

Remarks on some families of leaf-mining Microlepidoptera from central-southern Sardinia, with some ecological considerations (Lepidoptera: Nepticulidae, Bucculatricidae, Gracillariidae)*

Paolo TRIBERTI¹, Sonia BRAGGIO²

¹*clo Museo Civico di Storia Naturale, Lungadige Porta Vittoria 9, I-37129 Verona, Italy. E-mail: caloptilia@alice.it*

²*Via Moron 20, I-37024 Negrar (VR), Italy. E-mail: soniabraggio@libero.it*

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ABSTRACT

Results of a faunistic study in Sardinia on three families of leaf miners (Microlepidoptera: Nepticulidae, Bucculatricidae and Gracillariidae) are presented. The study areas are located in the south-western and central-eastern parts of the island: the Linas-Orida-Marganai Regional Park and the Golfo di Orosei and Gennargentu National Park. A total of 27 species are recorded, including 7 new for Sardinia and one (*Trifurcula rosmarinella* (Chrétien, 1914) (Nepticulidae)) new for Italy. Besides, in the family Nepticulidae the study of two species is still in progress whereas a third one, *T. montana* Laštůvka Z., Laštůvka A. & van Nieuwerkerken, 2007, was recently described as new for science. In the faunistic list each species is accompanied by a short comment on distribution and biology. Because of the notable supply of data in these last years, the list of all the species known from Sardinia of these three families is reported together with their hostplants. Particular attention is reserved to the evergreen oak leaf miners and the sampling of the mines of these insects is suggested for monitoring ecological changes.

Key words: *Lepidoptera, Nepticulidae, Bucculatricidae, Gracillariidae, leaf-miner monitoring.*

RIASSUNTO

Note su alcuni microlepidotteri minatori fogliari (Nepticulidae, Bucculatricidae, Gracillariidae) della Sardegna centro-meridionale, con alcune considerazioni ecologiche (Lepidoptera)

Sono riportati i risultati di una ricerca faunistica su tre famiglie di microlepidotteri minatori fogliari (Nepticulidae, Bucculatricidae e Gracillariidae) in Sardegna. Le aree interessate alla ricerca sono comprese nel Parco Regionale di Linas-Orida-Marganai e nel Parco Nazionale del Golfo di Orosei e del Gennargentu. Le specie segnalate sono 27, di cui 7 nuove per la Sardegna e 1 (*Trifurcula rosmarinella* (Chrétien, 1914) (Nepticulidae)) nuova per l'Italia. Inoltre, nella famiglia Nepticulidae due specie sono ancora in corso di studio mentre una terza, *T. montana* Laštůvka Z., Laštůvka A. & van Nieuwerkerken, 2007, è stata recentemente descritta come nuova per la scienza. Nell'elenco faunistico per ogni specie sono riportati brevi commenti sulla distribuzione e sulla biologia. Dato il notevole afflusso di dati in questi ultimi anni, è fornito l'elenco delle specie note a tutt'oggi per la Sardegna con le relative piante ospiti. Particolare attenzione è dedicata ai minatori delle querce sempreverdi e la raccolta delle mine di questi insetti è suggerita per monitorare i cambiamenti ecologici dell'ambiente.

INTRODUCTION

The aim of this paper is to examine the diversity patterns of the leaf-mining Microlepidoptera community in two reserves in central-southern Sardinia: the Linas-Orida-Marganai Regional Park and the Golfo di Orosei and Gennargentu National Park. The present knowledge of these families in the mentioned areas is mainly due to research by Amsel & Hering

(1933), Amsel (1936) and Hartig & Amsel (1952). These records are summed up in the Checklist of the species of the Italian Fauna (Karsholt et al. 1995; Gaedicke et al. 1995). The faunistic list presented in this study has been obtained from field research headed by Triberti during 1999, in the Golfo di Orosei and Gennargentu National Park, by Baldizzone & Triberti during 2004 and by the Centro Nazionale per lo Studio e la Conservazione della Biodiversità Fore-

stale "Bosco Fontana" of Verona (CNBFVR) during 2005–2006 in the Linas-Oridda-Marganai Regional Park. Some interesting, unpublished records from the authors' collections are added.

The evergreen oak forest is of particular importance in these reserves. It is dominated by the holm oak (*Quercus ilex*), often mixed with cork oak (*Q. suber*). These trees are long-lived, resprout readily after fire or cutting, and are very useful in the areas at hydrogeological risk and characterized by soil unbalance. Evergreen oak forest is included in the EU Habitats Directive as *Quercus suber* forests (code 9330) and *Quercus suber* and *Quercus rotundifolia* forests (code 9340). Sardinia can be considered one of Europe's largest reserves of these forests (Grill et al. 2005).

For this reason, particular attention is devoted to the leaf miners of *Quercus ilex* and *Q. suber*. It is also suggested to use these insects (and leaf miners in general) for evaluating and monitoring biodiversity as well as implementing conservation measures in evergreen oak forests.

STUDY AREA

Linis-Oridda-Marganai Regional Park

The reserve is located in the Carbonia-Iglesias and Medio Campidano provinces (SW Sardinia) and covers about 22,000 ha. Almost the whole area is hilly and mountainous and characterized by two different zones, both from a geological and floristic-vegetational point of view (Ballero & Angiolino 1991; Anonymous 2007). The first one is that of Mount Linas (1239 m), prevalently made of granitic rocks. The second one, more southern, is the area of Marganai, a limestone and schist massif reaching an altitude of 939 m. Most of the reserve is covered by *Quercus ilex*, *Q. suber* and dense Mediterranean shrublands (cf. Angius et al. 2011; Badiani 2011). *Quercus pubescens* is not present. It has been possible to study material from the southern surroundings of the reserve, from Mount Arcosu (Mossa et al. 1996), Musei and Porto Botte.

Golfo di Orosei and Gennargentu National Park

The territory is located in the Nuoro and Ogliastra provinces and covers a total area of about 74,000 ha. Three main geological units can be distinguished: the northern area is characterized by a calcareous upland crossed by the granitic valley of the Flumineddu river, the western one by granitic rocks, the Gennargentu and Ogliastra unit by a dominance of metamorphic rocks. In this reserve, *Quercus ilex* and *Q. suber* are

still dominant but often they are replaced by *Q. pubescens* (Arrigoni & Di Tommaso 1991).

MATERIAL AND METHODS

The research was conducted using 15W universal Wood and actinic light tubes powered by 12V batteries according to collecting systems broadly in use. Collecting sites were selected preferring clearings or open evergreen oak woodlands where the floristic abundance was high. Particular attention was paid to the fauna of the evergreen *Quercus* woods, where only the families Nepticulidae and Gracillariidae occur. Reference works for these groups are the following: van Nieukerken (1985), Laštůvka & Laštůvka (1997) and van Nieukerken & Johansson (2003) for Nepticulidae; Laštůvka & Laštůvka (2007a) for Gracillariidae (genus *Phyllomorcyter* Hübner, 1822). Nomenclature of hostplants follows Pignatti (1982). The distribution of each species is given, unless otherwise stated, according to the following catalogues: Checklist delle specie della fauna italiana (Karsholt et al. 1995, Nepticulidae; Gaedicke et al. 1995, Bucculatricidae and Gracillariidae) and Fauna Europaea (van Nieukerken 2004, Nepticulidae; Mey 2004, Bucculatricidae; Buszko 2004, Gracillariidae). For each mentioned species, records inferred from the literature and concerning the study areas were also added; they are listed under "Literature records".

