	<i>Rabdophaga terminalis</i>
	<i>Placochela nigripes</i>
	<i>Dictyomyia setubalensis</i>
	<i>Jaapiella floriperda</i>
	<i>Cystiphora sonchi</i>
	<i>Dasineura urticae</i>
	<i>Asphondylia verbasci</i>
	<i>Dasineura viciae</i>

NUMBER OF SPECIES FORMING THE PRESENT FAUNA OF SARDINIA

The present gall midge fauna of Sardinia involves, including findings of earlier authors, 44 species of which 31 are new records for Sardinia. Such number of species is not high but it is appropriate to dry and hot weather conditions where the composition of plant communities is relatively poor in plant species which may be hosts of gall midges. The number of gall midge

species in Sardinia corresponds to the species numbers occurring in other islands in the Mediterranean area: 38 species in Crete (SKUHRAVÁ & SKUHRAVY 1997), 36 species in Malta (SKUHRAVÁ *et al.*, in press) and 23 in Mallorca (SKUHRAVÁ & SKUHRAVY, in press).

The majority of gall midges found in Sardinia are phytophagous species, larvae of which cause galls or live in association with host plants. Most of these host plants are various herbs and only a small part - nine species - are shrubs and trees. Only three species, *Aphidoletes aphidimyza*, *Lestodiplosis asphodeli* and *Silvestriola asphodeli*, are predaceous gall midges. Larvae of *Aphidoletes aphidimyza* which attack aphids are used in several countries for biological control against aphids. Two other species - *Cystiphora sonchi* and *C. schmidti* are used in biological control of weeds, *Sonchus* and *Chondrilla*, respectively.

Five gall midge species were determined to the genus level only. All are undescribed species, the galls or damage on host plants were recorded for the first time. They will be described in the future only when adults will be reared from these galls.

CONTRIBUTION TO THE GALL MIDGE FAUNA OF ITALY

Four species, viz. *Cystiphora schmidti*, *Dasineura papaveris*, *Giraudiella inclusa* and *Lasioptera arundinis*, galls of which were found during our investigations in 1997 in Sardinia, are new records for the gall midge fauna of Italy. If we also include in the faunal list of the Italian fauna the species *Asphondylia trabutii* Marchal, 1896, forming galls on *Solanum nigrum* L., found by RIZZO & MASSA (1998) at several localities in southern Italy and Sicily, and the results of our investigations in South Tirols (SKUHRAVÁ *et al.*, 2001), the present known gall midge fauna of Italy includes 385 species.

ZOOGEOGRAPHY

During our investigations in 1997 at 15 localities of Sardinia which were situated from the sea level up to the altitude of about 700 m a.s.l., 35 gall midge species were found. Two to fifteen gall midge species were found at individual localities, on the average 6,5 species per locality. Such low species number per locality indicates that the gall midge fauna of Sardinia is not too rich. The highest number, 15 gall midge species, was found at the locality San Pantaleo, at an altitude of about 100 m a.s.l., where a relatively rich composition of various plants, herbs, small trees and shrubs occur on the rocks and along the brook. At most other localities it was difficult to find plants which should be hosts of gall midges because practically all vegetation is eaten by sheep. To find something, it is necessary to search herbs hidden

under shrubs at the margin of pastures.

From the point of zoogeographical analysis, the gall midge fauna of Sardinia is formed of 52% species belonging to Mediterranean, 14% to European, 30% to Eurosiberian and 4% to Holarctic species. The majority of gall midges (23 species) belong to Mediterranean elements the host plants of which occur only in the area of the Mediterranean, as for example *Asphondylia calycotomae*, *Braueriella phillyreae*, *Dasineura turionum* and *Myricomyia mediterranea*. Six gall midges belong to European species, viz *Contarinia ballotae*, *Dasineura capsulae*, *Lasioptera arundinis*, *L. carophila*, *Ozirhincus longicollis* and *Placochela nigripes*. Their host plants occupy a large distribution area in Europe and some of them occur also in northern Africa. Thirteen gall midge species belong to the Euro-Siberian element. They occupy large distribution areas extending from Europe up to western, central or eastern Siberia. *Kiefferia pericarpicola* is the typical representative of this group. Only two gall midge species occurring in Sardinia have Holarctic distribution. *Aphidoletes aphidimyza*, larvae of which prey on aphids and are used for biological control, and *Contarinia pyrivora*, a pest of pear.

In horizontal occurrence and abundance, the majority of gall midge species occur very rarely having been found only once (each at only one locality), twice (each at two localities) or three times (each species at three localities). *Asphondylia calycotomae* and *Dasineura papaveris* occur in Sardinia fairly numerously (each species having been found at six localities). Three species, viz. *Lasioptera carophila*, *Dasineura plicatrix* and *Dasineura turionum* are the most abundant gall midge species in Sardinia. They were found at practically every locality where the investigation was carried out.

ECONOMIC IMPORTANCE

At present there are no records of injury caused by gall midge species to cultivated plants in Sardinia. In the course of our investigations we found two species, viz. *Apiomyia bergenstammi* and *Contarinia pyrivora*, both associated with *Pyrus communis*, which should be taken into consideration as potential pests of pear in Sardinia.

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RIASSUNTO

CECIDOMIIDI (DIPTERA: CECIDOMYIIDAE) DELLA SARDEGNA: SECONDO CONTRIBUTO ALLA FAUNA D'ITALIA

Una indagine sui Cecidomiidi della Sardegna è stata eseguita nel 1997. Sono state effettuate raccolte in località comprese tra la costa e 700 m di altitudine con il rinvenimento di 35 specie delle quali 31 nuove per la Sardegna (che elevano il totale a 44) e 4 (*Cystiphora schmidti*, *Dasineura papaveris*, *Giraudiella inclusa* e *Lasioptera arundinis*) nuove per la fauna italiana.

Con queste nuove segnalazioni, la fauna italiana comprende 385 specie. In Sardegna sono state rinvenute 2-15 specie per località con una media di 6,5 specie per località.

Il maggior numero di specie (15) è stato accertato a San Pantaleo, nella parte più settentrionale della Sardegna. La fauna cecidomiidica è formata dal 52% di specie mediterranee, 14% europee, 30% euro-siberiane, 4% oloartiche. *Asphondylia calycotomae*, *Braueriella phillyreae*, *Dasineura turionum* e *Myricomyia mediterranea* sono tipici rappresentanti dell'ambiente mediterraneo. Al momento, *Lasioptera carophila*, *Dasineura plicatrix* e *Dasineura turionum* sono i Cecidomiidi più abbondanti in Sardegna. *Apiomyia bergenstammi* e *Contarinia pyrivora*, entrambi associati al *Pyrus communis*, sono potenziali organismi dannosi al pero in Sardegna. Viene fornita una lista dei cecidomiidi e delle loro piante ospiti. Infine alcuni caratteri morfologici degli adulti di *Myricomyia mediterranea* sono illustrati con micrografie al microscopio elettronico a scansione.

Parole chiave: Cecidomyiidae, faunistica, zoogeografia, Mediterraneo, Italia, Sardegna, distribuzione, importanza economica, organismi dannosi.

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