

# Georissidae, Elmidae, Dryopidae, Limnichidae and Heteroceridae of Sardinia (Coleoptera)\*

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## ABSTRACT

Four species of Georissidae (Hydrophiloidea) and 40 species of Byrrhoidea of the families Elmidae (15 species), Dryopidae (13), Limnichidae (3) and Heteroceridae (9) are recorded from Sardinia, but only 32 of the Byrrhoidea are currently known from the island. These numbers are based on literature data, the material collected by the Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" of Verona, and on unpublished material from the Authors' and museum collections. Each species of the faunistic list is accompanied by a short comment and summarized information on reference chorotype, Italian distribution and ecology. Further zoogeographic information is provided for the five above families occurring in Sardinia.

**Key words:** Byrrhoidea, Elmidae, Dryopidae, Limnichidae, Heteroceridae, Hydrophiloidea, Georissidae, checklist, Italy, Sardinia, faunistics, zoogeography, ecology.

## RIASSUNTO

*Georissidae, Elmidae, Dryopidae, Limnichidae ed Heteroceridae di Sardegna (Coleoptera)*

Quattro specie appartenenti alla famiglia Georissidae (Hydrophiloidea) e 40 specie di Byrrhoidea delle famiglie Elmidae (15 specie), Dryopidae (13), Limnichidae (3) ed Heteroceridae (9) sono segnalate per la Sardegna, ma solo 32 specie di questi Byrrhoidea sono attualmente note per l'Isola. Tali numeri si basano sui dati bibliografici, sulle raccolte effettuate dal Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" di Verona, dagli Autori e da materiale museale inedito. Nell'elenco faunistico sono riportate brevi informazioni sul corotipo, sulla distribuzione in Italia e sull'ecologia di ogni specie trattata. Inoltre sono fornite informazioni di carattere zoogeografico relative alle suddette cinque famiglie presenti in Sardegna.

## INTRODUCTION

The respective systematic position of the five families treated herein has undergone several changes during the course of the years. Until the 1930s, the Georissidae were considered close to the Dryopidae, Elmidae and Heteroceridae by some authors (Zaitzev 1910; Porta 1929; Portevin 1931), and to the Gyrinidae and Hydrophilidae by others (Sharp & Muir 1912); later they were placed within the superfamily Hydrophiloidea (Crowson 1955; Archangelsky 1998; Jäch 1998; Hansen 2004), where they still remain today. The Limnichidae, which were originally part of the Byrrhidae (Dalla Torre 1911), were placed near the Dryopidae by Hinton (1939), and later included in the superfamily Dryopoidea together with the Elmidae and the Heteroceridae (Crowson 1955). The other three

families – Elmidae, Dryopidae and Heteroceridae – have generally always been considered closely related; together with the Limnichidae and other families not mentioned here, they were included by Crowson (1978) in the superfamily Dryopoidea and by Lawrence & Britton (1994) in the superfamily Byrrhoidea. In the present work they are assigned to the Byrrhoidea following Löbl & Smetana (2006). The aim of this paper is to provide an updated catalogue of the species of these families occurring in Sardinia.

## MATERIAL AND METHODS

### Nomenclature and classification

The systematics and nomenclature followed are those of Hansen (2004) and Mascagni (2005b, 2007b) for

the Georissidae, Jäch (2005a), Jäch et al. (2006) and Čiampor & Kodada (2010) for the Elmidae, Jäch (2005b) and Kodada & Jäch (2006) for the Dryopidae, Ribera & Hernando (2005) and Hernando & Ribera (2006) for the Limnichidae, and Mascagni (2005a, 2005c, 2006, 2007a) for the Heteroceridae. Species are listed in alphabetical order within each genus, whereas genera are listed in systematical order.

### Data filing and species list

Distributional data for species are based on the literature (scarce for most of the treated taxa) and on previously unpublished records of the Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" of Verona (CNBFVR) and of the Authors (618 specimens altogether). For each listed species the following information is provided: distributional data from the literature; unpublished records (arranged according to the former Sardinian provinces: Cagliari, Nuoro, Oristano, Sassari); chorotype following Vigna Taglianti et al. (1999) and based on general distributions given by Hansen (2004) for the Georissidae, Jäch et al. (2006) for the Elmidae, Kodada & Jäch (2006) for the Dryopidae, Hernando & Ribera (2006) for the Limnichidae, and Mascagni (2006) for the Heteroceridae; Italian distribution; brief comments on ecology and conservation taken from Mascagni (2005a, 2005b, 2007a, 2007b). Sampling localities are listed in alphabetical order according to province; the unpublished data, which were briefly summarized in Mascagni (2005a, 2005b, 2007a, 2007b), are here fully reported with all label data together with more recent unpublished records under the single heading "Records". Details (UTM coordinates, vegetation, habitats, etc.) about the sites sampled by CNBFVR can be found in Mason et al. (2006), Cerretti et al. (2009), Angius et al. (2011) and Bardiani (2011). It should be stressed that Mascagni (2007a, 2007b) are only English versions of papers previously published in Italian (Mascagni 2005a, 2005b), and do not contain additional data.

### ABBREVIATIONS

COLLECTORS. AD = A. Doderò; ADe = A. Degiovanni; AM = A. Campanaro; BC = B. Cecchi; BCa = B. Carletti; BL = B. Lanza; CM = C. Meloni; CT = C. Torti; DA = D. Avesani; DB = D. Birtele; DG = D. Ghiliani; DW = D. Whitmore; EL = E. Laudanna; ET = E. Turati; FA = F. Angelini; FCa = F. Cassola; FCl = F. Callegari; FH = F. Hartig; FMr = F. Marrone; FS = F. Stoch; FT = F. Terzani; FP = F. Pederzani; GBi = G. Binaghi; GN = G. Nardi; GO = G. Osella; GR = G. Riese; GS = G. Scaglioni; IB = I. Buc-

ciarelli; LB = L. Briganti; LT = L. Tamanini; MB = M. Bardiani; MTr = M. Trizzino; NS = N. Sanfilippo; PA = P. Audisio; PCo = P. Cornacchia; PD = P. De Martin; PL = P. Leo; PLc = P. Lo Cascio; RB = R. & B. Cipriani; RP = R. Poggi; RPa = R. Papi; SR = S. Rocchi; SRi = S. Riese; UL = U. Lostia; VR = V. Rosa.

DEPOSITORIES. CAM = A. Mascagni (Scandicci, Florence); CCC = B. Cecchi & B. Carletti (Florence); CCM = C. Meloni c/o MCSN (Genoa); CFA = F. Angelini (Francavilla Fontana, Brindisi); CFC = F. Callegari (Ravenna); CFT = F. Terzani c/o MZUF (Florence); CMC = C. Monte (Florence); CPC = P. Cornacchia (Porto Mantovano, Mantua); CRF = R. Fabbri (Ferrara); CRP = R. Papi (Castelfranco di Sopra, Arezzo); CSR = S. Rocchi c/o MZUF (Florence); CNBFVR = Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" di Verona (Marmirolo, Mantua); MBCG = Museo Civico di Scienze Naturali "E. Caffi" (Bergamo); MCNV = Museo Civico di Storia Naturale (Venezia); MCSN = Museo Civico di Storia Naturale "Giacomo Doria" (Genoa); MRSN = Museo Regionale di Scienze Naturali (Turin); MSNM = Museo Civico di Storia Naturale (Milan); MSNV = Museo Civico di Storia Naturale (Verona); MZUF = Museo Zoologico "La Specola", Università degli Studi di Firenze (Florence); MZUR = Museo di Zoologia dell'Università, Sapienza Università di Roma (Rome); NMW = Naturhistorisches Museum (Wien, Austria).

OTHER ABBREVIATIONS AND RECURRENT TERMS USED IN FAUNISTIC LIST. Bacino = Basin; cantoniera = roadman's house; confluenza = confluence; dalla foce = from the river mouth; dint. = environs of; ex = specimen/s; Fiume = River; foce = river mouth; Golfo = Gulf; greto = pebbly shore; grotta = cave; immissario = tributary; Isola di = Island of; Lago = Lake; lt = light trap; Monte = Mount; ponte = bridge; Porto = Port; pozze residue = residual pools; pozze temporanee = temporary pools; presso = near; prov. = province; Rio = stream, small river; S.S. = State Road; sorgente = spring; stagno/i = pond/s; strada = road.

## FAUNISTIC LIST

### GEORISSIDAE Laporte, 1840

The Georissidae are a small family with about 80 species worldwide, only 5 of which occur in Europe and Italy, 4 in Sardinia (Mascagni 2004); all are very small, the Italian species varying in length between 1.0 and 2.1 mm. Due to their minuteness, cryptic colouration (Bameul 1989) and ecology (they occur under half-buried stones, in soil near the banks of water courses and in the sandy edges of pools and ponds), they are often overlooked by entomologists and the number of specimens stored in museum and private collections is extremely scarce (just over a thousand specimens from Italy and only 24 from Sardinia!). We thus consider it useful to report the current knowledge for this family in Sardinia.