The collecting localities are listed according to the current Sardinian provinces to which they belong (Cagliari, Carbonia-Iglesias, Medio Campidano, Nuoro, Ogliastra) and in alphabetical order, with the municipality listed first when known and the province in bold.

The examined material is preserved in the authors' collections. As these researches were not conducted using quantitative methods, the number of collected specimens was not reported.

ABBREVIATIONS

COLLECTORS. DA = D. Avesani; DB = D. Birtele; DW = D. Whitmore; EM = E. Minari; FH = F. Hartig; GB = G. Baldizzone; GD = G. Derra; GN = G. Nardi; KU = J.H. Kuchlein; MB = M. Badiani, MT = M. Tisato; PCe = P. Cerretti; PT = P. Triberti.

OTHER ABBREVIATIONS AND RECURRENT TERMS USED IN THE FAUNISTIC LIST. exl. = ex larva; F. = River; fove = river mouth; lt = light trap; Lago = Lake; leg. = legit; M. = Mount; M.ti = Mounts; mn = mine; sp. n. = new species; prov. = province; Rio = stream, small river.

FAUNISTIC LIST

NEPTICULIDAE

The Nepticulidae are a rather large, cosmopolitan family with about 260 species known from Europe (van Nieukerken 2004). They are considered one of the more primitive groups within the Lepidoptera. The adults are very small, 2.5–6.5 mm in wingspan, rarely up to 12 mm. The larvae mine the leaves of herbs, shrubs and trees; only rarely bark, petioles, buds and fruits of plants are also mined. They are permanent miners, feeding continuously between the epidermis and, with a few exceptions, they pupate outside the mine. The shape of the mines, and the pattern of disposition of the frass inside the mine are very characteristic and important characters to identify the larvae at species level. The Italian fauna includes about 140 species, 32 of which also known from Sardinia.

1. *Stigmella rolandi* van Nieukerken, 1990

RECORDS. **Carbonia-Iglesias prov.:** Iglesias, M.ti Marganai, 500 m, 3.IX.2006, DB PCe EM MT DW, lt; Iglesias, Conca Margiani, 725 m, 7.IX.2006, DA MB DB GN, lt; Rio Tiny, 200 m, 5.IX.1973, FH. **Nuoro prov.:** 10 km W Dorgali, 26.VII.1999, PT, lt.

DISTRIBUTION. Centralasiatic-European (Laštůvka & Laštůvka 1997). In Italy it is recorded from Venetia, Latium, Abruzzi, Sardinia (van Nieukerken 1990). ECOLOGY. Hostplants: *Rosa* spp. and *Sanguisorba* spp. (Laštůvka & Laštůvka 1997). Mine: a long and contorted gallery, frass deposited in a black central line throughout the mine leaving broad, clear margins. The larva is found in late August and September, adults from early June until early September (van Nieukerken 1990).

2. *Stigmella paradoxa* (Frey, 1858)

RECORDS. **Nuoro prov.:** F. Cedrino, 5 km SW Galtelli, 16.VII.1999, PT, lt.

DISTRIBUTION. Western, central, eastern and southern Europe, including southern Sweden. In Italy it is known only from the northern area and Sardinia. ECOLOGY. Hostplants: *Crataegus* spp. Mine: it starts as a slender gallery, but later it strongly widens into a blotch, with frass as a central patch. Bivoltine, larva is found in May, June and August (Laštůvka & Laštůvka 1997).

3. *Stigmella minusculella* (Herrich-Schäffer, 1855)

RECORDS. **Nuoro prov.:** 10 km W Dorgali, 26.VII.1999, PT, lt.

DISTRIBUTION. Europe, excluding the Iberian and Scandinavian peninsulas. Widespread in Italy (Karsholt et al. 1995), it is new for Sardinia. This distribution needs to be checked because of the recent recognition of a closely related species (Laštůvka & Laštůvka 2004).

ECOLOGY. Hostplants: *Pyrus* spp. (including *P. amygdaliformis*). Mine: as a slender gallery with linear frass in the first part; later it widens, with the frass distributed as a narrow line, leaving broad clear margins. Larvae feed from June to July and August to September. Adults fly from April to May and from July to October (Puplesis 1994).

4. *Stigmella* sp.

RECORDS. **Cagliari prov.:** M. Arcosu, Perdu Melis, 320 m, 25.VI.2004, PT GB, lt.

NOTES. Only one male was collected and this did not allow for a reliable identification. Van Nieukerken (pers. comm., 2009) considers it close to *S. salicis* (Stainton, 1854).

5. *Stigmella suberivora* (Stainton, 1869)

RECORDS. **Cagliari prov.:** M. Arcosu, Perdu Melis, 320 m, 25.VI.2004, PT GB, lt; M. Arcosu, Paddera, 600 m, 26.VI.2004, PT GB, lt; M. Arcosu, Sa Canna, 22–24.VI.2004, PT GB, lt. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 26–30.VI.2004, PT GB, lt; Domusnovas, Sa Duchessa, 350 m, 28.VI–2.VII.2004, PT GB, lt; Iglesias, Conca Margiani, 725 m, 7.IX.2006, DA MB DB GN, lt. **Medio Campidano prov.:** Villacidro, Canali Serci, 381 m, 7.IX.2006, DA MB DB GN, lt. **Nuoro prov.:** 10 km W Dorgali, 26.VII.1999, PT; F. Cedrino, 5 km SW Galtelli, 16.VII.1999, PT.

LITERATURE RECORDS. **Nuoro prov.:** Bacu Trotu, Ortuabis, 800 m, 23.VIII.1978, 3.IX.1978, 23.VI.1979, GD; Belvi, 650 m, 20.VII.1984, KU; Belvi surroundings, 700 m, 7.X.1975, FH; Belvi, M. Istiddi, 900 m, 9.VI.1977, FH; M. Istiddi, 700 m, 19–28.V.1975, 30.VI.1976, 13.VIII.1977, 1.IX.1978, GD; Mamoiada, 25.VII–30–31.VII.1983, KU; Palolu, Meana-Sardo, 6.VIII.1977, GD (van Nieukerken & Johansson 2003). **Ogliastra prov.:** Seùii, 1100 m, 20.VII.1983, KU; Villanova-Strisàili, 1–15.VIII.1983, 11–12–25.VII.1984, KU (van Nieukerken & Johansson 2003).

DISTRIBUTION. W-Mediterranean with extension to Portugal; introduced and established in southern England. In Italy it is known from Liguria, Venetia, Friuli, Latium, Campania, Sicily, Sardinia (van Nieukerken & Johansson 2003).