1. *Georissus (Georissus) crenulatus* (Rossi, 1794)

*Georyssus pygmaeus* Fabricius: Bertolini 1874: 101.  
*Georyssus integrostriatus* Motschulsky: Bertolini 1904: 26.  
*Georyssus crenulatus* Rossi: Luigioni 1929: 445.  
*Georyssus crenulatus* v. *integrostriatus* Motsch.: Luigioni 1929: 446.  
*Georissus crenulatus* Rossi, 1794: Audisio et al. 1995: 12; Mascagni 2004: 21.  
*Georissus crenulatus* (Rossi, 1794): Hansen 2005.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Audisio et al. 1995; Mascagni 2004; Hansen 2005).

RECORDS. **Sardinia:** Sardegna, ET, 3 ex (MZUF) (Mascagni 2005b).

CHOROTYPE. Sibero-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Latium, Apulia, Basilicata, Calabria, Sicily, Sardinia.

ECOLOGY. A very rare phytophagous species, characteristic of river and lake banks.

2. *Georissus (Georissus) substriatus* Heer, 1841

*Georissus substriatus* Heer, 1841: Mascagni 1993b: 73; Audisio et al. 1995: 12; Mascagni 2004: 22; Hansen 2005.

LITERATURE DATA. Sardinia (Mascagni 1993b, 2004; Audisio et al. 1995; Hansen 2005).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Piedmont, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Sardinia.

ECOLOGY. A very rare phytophagous species, characteristic of river banks.

3. *Georissus (Neogeorissus) costatus* Laporte de Castelnau, 1840

*Georyssus costatus* Laporte de Castelnau: Bertolini 1874: 101; Bertolini 1904: 26.

*Georyssus carinatus* Rossi: Bertolini 1874: 101.  
*Georyssus costatus* Castelnau: Luigioni 1929: 446; Porta 1929: 294.  
*Georissus costatus* Laporte de Castelnau, 1840: Mascagni 1993a: 73; Audisio et al. 1995: 12; Mascagni 2004: 23; Mascagni 2005b; Hansen 2005.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Porta 1929; Mascagni 1993a; Audisio et al. 1995; Mascagni 2004, 2005b; Hansen 2005).

RECORDS. **Cagliari prov.:** Cagliari, Rio Sa Picocca 40 m, Ponte Monte Acuto, Sarrabus, 16.VII.1988, CM, 5 ex (CCM), 1 ex (CAM). **Nuoro prov.:** Dorgali, VI.1911, AD, 4 ex (MSNM); Posada, greto Fiume di Posada, 24.V.1976, RP, 2 ex (MCSN). **Oristano prov.:** Ponte Mannu, Fiume Tirso, 4.VII.1975, CM, 1 ex (CCM); Oristano, 1892, UL, 1 ex (MCSN); 20.V.1976, GR, 1 ex (CSR). **Sassari prov.:** Olbia, greto Fiume Padrogiano, 22.V.1972, GBi, 1 ex (MCSN); Oschiri, Lago Coghinas, cant. Pedredu, 165 m, 28.V.1995, FA, 1 ex (CFA); Villa Assunta, Lago Baratz, 23.V.1995, FA, 3 ex (CFA), 1 ex (CAM).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Tuscany, Latium, Basilicata, Calabria, Sicily, Sardinia (Mascagni 1993, 2004, 2005b).

ECOLOGY. Phytophagous species typical of river and lake banks; it could be the only common species of the family in Sardinia.

4. *Georissus (Neogeorissus) laeicollis* Germar, 1831

*Georyssus laeicollis* Germar: Bertolini 1874: 101; Bertolini 1904: 27; Luigioni 1929: 446; Porta 1929: 294.

*Georissus laeicollis* Germar, 1831: Audisio et al. 1995: 12; Mascagni 2004: 23; Hansen 2005; Mascagni 2005b.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Porta 1929; Audisio et al. 1995; Mascagni 2004, 2005b; Hansen 2005).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Latium, Campania, Molise, Basilicata, Calabria, Sicily, Sardinia.

ECOLOGY. A very rare phytophagous species, characteristic of river banks.

ELMIDAE Curtis, 1830

Cosmopolitan family comprising approximately 1,200 species (Jäch 1998), mainly aquatic, particularly in lotic waters. Twenty-eight species occur in Italy, 12 of which are believed to occur also in Sardinia.

1. *Potamophilus acuminatus* (Fabricius, 1792)

*Potamophilus acuminatus* Fabricius: Bertolini 1904: 26; Luigioni 1929: 442; Porta 1929: 285.

*Potamophilus acuminatus* (Fabricius, 1792): Mascagni & Calamandrei 1992: 129; Angelini et al. 1995: 5; Jäch 2005b.

LITERATURE DATA. Sardinia (Bertolini 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995). Sardinia? (Jäch 2005b).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Emilia-Romagna, Latium, Sardinia.

ECOLOGY. Phytophagous species typical of running waters in both lowland and hilly environments.

NOTES. According to Olmi (1978) the presence of this species in Sardinia is doubtful.

## 2. *Elmis maugetii fossulata* (Kuwert, 1890)

*Helmis fossulata* Kuwert *Maugei* var. *aenea* Ganglbauer: Zaitzev 1910: 24.

*Helmis Maugei* v. *fossulata* Kuw.: Luigioni 1929: 444; Porta 1929: 292.

*Elmis maugetii fossulata* (Kuwert, 1890): Olmi 1976: 151; Angelini et al. 1995: 6; Guglielmino & Olmi 2001: 3; Jäch 2005a; Jäch et al. 2006: 433.

LITERATURE DATA. Sardinia (Zaitzev 1910; Luigioni 1929; Porta 1929; Angelini et al. 1995; Jäch 2005a; Jäch et al. 2006). **Nuoro prov.**: Aritzo; Orgosolo (Olmi 1976); Villanova Strisaili, Rio Calaresu (Guglielmino & Olmi 2001).

RECORDS. **Cagliari prov.**: Villacidro, Rio Cannisoni, 375 m, 21.V.2006, PCo MB DB DW, 1 ex (CNBFVR). **Nuoro prov.**: Desulo, Rio Aratu, 958 m, 16.V.2008, GN PA MB MTi, 2 ex (CNBFVR); Gennargentu, Bruncu Spina, 1200–1500 m, 4.VII.2004, PCo CS, 1 ex (CPC); Seui dint., M. Tonneri, Foresta di Montarbu, 930 m, cavità carsica con raccolta d'acqua e percolamento, 17.V.2008, GN PA MB MTi, 1 ex (CNBFVR). **Sassari prov.**: Cossoine, grotta "Sorigalza", presso sorgente, 365 m, 4.IX.2007, AM, 6 ex (CNBFVR), 1 ex (CAM).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Sardinia.

ECOLOGY. Sardo-Corsican microphagous subspecies, typical of running waters in lowland, hilly and mountain areas; not common.

## 3. *Esolus brevis* Kuwert, 1890

*Esolus brevis* Kuwert: Kuwert 1890: 46; Bertolini 1904: 26; Zaitzev 1910: 29; Winkler 1926: 671; Porta 1929: 290; Olmi 1976: 166; Angelini et al. 1995: 6; Jäch 2005a; Jäch et al. 2006: 434.

LITERATURE DATA. Sardinia (Bertolini 1904; Zaitzev 1910; Winkler 1926; Porta 1929; Angelini et al. 1995; Jäch 2005a; Jäch et al. 2006). **Cagliari prov.**: Musei; Santadi (Olmi 1976). **Sassari prov.**: Sassari (Kuwert 1890; Olmi 1976).

RECORDS. **Cagliari prov.**: Villacidro, Rio Cannisoni, 390 m, 19.V.2008, GN PA MB MTi, 1 ex (CNBFVR). **Sassari prov.**: Cossoine, grotta "Sorigalza", presso sorgente, 365 m, 4.IX.2007, AM, 3 ex (CNBFVR), 1 ex (CAM).

CHOROTYPE. Sardo-Corsican.

ITALIAN DISTRIBUTION. Sardinia.

ECOLOGY. Microphagous element typical of hill and mountain running waters; not a common species.

## 4. *Esolus filum* (Fairmaire, 1871)

*Esolus filum* Fairmaire: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. N-African.

ECOLOGY. Microphagous element typical of running waters.

NOTES. This species does not occur in Italy (Löbl & Smetana 2006). The above record is surely a misidentification.

## 5. *Esolus parallelepipedus* (Ph. Müller, 1806)

*Esolus parallelepipedus* Müller: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. S-European.

ECOLOGY. Microphagous element typical of running waters in lowland and hilly areas.

NOTES. Widespread throughout most of Europe, it occurs only in some regions of northern and central Italy (Mascagni 2005a). Bertolini's (1904) record almost certainly refers to wrongly identified specimens.

## 6. *Esolus pygmaeus* (Ph. Müller, 1806)

*Esolus pygmaeus* Müller: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. Europeo-Mediterranean.

ECOLOGY. Microphagous element typical of running waters.

NOTES. The species is not part of the Italian fauna (Löbl & Smetana 2006). The above record is surely a misidentification.

## 7. *Limnius intermedius intermedius* Fairmaire, 1881

*Limnius intermedius* Fairmaire, 1881: xi.