ECOLOGY. Hostplants: *Quercus ilex* and *Q. suber*, elsewhere also on *Q. coccifera* and *Q. rotundifolia*. Mine (fig. 1): a thin gallery filled with black frass, later leaving distinct clear margins. Larva feeds from December to April but probably there are two or more generations in the Mediterranean (Laštůvka & Laštůvka 1997). Adults fly from April to October.

NOTES. The mine of this species is similar to that of *Ectoedemia heringella* (Mariani, 1939) but usually much wider and longer, often with thin clear margins. Adults are easily distinguishable by the lack of white spots on the forewing. Recently, another closely related species was recognised as distinct: *S. ilicifoliella* (Mendes, 1918). Its occurrence in Italy is possible (van Nieukerken & Johansson 2003).

6. *Stigmella aurella* (Fabricius, 1775)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 26–30.VI.2004, PT GB, It; M. Arcosu, Sa Canna, 22.VI.2004, PT GB, It.

DISTRIBUTION. Central and southern Europe (Laštůvka & Laštůvka 1997). In Italy it is a rather common species, occurring from Venetia to Sicily and Sardinia.

ECOLOGY. Hostplants: *Rubus ulmifolius*, *Geum urbanum*, *Fragaria* spp. and *Agrimonia* spp. Mine: a long and contorted gallery, with frass deposited in a thin, discontinuous central line throughout the mine. In southern Europe the species has more than two generations.

7. *Acalyptis minimella* (Rebel, 1926)

RECORDS. **Cagliari prov.:** M. Arcosu, Sa Canna, 22.VI.2004, PT GB, It; M. Arcosu, Perdu Melis, 320 m, 25.VI.2004, PT GB, It; M. Arcosu, Su Tragu, 29.VI.2004, PT GB, It. **Nuoro prov.:** 10 Km W Dorgali, 26.VII.1999, PT, It; F. Cedrino, 5 km SW Gallu, 16.VII.1999, PT, It.

DISTRIBUTION. Mediterranean, not recorded from North Africa. In Italy it occurs in Basilicata, Sicily and Sardinia (van Nieukerken 2007).

ECOLOGY. Hostplants: *Pistacia lentiscus*. Mine: a long gallery, initially filled with frass, later leaving clear margins. A bivoltine species, or with more generations.

8. *Trifurcula (Glaucolepis) rosmarinella* (Chrétien, 1914)

RECORDS. **Cagliari prov.:** M. Arcosu, Sa Canna, 22.VI.2004, PT GB, It; M. Arcosu, Perdu Melis, 320 m, 25.VI.2004, PT GB, M.

Arcosu, Su Tragu, 29.VI.2004, PT GB, It.

DISTRIBUTION. Mediterranean, not recorded from North Africa: Portugal, Spain, France and Corsica, Cyprus (Laštůvka & Laštůvka 1997). New to Italy.

ECOLOGY. Hostplants: *Rosmarinus officinalis*. Mine: a long gallery, filled with frass, along the leaf margin. The species is univoltine. Adults are active from May to July, larvae from November to the following spring (Laštůvka & Laštůvka 1997).

9. *Trifurcula (Glaucolepis) montana* Laštůvka Z., Laštůvka A. & van Nieukerken, 2007

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 28.VI–2.VII.2004, PT GB, It [paratypes].

LITERATURE RECORDS. **Nuoro prov.:** Gennargentu, Arcu Frucca, 24.VI.1979, GD (Laštůvka & Laštůvka 2007b).

DISTRIBUTION. Spain and Sardinia (Laštůvka & Laštůvka 2007b).

ECOLOGY. The biology of this species is unknown. The adults have been collected at light from April to July in mountains between 350 and 2000 m, always close to patches of *Thymus vulgaris*, the possible host-plant (Laštůvka & Laštůvka 2007b).

10. *Trifurcula (Trifurcula)* sp. n.

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sedda Pranu Cardu, 500 m, 7.IX.2006, DA MB DB GN, It. **Medio Campidano prov.:** Villacidro, Canali Serci, 381 m, 7.IX.2006, DA MB DB GN, It; Villacidro, Pta piscina Argiolas, Serbatoio, 282 m, 12.IX.2006, DA MB DB GN, It.

NOTES. An unknown species, surely new for science, found (not rare) at light in some localities of the Linnas-Oridda-Marganai Park. Like the previous species it belongs to the genus *Trifurcula* Zeller 1848, members of which are exclusively miners of Fabaceae, the majority on brooms (Genisteae). This species is currently being studied by a specialist of the family (van Nieukerken, pers. comm.).

11. *Ectoedemia groschkei* (Skala, 1943)

RECORDS. **Nuoro prov.:** 10 km W Dorgali, 26.VII.99, PT, It.

DISTRIBUTION. Mediterranean, not recorded from North Africa, not found in the Iberian peninsula. In Italy it is known only from Liguria and Sicily (Klimesch 1978). New for Sardinia, and westernmost

known locality.

ECOLOGY. Hostplants: *Vitex agnus-castus*. Mine: a thin gallery, completely filled with frass, leading abruptly into an irregular blotch; frass is heaped in the basal part.

12. *Ectoedemia suberis* (Stainton, 1869)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sedda Pranu Cardu, 500 m, 7.IX.2006, DA MB DB GN, lt. **Medio Campidano prov.:** Villacidro, P.ta piscina Argiolas, Serbatoio, 282 m, 12.IX.2006, DA MB DB GN, lt.

LITERATURE RECORDS. **Nuoro prov.:** M. Istiddi, 1.IX.1978, GD; Bacu Trotu, Ortuabis, 800 m, 28.VIII.1978, GD (van Nieukerken 1985). **Ogliastra prov.:** Villanova Strisaili, 885 m, 7.VII.1983, KU (van Nieukerken 1985).

DISTRIBUTION. W-Mediterranean: Spain, France, Corsica, Sardinia and North Africa. In Italy it is recorded only from Sardinia (Karsholt et al. 1995).

ECOLOGY. Hostplants: in Sardinia it has been collected on *Quercus suber* and *Q. ilex*, but elsewhere it has been bred also from other evergreen oaks (*Q. rotundifolia*, *Q. coccifera* etc.). Mine (fig. 3): a very thin and contorted gallery, filled with black frass; later it becomes a large, irregular blotch, with the frass deposited in the basal half or forming two divergent lines. The larva feeds from January to March–April, adults are found from June–July to October (van Nieukerken 1985).

NOTES. The blotch mine of this species is easily distinguishable from those of *Stigmella suberivora* and *Ectoedemia heringella*. The adults are also easily recognisable by the medial white fascia on the forewing, that is almost straight.

13. *Ectoedemia heringella* (Mariani, 1939)

RECORDS. **Nuoro prov.:** Ortuabis, 6.VII.1978, FH.

DISTRIBUTION. E-Mediterranean (van Nieukerken et al. 2006): Great Britain, France, Corsica, Sicily, Italy, Croatia, Greece, Cyprus. The record from France, in the Estérel Massif, is adjacent to the main area of distribution, while the one from Britain is probably an introduction. In Italy it is known from Piedmont, Venetia, Liguria, Latium and Sicily (van Nieukerken 1985; van Nieukerken et al. 2010). New for Sardinia. ECOLOGY. Hostplants: *Quercus ilex* and *Q. alnifolia*. Mine: a much contorted gallery almost completely filled with black frass. The larva feeds from November to April, adults are found from April to June (van

Nieukerken 1985).

NOTES. The mine (fig. 2) is similar to that of *Stigmella suberivora* (see above). Adults are separable from *S. suberivora* and *Ectoedemia suberis* by the dorsal and costal medial white spots on the forewing, not forming any fascia; the male is particularly easy to recognise by the dark brown androconial scales on the hindwing upperside and forewing underside.

14. *Ectoedemia erythrognella* (Joannis, 1908)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 26–30.VI.2004, PT GB, lt.

DISTRIBUTION. Abroad it is known from south-western Europe and North Africa. In Italy it has been recorded from Friuli, Liguria, Latium, Sicily (van Nieukerken 1985) and Sardinia (van Nieukerken et al. 2010).

ECOLOGY. Hostplants: *Rubus ulmifolius*. Mine: a slender gallery following a nervation, then usually turning back and following a parallel contiguous course; later, the larva widens the gallery which finishes as a blotch, the black frass deposited more or less irregularly in the blotch. The larva is found in June–July and from the end of September to early December; the adults fly from June to August.

BUCCULATRICIDAE

A cosmopolitan family containing the single large genus *Bucculatrix* Zeller, 1839. There are 56 species known from Europe (Mey 2004), 32 of which are also found in Italy. In Sardinia only nine species are recorded but this family is here insufficiently known and new discoveries are expected. The adults are small (6–8 mm) and the larvae feed on leaves of herbs, shrubs and trees, most species being monophagous. They start as leaf-miners, making a gallery with linear frass, the duration of this phase differing between species; afterwards there is a free-feeding phase, the larva eating out "windows" in the lower epidermis and the mesophyll but leaving the upper epidermis intact. Sometimes, further mines or complete holes are created.

15. *Bucculatrix maritima* Stainton, 1851

RECORDS. **Carbonia-Iglesias prov.:** Porto Botte, 23.VII.1981, GB, lt.

DISTRIBUTION. Northern and central Europe (Mey 2004). In Italy it is only recorded from Romagna and

Apulia. New for Sardinia.

ECOLOGY. Hostplant: *Aster tripolium*. Mine: a narrow gallery containing frass; later, one or more shorter mines or windows are created. Adults fly in June and August, in two generations.

16. *Bucculatrix lavaterella* Milliere, 1865

RECORDS. **Cagliari prov.:** Musei, 120 m, 10.III.1972, 15.X.1973, 10.VI.1974, 5–21.VII.1974 exl. *Lavatera*, FH.

DISTRIBUTION. France, Sardinia, Sicily (Mey 2004). Records from Latvia have to be verified.

ECOLOGY. Hostplants: *Malva* spp., *Lavatera* spp. Mine: a thin gallery along the main ribs of the leaf, with frass deposited in a thin, central line; later it makes windows or complete holes. Probably two or more generations.

17. *Bucculatrix albiguttella* Milliere, 1886

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, 150 m, 14.VI.1974, FH; Domusnovas, Sa Duchessa, 350 m, 28.VI–2.VII.2004, PT GB, lt. **Cagliari prov.:** Musei, 120 m, 26.V–2.VI.1974, exl. *Achillea*, FH.

DISTRIBUTION. France, Italy (Latium). New for Sardinia.

ECOLOGY. Hostplants: this species was collected on the wing by Milliere (1886) and *Arundo donax* was assumed to be the host; however, Hartig's record on *Achillea* spp. seems to be more reliable. It is probably bivoltine.

18. *Bucculatrix santolinella* Walsingham, 1898

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 28.VI–2.VII.2004, PT GB, lt. **Nuoro prov.:** Aritzo, 19.VI.1975, exl. *Santolina*, FH.

DISTRIBUTION. France, Corsica, Sardinia, Italy (Mey 2004). On the Italian mainland it only occurs in Liguria.

ECOLOGY. Hostplants: *Santolina* spp.

GRACILLARIIDAE

The Gracillariidae are a very large family of worldwide distribution, with 254 species recorded from Europe (Buszko 2004). In Italy about 150 species are known, 45 of which also occur in Sardinia. The adults are small, from 6–12 mm to 18 mm in wingspan, and

the larvae mine the leaves of shrubs and trees, rarely herbs or bark. Hypermetamorphosis of the larvae chiefly distinguishes the Gracillariidae from the other leaf-miner families. The first instar larvae mine the epidermal cells of leaves, the body strongly flattened dorso-ventrally and the head reduced to a thin and wide wedge, with the mouthparts directed horizontally. In the last instars a morphological change takes place: the head becomes spherical, mouthparts are directed downwards and the legs are fully developed. During this stage, the larvae feed on parenchyma inside or outside the leaves.

The shape of mines is characteristic at genus level rather than at species level. The main types of mine of Gracillariidae genera found in and around the parks are the following:

- *Caloptilia* Hübner, 1825 and *Calybites* Hübner, 1822: in the first instar, the larva feeds in an epidermal gallery and in the second it expands the gallery into a blotch. Later, there is a transition from mining to external habits. Feeding is completed in two or three cones, rolls or folded leaf-edges caused by spinning. Pupation takes place in membranous cocoons in a rolled-up leaf or beneath the edge of a leaf, usually not that in which the larva has previously fed.
- *Dextellia* Triberti, 1986: unknown.
- *Acrocercops* Wallengren, 1881: only the species *A. brongniardella* (Fabricius, 1798) is known in Italy. Feeding starts in a tortuous gallery in the upper surface of the leaf. There are generally several mines in the same leaf and these converge to form a large blotch, similar to that of sawfly mines. Pupation probably takes place in the leaf-litter.
- *Phyllonorycter* Hübner, 1822: the larva feeds and pupates within the mine. In the first three instars a thin gallery ending in a blotch mine is created, by cutting through the mesophyll cells underlying the epidermis and feeding on the sap that is released by this process. By this stage the mine is visible as a flat, silvery blotch. Later, the mesophyll cells are eaten out to the opposite epidermis leading to a mottled appearance of the leaf's surface. Besides, the depth of the mine is increased by the larva spinning silken threads across its inner surface, which gives the mine a blister-shaped appearance (figs 5–6).

19. *Caloptilia coruscans* (Walsingham, 1907)

RECORDS. **Cagliari prov.:** M. Arcosu, Sa Canna, 22.VI.2004, PT GB, lt; M. Arcosu, Perdu Melis, 320 m, 3.VII.2004, PT GB, lt.

DISTRIBUTION. Mediterranean, including Portugal

and the Canary Islands. In Italy it is recorded from Liguria, Latium, Sardinia and Sicily.