*Limnius intermedius* Fairmaire: Bertolini 1904: 26.

*Lathelmis intermedia* Fairmaire: Zaitzev 1910: 34; Winkler 1926: 672.

*Latelmis intermedia* Fairmaire: Luigioni 1929: 445; Porta 1929: 292.

*Limnius intermedius intermedius* Fairmaire, 1881: Olmi 1976: 189; Angelini et al. 1995: 6; Jäch 2005a.

LITERATURE DATA. Sardinia (Fairmaire 1881; Bertolini 1904; Zaitzev 1910; Winkler 1926; Luigioni 1929; Porta 1929; Angelini et al. 1995; Jäch 2005a). **Cagliari prov.:** Santadi (Olmi 1976); **Nuoro prov.:** Orgosolo; Fonni (Olmi 1976).

RECORDS. **Cagliari prov.:** Decimomannu, Rio Flumineddu, 25.V.1977, CM, 1 ex (CCM); Olíaspeciosa, Rio Corr'e Pruna, Muravera, 4.VII.1986, NS, 1 ex (MCSN). **Sassari prov.:** Figaruia, Torre di Figaruia, 400 m, 19.III.2003, SR, 1 ex (CSR), 1 ex (CAM).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Liguria, Emilia-Romagna, Tuscany, Umbria, Marches, Latium, Abruzzi, Campania, Calabria, Sardinia, Sicily.

ECOLOGY. Microphagous taxon characteristic of running waters in lowland, hilly and mountain areas; it is quite a common species.

#### 8. *Limnius opacus* Ph. Müller, 1806

*Limnius opacus* Müller: Bertolini 1904: 26.

*Limnius oblongus* Kuwert: Bertolini 1904: 26.

*Lathelmis opaca oblonga* Rey: Zaitzev 1910: 35.

*Helmis opacus oblongus* Rey: Krausse 1913a: 62.

*Lathelmis opaca* Müller: Winkler 1926: 672.

*Latelmis opaca* Müller: Porta 1929: 291.

LITERATURE DATA. Sardinia (Bertolini 1904; Zaitzev 1910; Winkler 1926; Porta 1929).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Latium, Abruzzi, Molise, Campania, Basilicata, Calabria, Sicily.

ECOLOGY. Microphagous species typical of running waters in hilly and mountain areas.

NOTES. Luigioni (1929) did not report this species as occurring in Sardinia; Olmi (1978) excluded its presence on the island; Porta (1929) and Winkler (1926) both mentioned it from Sardinia, probably using the works of Bertolini (1904), Zaitzev (1910) and especially Krausse (1913a) as references. The last author recorded "*Helmis opacus oblongus* Rey" among the Dryopidae in his list of beetle species occurring near Sorgono on Mount Gennargentu; in any case

the identification is wrong because *Limnius muelleri* Erichson, 1847, of which *oblongus* Rey, 1889 is a synonym, is not part of the Italian fauna. Possibly, the specimen mentioned by Krausse (1913a) belongs to *L. sulcipennis sulcipennis* Fairmaire, 1881.

#### 9. *Limnius sulcipennis sulcipennis* Fairmaire, 1881

*Limnius sulcipennis* Fairmaire, 1881: xii.

*Limnius Damryi* Fairmaire: Bertolini 1904: 26.

*Limnius Damryi* Fairmaire v. *sulcipennis* F.: Bertolini 1904: 26.

*Lathelmis sulcipennis* Fairmaire: Zaitzev 1910: 35.

*Elmis damryi* Fairmaire: Champion 1911: 220.

*Lathelmis Damryi* Fairmaire: Winkler 1926: 672.

*Latelmis Damryi* Fairmaire: Luigioni 1929: 445; Porta 1929: 291.

*Limnius sulcipennis sulcipennis* Fairmaire, 1881: Olmi 1976: 184; Angelini et al. 1995: 6; Jäch 2005a; Jäch et al. 2006: 435.

LITERATURE DATA. Sardinia (Fairmaire 1881; Bertolini 1904; Zaitzev 1910; Champion 1911; Winkler 1926; Luigioni 1929; Porta 1929; Angelini et al. 1995; Jäch 2005a; Jäch et al. 2006). **Cagliari prov.:** Arcu Correboi (Olmi 1976). **Nuoro prov.:** Aritzu [= Aritzo] dint. (Champion 1911); Aritzo; Monti del Gennargentu (Olmi 1976).

RECORDS. **Cagliari prov.:** Villacidro, Rio Cannisoni, 390 m, 19.V.2008, GN PA MB MTr, 2 ex (CNBFVR). **Nuoro prov.:** Desulo, Rio Aratu, 958 m, 16.V.2008, GN PA MB MTr, 2 ex (CNBFVR), 1 ex (CAM); Talana dint., 478 m, 15.V.2008, GN PA MB MTr, 1 ex (CNBFVR).

CHOROTYPE. Sardo-Corsican.

ITALIAN DISTRIBUTION. Sardinia.

ECOLOGY. Microphagous taxon typical of running waters in hilly and mountain areas; uncommon.

#### 10. *Normandia nitens* (Ph. Müller, 1817)

*Esolus Sauteri* Kuwert: Bertolini 1904: 26.

*Riolus nitens* subsp. *Sauteri* Kuwert: Zaitzev 1910: 33.

*Riolus nitens* v. *Sauteri* Kuw.: Luigioni 1929: 445; Porta 1929: 293.

*Riolus nitens* s. *Sauteri* Kuwert: Winkler 1926: 672.

*Normandia nitens* (Ph. Müller, 1817): Olmi 1976: 195; Angelini et al. 1995: 6; Jäch 2005a.

LITERATURE DATA. Sardinia (Bertolini 1904; Zaitzev 1910; Winkler 1926; Luigioni 1929; Porta 1929; Angelini et al. 1995; Jäch 2005a). **Cagliari prov.:** Barumini; Fluminimaggiore (Olmi 1976). **Sassari prov.:** Tissi (Olmi 1976).

RECORDS. **Nuoro prov.:** Laconi, loc. Funtanamela, Rio Bau Onu, 10.IX.1988, CM, 5 ex (CCM), 1 ex (CAM).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Liguria, Tuscany, Sardinia.

ECOLOGY. Microphagous species typical of running waters in lowland, hilly and mountain areas; not common in Sardinia.

#### 11. *Oulimnius rivularis* (Rosenhauer, 1856)

*Oulimnius rivularis* Rosenhauer: Bertolini 1904: 26.

*Oulimnius neuter* Kuwert: Bertolini 1904: 26.

*Limnius variabilis* Stephens: Zaitzev 1910: 32; Winkler 1926: 671; Luigioni 1929: 444; Porta 1929: 290.

*Oulimnius rivularis* (Rosenhauer, 1856): Olmi 1976: 176; Angelini et al. 1995: 6; Jäch 2005a.

*Oulimnius rivularis* (Rosenhauer): Serra & Tagliasacchi Masala 1980: 177; Pisano et al. 1982: 167; Fonesu et al. 2005b: 645.

*Oulimnius rivularis*: Fonesu et al. 2005a: 14.

LITERATURE DATA. Sardinia (Bertolini 1904; Zaitzev 1910; Winkler 1926; Luigioni 1929; Porta 1929; Angelini et al. 1995; Jäch 2005a). **Cagliari prov.:** Cagliari, San Sperate (Olmi 1976); Porto Pino, Stagno di Foxi (Pisano et al. 1982); Pula, bacino Rio di Pula (Fonesu et al. 2005b); Rio Pula (Fonesu et al. 2005a); Saline di Santa Gilla, Rio Cixerri (Serra & Tagliasacchi Masala 1980); Santadi (Olmi, 1976). **Nuoro prov.:** Laconi (Olmi 1976).

RECORDS. **Cagliari prov.:** Olíaspeciosa, Rio Corr'e Pruna, Mura-vera, 50 m, 4.VII.1986, NS, 8 ex (MCSN), 1 ex (CAM); Quartu Sant'Elena, Rio Brandinati, 7.X.1955, NS, 1 ex (MCSN); Rio Geremèas, Geremèas, 10 m, 11.VII.1988, CM, 1 ex (CCM). Villasilimus, Rio Murredda, 50 m, 5.VII.1986, NS, 5 ex (MCSN), 1 ex (CAM). **Nuoro prov.:** Domusnovas, Lago Siuru, 322 m, 22.III.2006, PCo, 1 ex (CNBFVR); Fonni dint., P.te Gùspene, 940 m, 16.V.2008, GN PA MB MTr, 1 ex (CNBFVR); Montresta, Rio Cammarasiu, 290 m, 18.III.2003, SR, 1 ex (CSR); Oliena, dint. di San Giovanni, 150 m, 6.V.1995, FA, 1 ex (CFA). **Sassari prov.:** Ittiri, Rio Mannu, 150 m, 25.VI.2008, SR, 2 ex (CSR), 1 ex (CAM).

CHOROTYPE. W-European.

ITALIAN DISTRIBUTION. Sardinia, Sicily.

ECOLOGY. Microphagous species characteristic of running waters in lowland and hilly environments.