ECOLOGY. Hostplants: *Pistacia* spp., *Rhus* spp.; abroad, *Schinus molle* and *Myrica faya*. Larvae are active from July to September but probably there is a second generation in late spring. Adults emerge in September, overwintering and continuing on the wing until May. Adults collected in late June probably belong to the second generation.

20. *Caloptilia cuculipennella* (Hübner, 1796)

RECORDS. **Nuoro prov.:** "Sardegna centr.", ct. Fontanamela, 700 m, 3–4.VIII.1936, FH.

DISTRIBUTION. Holarctic, in Europe not recorded from the Iberian Peninsula. In Italy it occurs in central and northern regions. New for Sardinia.

ECOLOGY. Hostplants: *Fraxinus* spp., *Ligustrum vulgare*, *Jasminum* spp., *Syringa vulgaris*. Univoltine in central Europe but a small summer generation is possible in Sardinia (see *C. coruscans*).

21. *Calybites auroguttella* (Stephens, 1835)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 28.VI–2.VII.2004, PT GB, lt; M. Arcosu, Sa Canna, 22.VI.2004, PT GB, lt; M. Arcosu, Perdu Melis, 320 m, 3.VII.2004, PT GB, lt; M. Arcosu, Su Tragu, 27.VI.2004, PT GB, lt.

DISTRIBUTION. W-Palaearctic. In Italy it is recorded wherever the hostplant is present.

ECOLOGY. Hostplants: *Hypericum* spp. A bivoltine species, with larvae occurring in June and October, overwintering as a pupa.

22. *Dextellia dorsilineella* (Amsel, 1935)

RECORDS. **Nuoro prov.:** Orosei, foce [= mouth of] rio d'Osalla, 19.VII.1999, PT.

DISTRIBUTION. Mediterranean: Morocco, Tunisia, Spain, Malta, Italy, Greece, Israel (Buszko 2004). In mainland Italy it is known only from the Marches. New for Sardinia.

ECOLOGY. The hostplant of this species is unknown. We have always collected it in marshlands.

23. *Phyllonorycter rajella* (Linnaeus, 1758)

RECORDS. **Cagliari prov.:** M. Arcosu, Sa Canna, mn 3.VII.2004, *Alnus glutinosa*, exl. 6.VII.2004, PT GB.

DISTRIBUTION. Central northern Europe, including Albania, Serbia and Montenegro. In Italy it is common wherever the hostplants occur.

ECOLOGY. Hostplants: *Alnus glutinosa* and *A. incana*. Bivoltine: larvae in June–July and October.

24. *Phyllonorycter endryella* (Mann, 1855)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Tiny, 26.VIII.1979, 5.IX.1973, FH; Domusnovas, Sa Duchessa, 350 m, 28.VI.2004, PT GB, lt.

DISTRIBUTION. W-Mediterranean, including Portugal (Laštůvka & Laštůvka 2007a). In Italy it is known only from Sardinia.

ECOLOGY. Hostplants: *Quercus ilex*, *Q. suber*, *Q. coccifera*. The mine is formed on the underside of the leaf, oval, very similar to that of *P. suberifoliella* (Zeller, 1850) and *P. messaniella* (Zeller, 1846): the upper surface has a mottled appearance, finally turning brown, and the lower epidermis has one strong central crease. Probably a bivoltine species: adults occur from April to June and in August–September.

25. *Phyllonorycter messaniella* (Zeller, 1846)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 28.VI.2004, PT GB, lt.

DISTRIBUTION. Central and southern Europe, including the Canary Islands and North Africa, also introduced and established in the U.S.A., Australia and New Zealand (Laštůvka & Laštůvka 2007a). Common throughout Italy and its islands, wherever the hostplants occur.

ECOLOGY. It is a serious pest of oak in Australia and New Zealand, where it was accidentally introduced. The mine is formed on the underside of leaves of evergreen or deciduous oaks, less often on *Carpinus betulus*, *Castanea sativa* and *Fagus sylvatica*. In Sardinia, five or six irregular generations are possible (Arru 1956).

NOTES. Adults of this species are similar to those of *P. endryella*, but they are lacking the white median thoracic line and the projection of blackish hairs from the apex of forewings.

26. *Phyllonorycter suberifoliella* (Zeller, 1850)

RECORDS. **Cagliari prov.:** M. Arcosu, Paddera, 600 m, 26.VI.2004, PT GB, lt; M. Arcosu, Su Tragu, 27.VI.2004, PT GB, lt. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 3.VII.2004, PT GB, lt; M. Arcosu, Sa Canna, 22–24.

VI.2004, PT GB, It.

DISTRIBUTION. Southern Europe: Spain, France, Italy, Croatia, Greece (Laštůvka & Laštůvka 2007a). In Italy: Liguria, Tuscany, Marches, Latium, Apulia, Calabria, Sicily; new for Sardinia.

ECOLOGY. Hostplants: *Quercus suber*, *Q. ilex*. Probably a bivoltine species.

NOTES. Adults are easily distinguishable from those of *P. endryella* and *P. messaniella* for the presence of only one costal and dorsal strigula.

27. *Phyllonorycter staintoniella* (Nicelli, 1853)

RECORDS. **Carbonia-Iglesias prov.:** Domusnovas, Sa Duchessa, 350 m, 30.VI.2004, PT GB, It.

DISTRIBUTION. Western part of central and southern Europe, northwards up to southern Sweden (Laštůvka & Laštůvka 2006). In Italy: Liguria, Venetia, Trentino, Sardinia.

ECOLOGY. Hostplants: larvae are miners in the upper-side of leaves of *Genista* spp., *Laburnum anagyroides*, *Cytisus scoparius*, *C. nigricans*, *C. procumbens*. The larvae may be present from March to November in several generations.

RESULTS

A total of 27 leaf miner species are recorded, 14 belonging to the Nepticulidae, 4 to the Bucculatricidae and 9 to the Gracillariidae. Among them, 7 species are new for Sardinia, one new for Italy. A new species for science is recorded in the Nepticulidae and the study of a further two is still in progress. In the Italian fauna about 320 species are listed for these three families, 88 of which occur in Sardinia (tab. 1).