NOTES. Without a doubt the most common species of the family in Sardinia.

#### 12. *Oulimnius troglodytes* Gyllenhal, 1827

*Oulimnius troglodytes* Gyllenhal: Bertolini 1904: 26.

*Limnius troglodytes* Gyllenhal: Porta 1929: 290.

*Oulimnius troglodytes* (Gyllenhal, 1827): Mascagni & Calamandrei 1992: 131; Angelini et al. 1995: 6; Jäch 2005a.

LITERATURE DATA. Sardinia (Bertolini 1904; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005a).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Lombardy, Liguria, Sardinia.

ECOLOGY. Microphagous species typical of running waters in lowland, hilly and mountain areas.

NOTES. Those by Bertolini (1904) and Porta (1929), repeated by Mascagni & Calamandrei (1992), are the only published records for this species in Sardinia; its occurrence on the island remains doubtful.

#### 13. *Oulimnius tuberculatus* (Ph. Müller, 1806)

*Limnius tuberculatus* Müller: Bertolini 1874: 102; Porta 1929: 290.

*Limnius Dargelasii* Latreille: Bertolini 1874: 102.

*Limnius Dargelasii* Latreille: Costa 1886: 20.

*Oulimnius Dargelasi* Latreille: Bertolini 1904: 26.

*Limnius variabilis* Stephens: Luigioni 1929: 444; Porta 1929: 290.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Porta 1929). **Sassari prov.:** Olbia, Fiume Padrogiano (Costa 1886).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Tuscany, Latium, Abruzzi, Molise, Campania, Calabria, Sardinia.

ECOLOGY. Microphagous taxon typical of running waters in lowland, hilly and mountain areas.

NOTES. Those by Bertolini (1874, 1904), Costa (1886), Luigioni (1929) and Porta (1929) are the only published records for this species in Sardinia; its occurrence on the island remains doubtful.

#### 14. *Stenelmis canaliculata* (Gyllenhal, 1808)

*Stenelmis canaliculatus* Gyllenhal: Bertolini 1874: 102; Bertolini 1904: 26.

*Stenelmis canaliculata* Gyllenhal: Luigioni 1929: 443; Porta 1929: 290.

*Stenelmis canaliculata* (Gyllenhal, 1808): Olmi 1976: 135; Mascagni & Calamandrei 1992: 129; Angelini et al. 1995: 6; Jäch 2005a.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Porta 1929; Olmi 1976; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005a).

CHOROTYPE. Central-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Latium, Abruzzi, Sardinia.

ECOLOGY. Microphagous species characteristic of running waters in lowlands and hills; rare in Sardinia.

15. *Stenelmis consobrina* Dufour, 1835

*Stenelmis consobrinus* Dufour: Bertolini 1874: 102; Bertolini 1904: 26.

*Stenelmis consobrina* Dufour, 1835: Zaitzev 1910: 22; Winkler 1926: 670; Mascagni & Calamandrei 1992: 129; Angelini et al. 1995: 6; Jäch 2005a.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Zaitzev 1910; Winkler 1926; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005a).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Venetia, Emilia-Romagna, Tuscany, Latium, Marches, Basilicata, Sardinia.

ECOLOGY. Microphagous species typical of running waters in lowlands and hills.

NOTES. According to Olmi (1978) the occurrence of this species in Sardinia is doubtful.

DRYOPIDAE Billberg, 1820

A cosmopolitan family comprising approximately 240 species (Jäch 1998), with prevalently terrestrial larvae and mainly aquatic adults, inhabiting both lotic and lentic habitats. Eighteen species of Dryopidae are recorded from Italy, 9 of which occur in Sardinia. *Parnus impressus* Gené from "Sardinia" (Giachino 1982: 359) is a *nomen nudum* (cf. Kodada & Jäch 2006), so it is not considered hereunder.

1. *Dryops algiricus* (Lucas, 1849)

*Dryops algiricus* Lucas: Bertolini 1874: 101; Bertolini 1904: 26; Luigioni 1929: 442; Porta 1929: 288.

*Dryops hydrobates* Kiesenwetter: Bertolini 1904: 26.

*Parnus algiricus* Lucas: Krausse 1911: 101.

*Dryops algiricus* (Lucas): Dodero 1918: 101.

*Dryops algiricus* (Lucas, 1849): Olmi 1976: 55; Angelini et al. 1995: 5. Mascagni & Calamandrei 1992: 128; Jäch 2005b.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Krausse 1911; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b). **Cagliari prov.**: Assemmini; Cagliari; Gonnesa; Domusnovas; Fluminimaggiore (Dodero 1918; Olmi 1976); Quartu Sant'Elena (Olmi 1976); San Sperate; Santadi (Dodero 1918; Olmi 1976). **Nuoro prov.**: Laconi (Dodero 1918; Olmi 1976). **Sassari prov.**: Golfo degli Aranci (Olmi

1976); Ploaghe; Ozieri (Dodero 1918; Olmi 1976).

RECORDS. **Cagliari prov.**: Domusnovas, Lago Siuru, 322 m, 6.VI.2004, GN, 3 ex (CNBFVR); 22.III.2006, PCo, 2 ex (CNBFVR); 23.V.2006, PCo MB DB DW, 2 ex (CNBFVR), 1 ex (CAM); Giara di Gesturi, Pauli Oromeo, 580 m, 30.IV.2005, SR, 1 ex (CSR); Gonnosfanàdiga, dint. ovile Linas, 710 m, in a water tank, 22.V.2006, PCo MB DB DW, 1 ex (CNBFVR), 1 ex (CAM); Muravera, Fiume Flumendosa 3.5–4 km dalla foce, 5–11.V.2001, FCl, 6 ex (CFC), 2 ex (CAM); Pabillonis loc. Is Arenas, 50 m, 24.IV.1981, SRi, 1 ex (MCSN), CM, 5 ex (CCM), 1 ex (CAM); Quirra, 35 m, 2003, SR, 1 ex (CSR); San Priamo, Rio Sa Picocca presso la foce, 12.V.2001, FCl, 1 ex (CFC); Villacidro, Canale Monincu, 450 m, 21.V.2006, PCo MB DB DW, 1 ex (CNBFVR). **Nuoro prov.**: Lula, Torrente Sologo, S.S.. Lula – Dorgali, 510 m, 5.V.1995, FA, 1 ex (CFA); dint. di Oliena, 350 m, 6.V.1995, FA, 1 ex (CFA); Oliena, dint. San Giovanni, 150 m, 6.V.1995, FA, 12 ex (CFA), 4 ex (CAM); Torpè, 3 km E Concas, pozze residue immissario Lago Posada, 100 m, 5.VII.2003, FP, 1 ex (CSR). **Oristano prov.**: Oristano, 10 m, 1.V.1980, CM, 1 ex (CCM); Pauli Cùccuru Sperrau, Cabras, 29.IV.2005, SR, 4 ex (CSR), 2 ex (CAM); Santuario Nuragico Cabu Abbas, 14.IV.1997, PLc BL, 2 ex (CAM); Simaxis, Fiume Tirso, 17.III.2003, SR, 1 ex (CSR), 1 ex (CAM). **Sassari prov.**: Golfo degli Aranci, Cantoniera Marinella, 19.III.2003, SR, 2 ex (CSR), 2 ex (CAM); Monti, Sos Sambizos, III.2003, SR, 1 ex (CSR); Ozieri, Rio Mannu, 200 m, 27.VI.2008, SR, 2 ex (CSR), 2 ex (CAM); Porto San Paolo, Rio Scalimala, 20 m, 2.V.2004, SR, 2 ex (CSR), 1 ex (CAM); Porto Torres, Stagno di Pilo, 24.V.1995, FA, 1 ex (CFA), 1 ex (CAM); Romana, Rio Santa Lunghia, 207 m, 25.VI.2008, SR, 1 ex (CSR).

CHOROTYPE. Mediterranean.

ITALIAN DISTRIBUTION. Lombardy, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Latium, Abruzzi, Molise, Campania, Apulia, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Microphagous species typical of stagnant and running waters in lowlands and hills.

NOTES. Without a doubt the most common species of the family in Sardinia.

2. *Dryops costae* (Heyden, 1891)

*Parnus Costae* Heyden: Heyden et al. 1891: 76.

*Dryops Costae* Heyden: Bertolini 1904: 26; Dodero 1918: 101; Luigioni 1929: 443; Porta 1929: 287.

*Dryops Costai* Heyden: Zaitzev 1910: 13; Winkler 1926: 670.

*Dryops costae* (Heyden, 1891): Olmi 1976: 46; Mascagni & Calamandrei 1992: 128; Angelini et al. 1995: 5; Jäch 2005b; Kodada & Jäch 2006: 441.

LITERATURE DATA. Sardinia (Bertolini 1904; Zaitzev 1910;

Winkler 1926; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b; Kodada & Jäch 2006). **Cagliari prov.:** Quartu Sant'Elena (Dodero 1918; Olmi 1976). **Nuoro prov.:** Aritzo (Dodero 1918; Olmi 1976); Dorgali (Olmi 1976); Fonni; Monte dei Sette Fratelli (Dodero 1918; Olmi 1976); Monti del Gennargentu; Orgosolo; Siniscola; Torpè (Olmi 1976). **Sassari prov.:** Olbia; Ozieri (Dodero 1918; Olmi 1976); Pèrfugas (Heyden et al. 1891); Vignola Mare (Olmi 1976).