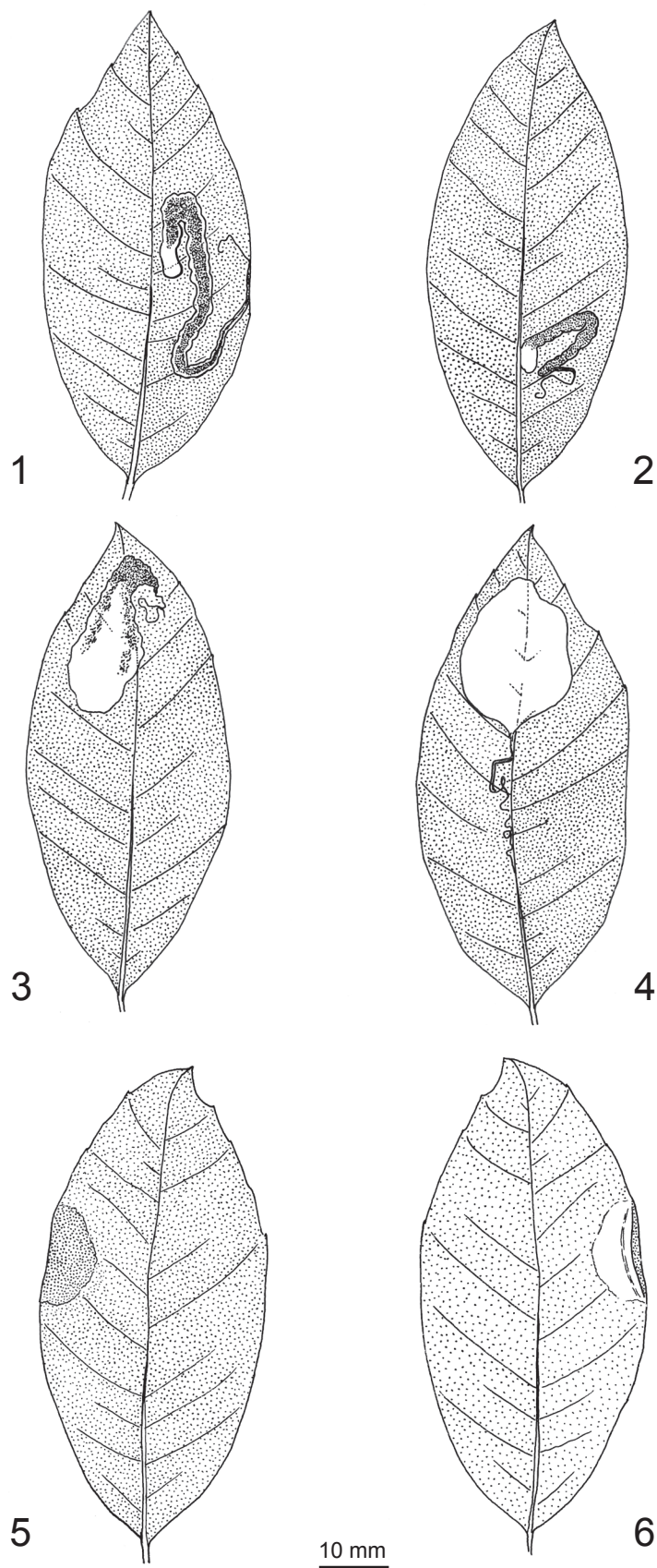
As mentioned above, the holm- and cork-oak fauna were particularly investigated. Only the Nepticulidae and Gracillariidae include species feeding on evergreen oak (tab. 2). Along the Mediterranean coasts, 17 species are known: 9 of them occur in the western region, 2 in the eastern one and 6 in the whole Mediterranean. This predominance of western elements is also particularly evident in the Sardinian fauna, where only *Ectoedemia heringella*, known on a single capture, is an eastern species. No endemic species were found.

ECOLOGICAL CONSIDERATIONS

Mediterranean vegetation, and evergreen oak forest

in particular, is considered important for a number of reasons: fight against soil erosion and desertification, aesthetic-landscape value and very particular habitat for biodiversity (Grill et al. 2005). Protection of this environment has to be one of the major tasks of conservation biologists in Sardinia. There are different views on how to achieve this, all suggested by typical indicators of a stressed system: reduction of species number, disappearance of sensitive species, dominance of tolerant species, reduction of individuals within a species (Rossaro et al. 2004). The criterion of biodiversity indicators, which is based on the recognition of assemblages of sensitive species, typical for specific habitats, seems the most interesting approach to the problem (Kremen et al. 1993; Kati et al. 2003; Fleishman et al. 2004; Pearman & Weber 2007). These focal species include umbrella, flagship and other kinds of indicator species. They can indicate ecological change, patterns of richness or habitat type. The use of surrogate species may be a valuable tool for conservation planning, allowing considerable reductions of time and funding costs. Many researchers have proposed a number of criteria that are important for selecting indicator species (Cleary 2004; Summerville et al. 2004). Indicator taxa should: 1) have a well known taxonomy and life history; 2) be readily surveyed and manipulated; 3) be widely distributed; 4) show habitat fidelity; 5) be responsive to biodiversity patterns of other taxa.

Lepidoptera have been demonstrated to be important indicators of habitat structure and community health for several different ecosystems. This is mainly due to the highly significant, positive relationship between Lepidoptera and plant species richness (Haysom & Coulson 1998; Grill et al. 2005; Scalercio 2006). Recently, they have been proposed: as indicators of logging-induced disturbance, deforestation or habitat changes in forests (Cleary 2004; Summerville et al. 2004; Bucheli et al. 2006); to assess whether land-use practices influence species richness (Grill et al. 2005); as indicators for a diverse set of wet meadows (Sawchik et al. 2005); to predict species richness of multiple taxonomic groups (Kati et al. 2003; Fleishman et al. 2004; Pearman & Weber 2007). Diurnal Lepidoptera are mainly used for these aims. They can be mostly identified on wing pattern and can be caught with a hand held net and released immediately after identification. Transects of various dimensions are sampled, the observer crossing repeatedly on foot from one end to the other at a steady pace, only stopping to take notes or to collect the butterflies. Most of the individuals have to be marked before release, to avoid



Figs 1–6. Leafmines on *Quercus ilex*. Nepticulidae: 1. *Stigmella suberivora*, upper surface; 2. *Ectoedemia heringella*, upper surface; 3. *Ectoedemia suberis*, upper surface. Gracillariidae: 4. *Acrocercops brongniardella*, upper surface; 5. *Phyllonorycter suberifoliella*, upper surface; 6. *ibidem*, lower surface (drawing by P. Triberti).

multiple observations. However, complications are introduced by a large number of extrinsic factors, such as unequal landscape effects of community composition, unequal efforts or different sampling protocols, unpredictable weather conditions and so on (Süssenbach & Fiedler 1999; Bucheli et al. 2006). Compared to diurnal Lepidoptera, moths are less used for ecological and conservation studies, even though they are much more abundant and rich in species, particularly in forest communities (Summerville et al. 2004; Scalercio 2006). Attraction to light sources is the most commonly used sampling method. However it is based on an artificial stimulus, the response to which is still not satisfactorily understood (Süssenbach & Fiedler 1999). Besides, a correct assignment to a particular habitat may be difficult because of their strong vagility in combination with polyphagy, particularly for sampling of small areas.

Also Microlepidoptera are very rarely taken into account in conservation programmes. Lack of expertise for species-level identification and difficulty to prepare them makes this group of Lepidoptera the least attractive for current conservation efforts. However, leaf miners may be an exception. In this case, the presence of the insect is indicated not only by the adult but also by the mine left by the larva on the leaves of the hostplant. Mines can be recognized either in or ex situ with a good certainty at family, genus and, very often, species level. They can be easily counted, within suitable transects, through a simple leaf examination. This sampling method makes use of a natural behavioural context and it might have the potential to reveal ecological change or patterns of richness more accurately. This method may be of limited use in herbaceous coenoses, where the mines are more difficult to find.

Miner taxa assemblages as ecological indicators in Sardinian evergreen oak forest can be found in the Nepticulidae and Gracillariidae. Seven species are recorded, five of which restricted to *Quercus ilex* and *Q. suber* (tab. 2). With the exception of *Ectoedemia heringella* (rare in Sardinia) and *Acrocercops bronniardella* (rare on evergreen oaks), they are widely distributed and very common in Mediterranean forests. Other criteria are also satisfied: well known taxonomy and life history thanks to the good recent works (see above); readily surveyed and manipulated (thanks to the mines); specialized habitat.

Mines are easily identifiable at family level and in the Nepticulidae they can also be used at species level. *Stigmella suberivora* (fig. 1) forms a thin gallery filled with black frass, with distinct clear margins, not

present in *Ectoedemia heringella* (fig. 2); *E. suberis* forms a blotch mine (fig. 3). In the Gracillariidae differences between the blotch mines of *Acrocercops* and *Phyllonorycter* are evident (figs. 4–6), but within the latter they are difficult to distinguish at species level. However, use of a genus as an indicator taxon has to be considered if demonstrated that the included species show similar tolerance or response to ecological changes, and that the aggregation does not alter the indicator value of the group (Rossaro et al. 2004). Cleary (2004) assessed the use of butterflies as indicators of logging at three taxonomic levels (species, genus and subfamily), finding a good response at all levels, but the best overall taxa (highest indicator values) were found at generic level.

CONCLUSIONS

A first study of the material collected points out how the Microlepidoptera of the evergreen oak forests and dense Mediterranean shrublands of Sardinia are little known. In fact, besides what reported on the leaf miner families, further remarkable data were supplied by other microlepidopteran families, particularly those with a special diet (detritivores, scavengers, lichenophiles and algivores), such as two new species of Tineidae (Gaedicke 2007) and two new species of Autostichidae (Sutter 2007). Also in the Macrolepidoptera results were surprising, for example the description of a new species of Geometridae (Govi & Fiumi 2005).

The importance of this habitat stresses the necessity of its protection. This could be achieved through a monitoring programme using leaf mining Microlepidoptera feeding on evergreen oaks as indicators, through sampling of mines of some species or genera of Nepticulidae and Gracillariidae (and no adults) along suitable transects. This method, besides being easy to carry out, is not in conflict with the natural behaviour of these insects. In the current study, although we focus on evergreen oaks, further hostplants representative of this habitat (and with well known leaf miner species) may be used, such as for example *Pistacia* spp.

Clearly, more research is needed on the response of these taxa to a broad range of environmental factors. It would be important to verify if they may constitute good indicators of overall lepidopteran (and other taxa) species richness as well as habitat changes in evergreen forest. If that were the case, they could also be important for identifying potential hot spots, and be of considerable conservation relevance.

Tab. 1. List of the species of Nepticulidae, Bucculatricidae and Gracillariidae occurring in Sardinia and their hostplants.

Species	herbs	shrubs	trees	host plants
NEPTICULIDAE				
<i>Simplimorpha promissa</i> (Staudinger, 1871)		x		<i>Cotinus, Pistacia, Rhus</i>
<i>Stigmella freyella</i> (Heyden, 1858)	x			Convolvulaceae
<i>Stigmella glutinosae</i> (Stainton, 1858)			x	<i>Alnus</i>
<i>Stigmella alnetella</i> (Stainton, 1856)			x	<i>Alnus</i>
<i>Stigmella microtheriella</i> (Stainton, 1854)			x	Corylaceae
<i>Stigmella ulmivora</i> (Fologne, 1860)			x	<i>Ulmus</i>
<i>Stigmella rolandi</i> van Nieukerken, 1990	x	x		<i>Rosa, Sanguisorba</i>
<i>Stigmella paradoxa</i> (Frey, 1858)		x		<i>Crataegus</i>
<i>Stigmella minusculella</i> (Herrich Schäffer, 1855)			x	<i>Pyrus</i>
<i>Stigmella salicis</i> (Stainton, 1854)			x	<i>Salix</i>
<i>Stigmella</i> near <i>salicis</i>				unknown
<i>Stigmella trimaculella</i> (Haworth, 1828)			x	<i>Populus</i>
<i>Stigmella plagiolella</i> (Stainton, 1854)			x	<i>Prunus</i>
<i>Stigmella aurella</i> (Fabricius, 1775)	x	x		<i>Rubus, Fragaria, Geum</i>
<i>Stigmella incognitella</i> (Herrich Schäffer, 1855)			x	<i>Malus</i>
<i>Stigmella perpygmaeella</i> (Doubleday, 1859)		x		<i>Crataegus</i>
<i>Stigmella suberivora</i> (Stainton, 1869)			x	evergreen <i>Quercus</i>
<i>Stigmella roborella</i> (Johansson, 1971)			x	deciduous <i>Quercus</i>
<i>Stigmella eberhardi</i> (Johansson, 1971)			x	deciduous <i>Quercus</i>
<i>Acalyptis minimella</i> (Rebel, 1924)			x	<i>Pistacia lentiscus</i>
<i>Trifurcula melanoptera</i> van Nieukerken & Puplesis, 1991			x	? <i>Prunus</i>
<i>Trifurcula montana</i> Z.Laštůvka, A.Laštůvka & van Nieukerken, 2007	x			? <i>Thymus vulgaris</i>
<i>Trifurcula</i> sp.n.				unknown
<i>Trifurcula eurema</i> (Tutt, 1899)	x			<i>Lotus, Dorycnium</i>
<i>Trifurcula rosmarinella</i> (Chrétien, 1914)	x			<i>Rosmarinus officinalis</i>
<i>Ectoedemia septembrella</i> (Stainton, 1849)	x			<i>Hypericum</i>
<i>Ectoedemia groschkei</i> (Skala, 1943)		x		<i>Vitex agnus-castus</i>
<i>Ectoedemia suberis</i> (Stainton, 1869)			x	evergreen <i>Quercus</i>
<i>Ectoedemia heringella</i> (Mariani, 1939)			x	<i>Quercus ilex</i>
<i>Ectoedemia pubescivora</i> (Weber, 1937)			x	<i>Quercus pubescens</i>
<i>Ectoedemia erythrogonella</i> (Joannis, 1908)		x		<i>Rubus</i>
BUCCULATRICIDAE				
<i>Bucculatrix albiguttella</i> Millière, 1886	x			<i>Achillea</i>
<i>Bucculatrix albedinella</i> (Zeller, 1839)			x	<i>Ulmus, Tilia</i>
<i>Bucculatrix cidarella</i> (Zeller, 1839)			x	Betulaceae
<i>Bucculatrix gnaphaliella</i> (Treitschke, 1833)	x			<i>Gnaphalium</i>
<i>Bucculatrix helichrysellae</i> Constant, 1889	x			<i>Helichrysum</i>
<i>Bucculatrix lavaterella</i> Millière, 1865	x			<i>Malva, Lavatera</i>
<i>Bucculatrix maritima</i> Stainton, 1851	x			<i>Aster tripolium</i>
<i>Bucculatrix nigricomella</i> (Zeller, 1839)	x			<i>Leucanthemum vulgare</i>
<i>Bucculatrix santolinella</i> Walsingham, 1898	x			<i>Santolina</i>
<i>Bucculatrix ulmella</i> Zeller, 1848			x	Fagaceae, Rosaceae, Ulmaceae
<i>Bucculatrix ulmifoliae</i> Hering, 1931			x	<i>Ulmus</i>