RECORDS. **Cagliari prov.:** Monti dei Sette Fratelli, Rio Maidópis, 350 m, 21.VI.1988, CM, 1 ex (CCM); S. Priamo, Muravera, Rio Sa Picocca, 7.IX.1977, LT, 4 ex (CAM); Sarrabus, Rio Sa Picocca, ponte Monte Acuto, 38 m, 16.VIII.1981, CM, 2 ex (CCM); 5.VI.1987, CM, 1 ex (CAM); Sarròch, Rio Monte Nieddu, 75 m, 1.VII.1984, CM, 2 ex (CCM), 2 ex (CAM); Villacidro, radura riva sin. Rio Cannisoni, 400 m, 19–24.V.2006, PCo MB DB DW, lt, 4 ex (CNBFVR), 1 ex (CAM); Villacidro, Rio Cannisoni, 382 m, 5.IX.2007, DA, 5 ex (CNBFVR), 1 ex (CAM); Villacidro, Canale Monincu, 450 m, 21.V.2006, PCo MB DB DW, 1 ex (CNBFVR), 1 ex (CAM). **Nuoro prov.:** Barbàgia di Belvi, confluenza Riu Su Fruscu col Fiume Flumendosa, 520 m, 10.VI.2007, RB, 2 ex (CMC); Bari Sardo, Cardedu, 27.VI.1987, CT, at light, 1 ex (MCSN); Cantoniera Pira 'e Onni, Rio Calaresu, 872 m, 4.VII.1997, FP, 2 ex (CSR), 2 ex (CAM); Laconi loc. Funtanamela, 720 m, 10.IX.1988, CM, 1 ex (CCM); Orosei, Rio sos Alinos, 4.VIII.1959, FP, 2 ex (CSR), 1 ex (CAM); Siniscola, 28.VII.1959, FP, 4 ex (CAM); Talàna, affluente Rio 'e Gurue, 150 m, VII.1997, FP, 1 ex (CSR); Villanova Strisaili, Bau e Mela, 850 m, VII.1997, FP, 1 ex (CSR).

CHOROTYPE. Sardo-Corsican.

ITALIAN DISTRIBUTION. Sardinia.

ECOLOGY. Common microphagous species typical of running waters in lowlands and hills.

### 3. *Dryops doderoi* Bollow, 1936

*Dryops doderoi* Bollow, 1938: Bollow 1938: 348; Angelini et al. 1995: 5; Jäch 2005b.

LITERATURE DATA. Sardinia (Bollow 1938; Angelini et al. 1995; Jäch 2005b). **Cagliari prov.:** Fluminimaggiore (Olmi 1976).

RECORDS. **Cagliari prov.:** Gesturi, Giara di Gesturi, 568 m, 15.VI.2004, GN, 1 ex (CNBFVR), 1 ex (CAM); Pauli s'Ala di Mengianu, Giara di Gesturi, 570 m, 13.III.2008, FS FMr, 1 ex (CSR).

CHOROTYPE. Mediterranean.

ITALIAN DISTRIBUTION. Liguria, Tuscany, Latium, Campania, Apulia, Basilicata, Sardinia, Sicily.

ECOLOGY. Microphagous species typically found on marsh banks among sphagnum and small *Carex*

mounds; quite rare in Sardinia.

### 4. *Dryops gracilis* (Karsch, 1881)

*Dryops gracilis* Karsch: Bollow 1938: 344.

*Dryops gracilis* Karsch, 1881: Rocchi & Mascagni 2003: 33; Jäch 2005b.

LITERATURE DATA. Sardinia (Bollow 1938; Jäch 2005b). **Nuoro prov.:** Lula (Rocchi & Mascagni 2003).

CHOROTYPE. Mediterranean.

ITALIAN DISTRIBUTION. Liguria, Sardinia, Sicily.

ECOLOGY. Microphagous species characteristic of stagnant and running waters in lowlands and hills; uncommon.

### 5. *Dryops luridus* (Erichson, 1847)

*Dryops luridus* Erichson: Bertolini 1874: 101; Bertolini 1904: 26; Luigioni 1929: 443; Porta 1929: 287; Strassen 1954: 273.

*Parnus luridus* Erichson: Costa 1883: 41.

*Parnus luridus* Er.: Krausse 1913b: 184.

*Dryops luridus* (Erichson): Dodero 1918: 101.

*Dryops luridus* (Erichson, 1847): Olmi 1976: 60; Mascagni & Calamandrei 1992: 128; Angelini et al. 1995: 5; Jäch 2005b.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b). **Cagliari prov.:** Cagliari; Santadi (Dodero 1918; Olmi 1976). **Nuoro prov.:** Dorgali (Dodero 1918; Olmi 1976); Laconi (Olmi 1976); Monti del Gennargentu (Dodero 1918; Olmi 1976); Sorgono dint. (Krausse 1913b). **Sassari prov.:** Aggius dint. (Costa 1883); Porto Torres (Strassen 1954).

RECORDS. **Cagliari prov.:** Domusnovas, Valle Oridda, Rio d'Oridda, 592 m, 8.VI.2004, GN, 1 ex (CNBFVR), 1 ex (CAM). **Nuoro prov.:** Aritzo, Rio Castiau, 450 m, 8.V.1983, CM, 1 ex (CCM); Belvi, 700 m, 9.V.1995, FA, 1 ex (CAM); Desulo, Arcu Guddetorgiu, 950 m, FA, 1 ex (CFA). **Oristano prov.:** Oristano, 30.IV.1982, SRi, 1 ex (MCSN). **Sassari prov.:** Alà dei Sardi, strada Torpè 2 km W Piras, pozze residue del torrente, 260 m, 5.VII.2003, FP, 1 ex (CSR).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Latium, Apulia, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Microphagous species typical of stagnant and running waters in lowlands, hills and mountains; common in Sardinia.



6. *Dryops lutulentus* (Erichson, 1847)

*Parnus lutulentus* Erichson: Costa 1883: 41.

*Dryops lutulentus* Erichson: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904). **Nuoro prov.:** Nuoro dint. (Costa 1883).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. The species occurs in all regions except Sardinia and Corsica, where *D. costae* (Olmi 1978) occurs as its vicariant.

ECOLOGY. Microphagous species typical of running waters in lowlands and hills.

NOTES. Due to what stated above, the occurrence of this species in Sardinia is impossible. The above record is surely a misidentification.

7. *Dryops rufipes* (Krynicky, 1832)

*Dryops corsicus* Kuwert: Bertolini 1904: 26.

*Dryops pilosellus* Erichson: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Occurs in all northern and central Italian regions, but not in the extreme south of the peninsula and its islands (Olmi 1978).

ECOLOGY. Microphagous species typical of stagnant and running waters in lowlands and hills.

NOTES. The record by Bertolini (1904) is certainly due to a misidentification.

8. *Dryops similis* Bollow, 1936

*Dryops similis* Bollow, 1936: Bollow 1936: 152; Olmi 1978: 30; Mascagni & Calamandrei 1992: 128; Angelini et al. 1995: 5; Jäch 2005b.

LITERATURE DATA. Sardinia (Bollow 1936; Olmi 1978; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Latium, Abruzzi, Molise, Apulia, Basilicata, Sardinia.

ECOLOGY. Microphagous species typical of marshy habitats with abundant riparian vegetation; rare in Sardinia.

9. *Dryops striatellus* (Fairmaire & Brisout, 1859)

*Dryops striatellus* (Fairmaire & Brisout, 1859): Rocchi & Mascagni 2003: 34; Jäch 2005b.

LITERATURE DATA. Sardinia (Jäch 2005b). **Sassari prov.:** Cantoniera Scala Piccada (Rocchi & Mascagni 2003).

RECORDS. **Cagliari prov.:** Giara di Gesturi, Pauli Oromeo, 580 m, 30.IV.2005, SR, 1 ex (CSR).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Tuscany, Umbria, Latium, Basilicata, Sardinia, Sicily.

ECOLOGY. Microphagous species characteristic of stagnant and running waters in lowlands and hills; uncommon in Sardinia.

10. *Dryops striatopunctatus* (Heer, 1841)

*Dryops striatopunctatus* Heer: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. European.

ITALIAN DISTRIBUTION. Occurs in all Italian regions except for the extreme south of the peninsula and the islands (Olmi 1978).

ECOLOGY. Microphagous species typical of running waters in hills and mountains.

NOTES. The record by Bertolini (1904) certainly refers to misidentified specimens.

11. *Dryops sulcipennis* (A. Costa, 1883)

*Parnus sulcipennis* Costa: Costa 1883: 86.

*Dryops sulcipennis* Costa: Bertolini 1904: 26; Zaitzev 1910: 16; Dodero 1918: 101; Winkler 1926: 669; Luigioni 1929: 443; Porta 1929: 288; Strassen 1954: 273.

*Dryops sulcipennis* (A. Costa, 1883): Olmi 1976: 52; Mascagni & Calamandrei 1992: 128; Angelini et al. 1995: 5; Jäch 2005b.

LITERATURE DATA. Sardinia (Costa 1883; Bertolini 1904; Zaitzev 1910; Winkler 1926; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b). **Cagliari prov.:** Asuni (Dodero 1918; Olmi 1976); Barumini; Palmas (Olmi 1976); San Basilio (Dodero 1918; Olmi 1976). **Nuoro prov.:** Désulo (Strassen 1954); Oliena (Costa 1883); Siniscola (Olmi 1976). **Sassari prov.:** Olbia (Dodero 1918).

RECORDS. **Cagliari prov.:** Decimomannu, Rio Sési, 4.VII.1990, CM, 2 ex (CCM), 1 ex (CAM). **Nuoro prov.:** Cantoniera Pira 'e Onni, Rio Calaresu, 872 m, 4.VII.1997, FP, 1 ex (CSR); Oliena, Sorgente Su Cologone, 2.VII.2000, PCo, 2 ex (CPC), 1 ex (CAM). **Oristano prov.:** Fiume Tirso, ponte Mannu, 9.VII.1973,

CM, 1 ex (CCM), 1 ex (CAM), 9.V.1982, CM, 1 ex (CCM). **Sassari prov.:** Isola Caprera, Monte Teialone, 11.XI.1986, GO, 1 ex (CNBFVR); Terme di Casteldoria, Fiume Coghinas, 200 m, SR, 4 ex (CSR), 4 ex (CAM).

CHOROTYPE. Mediterranean.

ITALIAN DISTRIBUTION. Piedmont, Tuscany, Latium, Abruzzi, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Microphagous species characteristic of stagnant and running waters in lowlands and hills; uncommon in Sardinia.

## 12. *Dryops viennensis* (Laporte, 1840)

*Dryops obscurus* Duftschmid: Bertolini 1904: 26.

LITERATURE DATA. Sardinia (Bertolini 1904).

CHOROTYPE. Central-European.

ITALIAN DISTRIBUTION. It occurs in all northern and central Italian regions except the extreme south of the peninsula and the islands (Olmì 1978).

ECOLOGY. Microphagous species typical of running waters in hill and mountain habitats.

NOTES. The record by Bertolini (1904) certainly refers to misidentified specimens.

## 13. *Pomatinus substriatus* (Ph. Müller, 1806)

*Helichus substriatus* Müller: Krausse 1913a: 62; Luigioni 1929: 443.

*Helichus substriatus* (Ph. Müller, 1806): Olmì 1976: 31.

*Pomatinus substriatus* (Ph. Müller, 1806): Mascagni & Calamandrei 1992: 128; Angelini et al. 1995: 5; Jäch 2005b.

*Helichus substriatus*: Fonnesu et al. 2005a: 14.

LITERATURE DATA. Sardinia (Luigioni 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Jäch 2005b). **Cagliari prov.:** Rio Pula (Fonnesu et al. 2005a). **Nuoro prov.:** Sorgono dint., Gennargentu (Krausse 1913a); Orgosolo (Olmì 1976).

RECORDS. **Cagliari prov.:** Villacidro, C. Sarais, 251 m, 9.IX.2006, GN, 1 ex (CNBFVR). **Nuoro prov.:** Cantoniera Pira e' Onni, Rio Calaresu, 900 m, V.1997, FCI, 1 ex (CFC); Orgosolo dint., 650 m, 6.V.1995, FA, 1 ex (CFA); Siniscola, 50 m, 28.VII.1959, FP, 3 ex (CAM); Villanova Strisaili, Rio Bau e Mandara, 6.VII.1997, SR, 1 ex (CSR).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Marches, Latium, Abruzzi, Campania, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Microphagous species typical of running waters in hills and mountains; rather common in Sardinia.

LIMNICHIDAE Erichson, 1847

Cosmopolitan family comprising about 220 species (Jäch 1998). In most species the larvae and the adults live along the banks of water courses and other water bodies. Nine species occur in Italy, 3 of which are also recorded from Sardinia.

## 1. *Bothriophorus atomus* Mulsant & Rey, 1852

*Bothriophorus atomus* Mulsant & Rey: Bertolini 1904: 59; Porta 1929: 311; Luigioni 1929: 543.

*Bothriophorus atomus* Mulsant & Rey, 1842: Mascagni & Calamandrei 1992: 127; Angelini et al. 1995: 5; Ribera & Hernando 2005.

LITERATURE DATA. Sardinia (Bertolini 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Ribera & Hernando 2005).

RECORDS. **Cagliari prov.:** Muravera, Torre Salinas, stagno Saline, 12.V.1995, FA, 1 ex (CFA). **Oristano prov.:** Stagno di Cabras, 19.V.1995, FA, 2 ex (CFA), 1 ex (CAM). **Sassari prov.:** Porto Torres, Stagno di Pilo, 24.V.1995, FA, 18 ex (CFA), 9 ex (CAM).

CHOROTYPE. S-European.

ITALIAN DISTRIBUTION. Venetia, Emilia-Romagna, Tuscany, Apulia, Basilicata, Calabria, Sardinia, Sicily. ECOLOGY. Microphytophagous species characteristic of river and pond banks, mainly in halophilous reedbeds; quite common in Sardinia

## 2. *Limnichus angustulus* Weise, 1877

*Limnichus angustulus* Weise: Bertolini 1904: 59; Dalla Torre 1911: 6; Krausse 1914: 98; Winkler 1926: 682; Luigioni 1929: 543; Porta 1929: 310.

*Limnichus angustulus* Weise, 1877: Mascagni & Calamandrei 1992: 127; Angelini et al. 1995: 5; Ribera & Hernando 2005; Hernando & Ribera 2006: 444.

LITERATURE DATA. Sardinia (Bertolini 1904; Dalla Torre 1911; Winkler 1926; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Ribera & Hernando 2005; Hernando & Ribera 2006). **Nuoro prov.:** Sorgono (Krausse 1914).

CHOROTYPE. Sardo-Corsican.

ITALIAN DISTRIBUTION. Sardinia.

ECOLOGY. Rare microphytophagous species characteristic of river banks.

### 3. *Pelochares versicolor* (Waltl, 1838)

*Pelochares versicolor* Waltl: Bertolini 1904: 59; Luigioni 1929: 542; Porta 1929: 310.

*Pelochares versicolor* (Waltl, 1838): Mascagni & Calamandrei 1992: 127; Angelini et al. 1995: 5; Ribera & Hernando 2005.

LITERATURE DATA. Sardinia (Bertolini 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Ribera & Hernando 2005).

RECORDS. **Cagliari prov.:** San Priamo, Rio Picocca, 12.V.1995, FA, 1 ex (CFA). **Nuoro prov.:** Lula, Torrente Sologo, S.S. Lula – Dorgali, 450 m, 5.V.1995, FA, 1 ex (CAM). **Oristano prov.:** Ponte Mannu, Fiume Tirso, 6.VIII.1975, CM, 1 ex (CCM), 1 ex (CAM). **Sassari prov.:** Óschiri, Lago Coghinas, 20.V.1974, VR, 1 ex (MCSN).

CHOROTYPE. Turano-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Liguria, Emilia-Romagna, Tuscany, Umbria, Abruzzi, Molise, Apulia, Campania, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Microphytophagous species typical of river and lake banks in lowland and hilly habitats; uncommon in Sardinia.

## HETEROCERIDAE MacLeay, 1825

Cosmopolitan family comprising approximately 200 species (Jäch 1998). Both the larvae and the adults live alongside water courses and water bodies buried in sand and mud. The family includes 18 species in Italy, 8 of which occur in Sardinia.

### 1. *Augyles flavidus* (Rossi, 1794)

*Heterocerus flavidus* Rossi: Bertolini 1874: 103; Kuwert 1898b: 78; Bertolini 1904: 27; Heyden et al. 1906: 376; Luigioni 1929: 448; Porta 1929: 297; Mascagni 1985: 347.

*Littorimus flavidus* (Rossi, 1794): Mascagni & Calamandrei 1992: 124; Angelini et al. 1995: 4.

*Augyles flavidus* (Rossi, 1794): Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Kuwert 1898; Heyden et al. 1906; Luigioni 1929; Porta 1929; Mascagni 1985; Mascagni & Calamandrei 1992; Angelini et al. 1995; Mascagni, 2005a, 2005c).

RECORDS. Sardinia, 1860, DG, 1 ex (MCSN).

CHOROTYPE. Centralasiatic-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Marches, Latium, Abruzzi, Molise, Campania, Apulia, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Limivorous species typical of river and lake banks; very rare in Sardinia.

### 2. *Augyles maritimus* (Guérin-Méneville, 1844)

*Heterocerus nanus* Gené: Gené 1836: 23.

*Heterocerus maritimus* Guérin-Méneville: Bertolini 1874: 103; Bertolini 1904: 27.

*Heterocerus maritimus* Guérin-Méneville, 1844: Mascagni 1985: 345.