GRACILLARIIDAE

<i>Micrurapteryx kollariella</i> (Zeller, 1839)	x		Fabaceae
<i>Gracillaria syringella</i> (Fabricius, 1794)		x	Oleaceae
<i>Caloptilia robustella</i> Jäckh, 1972		x	deciduous <i>Quercus</i>
<i>Caloptilia coruscans</i> (Walsingham, 1907)	x		Anacardiaceae
<i>Caloptilia cuculipennella</i> (Hübner, 1796)		x	Oleaceae
<i>Caloptilia falconipennella</i> (Hübner, 1813)		x	<i>Alnus</i>
<i>Aspilapteryx tringipennella</i> (Zeller, 1839)	x		<i>Plantago</i>
<i>Euspilapteryx auroguttella</i> (Stephens, 1835)	x		<i>Hypericum</i>
<i>Calybites phasianipennella</i> (Hübner, 1813)	x		Polygonaceae, Primulaceae, Chenopodiaceae
<i>Povolnya leucapennella</i> (Stephens, 1835)		x	deciduous <i>Quercus</i>
<i>Sauterina hofmanniella</i> (Schleich, 1867)	x		<i>Lathyrus</i>
<i>Acrocercops brongniardella</i> (Fabricius, 1798)		x	<i>Quercus</i>
<i>Dialectica scalariella</i> (Zeller, 1850)	x		Boraginaceae
<i>Spulerina simploniella</i> (Fischer v. R., 1840)		x	Fagaceae
<i>Metriochroa latifoliella</i> (Millière, 1886)		x	Oleaceae
<i>Dextellia dorsilineella</i> (Amsel, 1935)			unknown
<i>Parornix anglicella</i> (Stainton, 1850)	x	x	Rosaceae
<i>Parornix anguliferella</i> (Zeller, 1847)	x	x	Rosaceae
<i>Parornix atripalpella</i> Wahlström, 1979			unknown
<i>Parornix carpinella</i> (Frey, 1863)		x	Corylaceae
<i>Parornix szoecsi</i> (Gozmány, 1952)		x	<i>Prunus</i>
<i>Parornix torquillella</i> (Zeller, 1850)		x	<i>Prunus</i>
<i>Parornix finitimella</i> (Zeller, 1850)		x	<i>Prunus</i>
<i>Phyllonorycter cerisoella</i> (Peyerimhoff, 1872)		x	<i>Sorbus</i>
<i>Phyllonorycter comparella</i> (Duponchel, 1843)		x	<i>Populus</i>
<i>Phyllonorycter corylifoliella</i> (Hübner, 1796)	x	x	Rosaceae
<i>Phyllonorycter cytisis</i> (Amsel & Hartig, 1952)	x		<i>Cytisus</i>
<i>Phyllonorycter emberizaepennella</i> (Bouché, 1834)	x		Caprifoliaceae
<i>Phyllonorycter endryella</i> (Mann, 1855)		x	evergreen <i>Quercus</i>
<i>Phyllonorycter froelichiella</i> (Zeller, 1839)		x	<i>Alnus</i>
<i>Phyllonorycter kleemannella</i> (Fabricius, 1781)		x	<i>Alnus</i>
<i>Phyllonorycter mespilella</i> (Hübner, 1805)		x	Rosaceae
<i>Phyllonorycter messaniella</i> (Zeller, 1846)		x	<i>Quercus</i>
<i>Phyllonorycter oxyacanthae</i> (Frey, 1856)	x	x	Rosaceae
<i>Phyllonorycter parisiella</i> (Wocke, 1848)		x	<i>Quercus pubescens</i>
<i>Phyllonorycter platani</i> (Staudinger, 1870)		x	<i>Platanus</i>
<i>Phyllonorycter najella</i> (Linnaeus, 1758)		x	<i>Alnus</i>
<i>Phyllonorycter suberifoliella</i> (Zeller, 1850)		x	<i>Quercus ilex</i> , <i>Q. suber</i>
<i>Phyllonorycter sublautella</i> (Stainton, 1869)		x	deciduous <i>Quercus</i>
<i>Phyllonorycter schreberella</i> (Fabricius, 1781)		x	<i>Ulmus</i>
<i>Phyllonorycter spinicolella</i> (Zeller, 1846)		x	Rosaceae
<i>Phyllonorycter staintoniella</i> (Nicelli, 1853)	x		Fabaceae
<i>Phyllonorycter trifasciella</i> (Haworth, 1828)		x	Caprifoliaceae
<i>Phyllonorycter triflorella</i> (Peyerimhoff, 1872)	x		Fabaceae
<i>Phyllocnistis labyrinthella</i> (Bjerkander, 1790)		x	<i>Populus</i>
<i>Phyllocnistis saligna</i> (Zeller, 1839)		x	<i>Salix</i>
	24	15	51

Tab. 2. Nepticulidae and Gracillariidae species from Sardinia and the Mediterranean mining *Quercus ilex* and *Q. suber*.

Species	Sardinia	W Med	E Med	only evergreen	also deciduous
NEPTICULIDAE					
<i>Stigmella suberivora</i> (Stainton, 1869)	x	x		x	
<i>S. ilicifoliella</i> (Mendes, 1918)		x		x	
<i>S. zangherii</i> (Klimesch, 1951)			x		x
<i>S. eberhardi</i> (Johansson, 1971)	x	x	x		x
<i>Ectoedemia suberis</i> (Stainton, 1869)	x	x		x	
<i>E. algeriensis</i> van Nieukerken, 1985		x		x	
<i>E. andalusiae</i> van Nieukerken, 1985		x		x	
<i>E. hendrikseni</i> Laštůvka A., Laštůvka Z. & van Nieukerken, 2009		x		x	
<i>E. haraldi</i> (Soffner, 1942)		x		x	
<i>E. ilicis</i> (Mendes, 1910)		x		x	
<i>E. heringella</i> (Mariani, 1939)	x		x	x	
GRACILLARIIDAE					
<i>Acrocercops brongniardella</i> (Fabricius, 1798)	x	x	x		x
<i>Phyllonorycter endryella</i> (Mann, 1855)	x	x		x	
<i>P. suberifoliella</i> (Zeller, 1850)	x	x	x	x	
<i>P. belotella</i> (Staudinger, 1859)		x	x		x
<i>P. messaniella</i> (Zeller, 1846)	x	x	x		x
<i>P. quercifoliella</i> (Zeller, 1839)		x	x		x

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