*Littorimus maritimus* (Guérin-Méneville, 1844): Mascagni & Calamandrei 1992: 125; Angelini et al. 1995: 4.

*Augyles maritimus* (Guérin-Méneville, 1844): Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1874, 1904; Mascagni & Calamandrei 1992; Angelini et al. 1995; Mascagni 2005a, 2005c). **Cagliari prov.:** Isola di San Pietro (Gené 1836; Mascagni 1985). **Sassari prov.:** Sassari (Mascagni 1985).

RECORDS. **Cagliari prov.:** Isola di San Pietro, Carloforte, 10 m, 27.IV.1902, AD, 1 ex (MCSN), 1 ex (CAM); Decimomannu, Rio Sési, 23.VII.1989, CM, 1 ex (CCM), 1 ex (CAM); Gonnesa, 40 m, 5.IV.1912, AD, 9 ex (MCSN); Maracalagonis, stagno, VII.1997, PL, 1 ex (CCM).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Molise, Apulia, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Limivorous species characteristic of brackish and backdune pond banks of river deltas; quite common in Sardinia.

### 3. *Augyles marmota* (Kiesenwetter, 1850)

*Heterocerus marmota* Kiesenwetter: Bertolini 1904: 27; Porta 1929: 297; Mascagni 1985: 346.

*Heterocerus funebris* Schaufuss: Bertolini 1904: 27.

*Littorimus marmota* (Kiesenwetter): Mascagni & Calamandrei 1992: 125.

*Augyles marmota* (Kiesenwetter): Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1904; Porta 1929; Mascagni 1985; Mascagni & Calamandrei 1992; Mascagni 2005a, 2005c).

CHOROTYPE. Europeo-Mediterranean.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Emilia-Romagna, Tuscany, Umbria, Marches, Latium, Abruzzi, Molise, Apulia, Campania, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Limivorous species typical of river banks.

NOTES. The presence of this species on the island needs confirming, as it was often confused with *A. maritimus* in the past. The records by Bertolini (1904) and Porta (1929), later reported also by Mascagni (1985, 2005a) and Mascagni & Calamandrei (1992), may actually refer to *A. maritimus*.

#### 4. *Heterocerus aragonicus* Kiesenwetter, 1850

*Heterocerus aragonicus* v. *pictus* Mulsant & Rey: Bertolini 1904: 27.  
*Heterocerus aragonicus* Kiesenwetter: Porta 1929: 295; Strassen 1954: 273.

*Heterocerus aragonicus* Kiesenwetter, 1850: Mascagni 1985: 350; Mascagni & Calamandrei 1992: 126; Angelini et al. 1995: 4; Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1904; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Mascagni 2005a, 2005c). **Cagliari prov.:** Capoterra (Mascagni 1985). **Sassari prov.:** Lago Búnnari; Lago Mussolini (Strassen 1954).

CHOROTYPE. W-Mediterranean.

ITALIAN DISTRIBUTION. Liguria, Tuscany, Latium, Campania, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Limivorous species typical of river banks; rare in Sardinia.

#### 5. *Heterocerus fenestratus* (Thunberg, 1784)

*Heterocerus laevigatus* Panzer: Bertolini 1904: 27.  
*Heterocerus fenestratus* Thunberg: Luigioni 1929: 447; Porta 1929: 296.

*Heterocerus fenestratus* (Thunberg, 1794): Mascagni 1985: 350; Mascagni & Calamandrei 1992: 125; Angelini et al. 1995: 4; Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Mascagni 2005a, 2005c). **Cagliari prov.:** San Vito (Mascagni 1985). **Oristano prov.:** Oristano (Mascagni 1985). **Sassari prov.:** bacino di Sassari; Sassari, Rio Mascari (Mascagni 1985).

RECORDS. **Cagliari prov.:** Assémini, Rio Cixerri, 1.V.1991, CM, 2 ex (CCM), 1 ex (CAM); Capoterra, foce Rio Santa Lucia, 18.V.1987, CM, 1 ex (CCM); Decimomannu, Rio Sési, 4.VII.1990, CM, 11 ex (CCM), 2 ex (CAM); Maracalagonis, stagno, 5.VII.1999, PL, 1 ex (CCM); San Priamo, Torrente Picocca,

10 m, 28.V.1994, PCR, 1 ex (CFA); Tadasuni, Lago Omodeo, 115 m, 21.V.1995, FA, 55 ex (CFA), 6 ex (CAM). **Nuoro prov.:** Belvi, 700 m, X.1975, FH, 1 ex (MRSN); Catena del Marghine, strada Bolotana–Burgos, 22.V.1995, FA, 1 ex (CFA); Ottana dint., 160 m, 21.V.1995, FA, 1 ex (CFA). **Oristano prov.:** Sédilo, Fiume Tirso, S.S. 131, 120 m, 21.V.1995, FA, 13 ex (CFA), 4 ex (CAM). **Sassari prov.:** Chilivani, 220 m, 2.VI.1972, 4 ex (CRF), 1 ex (CAM); Isola Maddalena, I Pozzoni, 18.VI.1987, NS, 24 ex (MCSN), 1 ex (CAM); Olbia, 9 ex (NMW), 1 ex (CAM); Platamona Lido, Stagno Platamona, 3.VI.1967, FCa, 5 ex (MZUR), 1 ex (CAM); Trinità d'Agultu, Costa Paradiso, 365 m, 13–31.VII.1998, BC BCa, It, 25 ex (CAM), 3 ex (CCC), 2 ex (MZUF); Tula, Lago Coghinas, 165 m, 27.V.1995, FA, 2 ex (CFA), 1 ex (CAM); Tula, Rio Mannu alla confluenza col Lago Coghinas, 165 m, 28.VI.2008, SR FT, 6 ex (CSR), 4 ex (CFT), 41 ex (CAM); Tula, pozze temporanee, 200 m, 27.V.1995, FA, 33 ex (CFA), 5 ex (CAM); Villa Assunta, Lago Baratz, 18.III.2001, ADe, 1 ex (MCSN).

CHOROTYPE. Holarctic.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Trentino-Alto Adige, Venetia, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, Marches, Latium, Abruzzi, Molise, Campania, Apulia, Basilicata, Calabria, Sardinia, Sicily.

ECOLOGY. Limivorous species occurring on river and lake banks, also brackish ones, and on the edges of marshes and ponds.

NOTES. Without a doubt the most common species of the family in Sardinia and Italy.

#### 6. *Heterocerus flexuosus* Stephens, 1828

*Heterocerus hamifer* Gené: Gené 1836: 22; Costa 1886: 20; Kuwert 1898b: 78; Mascagni 1985: 347.

*Heterocerus Damryi* Kuwert 1898a: 50; Bertolini 1904: 27.  
*Heterocerus flexuosus* Stephens: Luigioni 1929: 446; Porta 1929: 295.

*Heterocerus flexuosus* Stephens, 1828: Mascagni 1985: 342; Mascagni 1991: 79; Mascagni & Calamandrei 1992: 126; Angelini et al. 1995: 4; Mascagni 2005a, 2005c; Mascagni 2006: 448.

LITERATURE DATA. Sardinia (Gené 1836; Kuwert 1898a, 1898b; Bertolini 1904; Luigioni 1929; Porta 1929; Mascagni & Calamandrei 1992; Angelini et al. 1995; Mascagni 2005a, 2005c). **Cagliari prov.:** Capo Spartivento, Stagno di Chia; Carloforte; Chia, Domus De Maria; Giorgino; San Giovanni, Stagno di Porto Botte; Stagno di Colostrai; Stagno di Quartu (Mascagni 1985). **Nuoro prov.:** Stagno di San Teodoro (Costa 1886; Mascagni 1985). **Oristano prov.:** Capo Mannu, Stagno Sale Porcus; Putzu Idu, Riola (Mascagni 1985); Stagno di Càbras, (Mascagni 1985, 1991); Stagno Isarchas (Mascagni 1985). **Sassari prov.:** Olbia dint.; Porto Torres, Stagno di Pilo; Golfo Aranci (Mascagni 1985).

RECORDS. **Cagliari prov.:** Cala su Pallosu, stagni, 29.V.1972, PD, 5 ex (MCNV), 1 ex (CAM); Capoterra, foce Rio Santa Lucia, 28.VI.1978, CM, 4 ex (CCM), 1 ex (CAM); Giorgino, III.1890, UL, 1 ex (MCSN); Isola di San Pietro, Stagno della Vivagna, 27.VI.1987, RP, 1 ex (MCSN); Quartu Sant'Elena, Stagno di Quartu, 1.IV.1970, CM, 2 ex (CCM), IV.1973, PL, 1 ex (CCM), 1 ex (CAM); Quartu Sant'Elena, Stagno di Simbirizzi, 21 m, 31.III.1986, CM, 1 ex (CCM), 7.IV.1986, CM, 1 ex (CCM), 1 ex (CAM); San Priamo, Rio Picocca, 12.V.1995, FA, 1 ex (CFA); Serdiana, Stagno di Serdiana, 100 m, 12.VI.1986, CM, 1 ex (CCM), 1 ex (CAM); Stagno di Molentargius, VII.1895, UL, 1 ex (MCSN); Stagno di Molentargius, 3 m, 13.VII.1978, CM, 1 ex (CCM), 1 ex (CAM). **Nuoro prov.:** Budoni, Tanaunella, brackish water, 1–12.IX.1999, RPa, 1 ex (CRP), 3 ex (CAM); Orosei, Rio sos Alinos, 4.VIII.1959, FP, 1 ex (CSR). **Oristano prov.:** Putzu Idu, 1.VI.1974, IB, 2 ex (MCSN); Putzu Idu, Stagno Saline, Sinis, 21–26.V.1974, LB, 1 ex (MBCG). **Sassari prov.:** Alghero, Fertilia, V.1960, EL, 1 ex (MSNV); Olbia, Golfo Aranci, 6.VI.1908, AD, 1 ex (MCSN); VII.1910, AD, 1 ex (MCSN); IX.1928, AD, 2 ex (MCSN); 2.V.1995, FA, 1 ex (CFA); Stintino, Tonnara Saline, 26.VI.2008, SR FT, 4 ex (CSR), 4 ex (CFT), 16 ex (CAM).

CHOROTYPE. Palaearctic.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Venetia, Friuli-Venezia Giulia, Emilia-Romagna, Tuscany, Molise, Apulia, Basilicata, Sardinia, Sicily.

ECOLOGY. Limivorous species characteristic of brackish and backdune pond banks of river deltas; common in Sardinia.

#### 7. *Heterocerus fossor* Kiesenwetter, 1843

*Heterocerus fossor* Kiesenwetter: Bertolini 1904: 27; Porta 1929: 295.  
*Heterocerus fossor* Kiesenwetter, 1843: Mascagni 1985: 342; Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Bertolini 1904; Porta 1929; Mascagni 1985, 2005a, 2005c).

CHOROTYPE. Sibero-European.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Venetia, Friuli-Venezia Giulia, Emilia-Romagna, Tuscany, Umbria, Latium, Sardinia.

ECOLOGY. Limivorous species of river banks.

NOTES. Because this species was often confused with *H. flexuosus* in the past, records by Bertolini (1904) and Porta (1929), later cited also by Mascagni (1985, 2005a, 2005c), need confirming in our opinion.

#### 8. *Heterocerus marginatus* (Fabricius, 1787)

*Heterocerus marginatus* Fabricius: Kuwert 1890: 15; Heyden et al.

1906: 376; Barthe 1926: 15; Porta 1929: 296.

*Heterocerus sulcatus* Kuwert: Bertolini 1904: 27.

*Heterocerus marginatus* (Fabricius, 1797): Mascagni 1985: 349; Mascagni 2005a, 2005c.

LITERATURE DATA. Sardinia (Kuwert 1890; Bertolini 1904; Heyden et al. 1906; Barthe 1926; Porta, 1929; Mascagni 1985, 2005a, 2005c).

CHOROTYPE. Palaearctic.

ITALIAN DISTRIBUTION. Piedmont, Lombardy, Venetia, Sardinia, Sicily.

ECOLOGY. Very rare limivorous species characteristic of river banks and deltas.

#### 9. *Heterocerus sardous* Fairmaire, 1881

*Heterocerus sardous* Fairmaire, 1881: xi.

*Heterocerus sardous* Fairmaire: Bertolini 1904: 27.

LITERATURE DATA. Sardinia (Fairmaire 1881; Bertolini 1904).

NOTES. Despite a careful search, we were unable to find the type specimen. The record by Bertolini (1904) also represents the last citation of *H. sardous* in the literature. On the basis of the original description, this species is probably a synonym of *Augyles maritimus* Guérin-Méneville.

## CONCLUSIONS

### Zoogeographical aspects

As far as the four families of Byrrhoidea are concerned and excluding the species *Esolus parallelepipedus*, *Limnius opacus*, *Oulimnius troglodytes* and *Heterocerus fossor*, the occurrence of which in Sardinia is extremely doubtful, the above catalogue contains a total of 29 species. Thirteen (44.83%) are widely distributed in the Holarctic region, 6 (20.69%) are widespread in Europe, 5 (17.24%) are widespread in the Mediterranean basin and 5 (17.24%) are Sardo-Corsican endemics (fig. 1). Analysing the four families separately, the following differences emerge:

a) Species widespread in the Holarctic region: Elmidae 30%; Dryopidae 33.33%; Limnichidae 33.33%; Heteroceridae 85.72%.

b) Species widespread in Europe: Elmidae 40%; Dryopidae 11.11%; Limnichidae 33.33%; Heteroceridae 0%.

c) Species widespread in the Mediterranean basin: Elmidae 0%; Dryopidae 44.45%; Limnichidae 0%; Heteroceridae 14.28%.

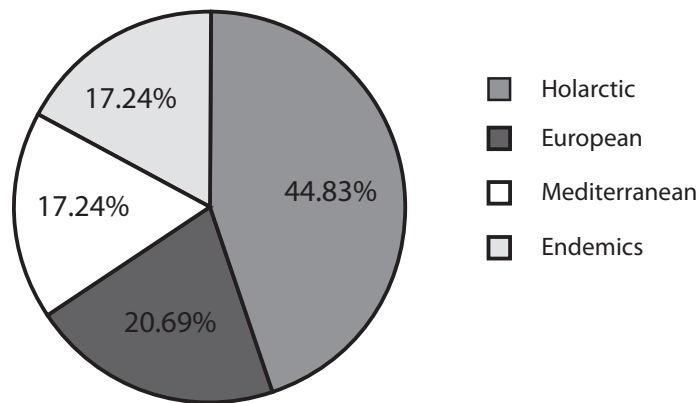


Fig. 1. Percentages of species of the four families of Byrrhoidea according to chorotype category.

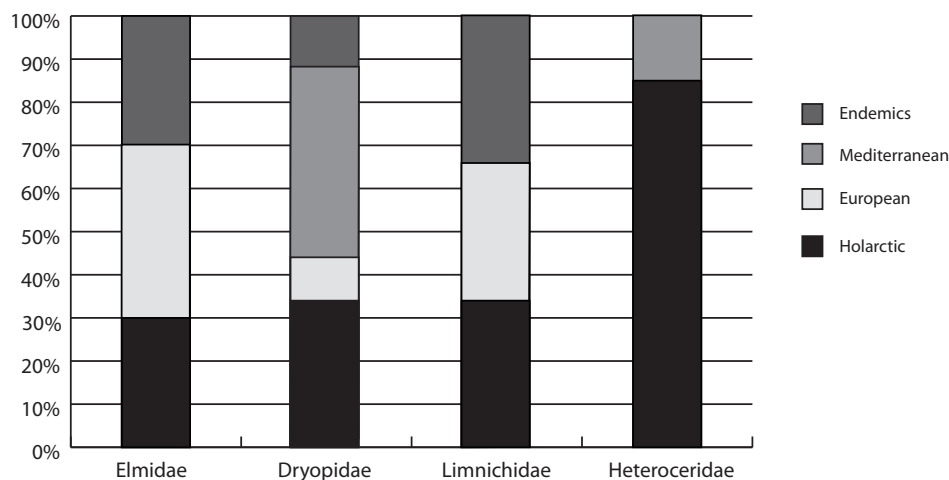


Fig. 2. Percentages of species within each family of Byrrhoidea, according to chorotype.

d) Endemics: Elmidae 30%; Dryopidae 11.11%; Limnichidae 33.33%; Heteroceridae 0%.

Thus, amongst the Heteroceridae, species with a widespread Holarctic distribution prevail, whereas species widespread in Europe are prevalent in the Elmidae and species widespread in the Mediterranean basin are prevalent in the Dryopidae; in the Limnichidae, species widespread in the Mediterranean are missing altogether and all species of this family are equally distributed in the three remaining categories (fig. 2).

As for the Georissidae, all species are widespread either in the Holarctic region or in Europe.

### Ecology

All members of the five families can certainly be considered good bioindicators because of their preferred habitats: both the larvae and the adults live in humid areas close to the water or inside lotic or lentic water.

### Conservation

As already mentioned, the knowledge of the true distribution and abundance of these insects in Sardinia cannot be considered satisfactory. However, the current picture warns of some species at risk of extinction, due to their rarity and to their occurrence in areas being progressively modified and destroyed by man. Some taxa may have already become extinct, such as *Potamophilus acuminatus*, *Oulimnius tuberculatus*, *Stenelmis canaliculata*, *S. consobrina*, *Dryops similaris*, *Augyles flavidus*, *Heterocerus marginatus*, *Georissus crenulatus*, *G. substriatus*, and *G. laeicollis*. As for the Sardinian endemics the only seriously threatened one is *Limnichus angustulus*, a rare species which has not been collected for a long time; the remaining four taxa (*Elmis maugetii fossulata*, *Esolus brevis*, *Limnius sulcipennis sulcipennis*, *Dryops costae*) are not endangered and *Dryops costae* is actually quite common throughout the island. Nonetheless, maximum care should be given to all humid areas in Sardinia and

further focused research would be desirable in these areas in order to better estimate the true Sardinian fauna of beetles belonging to these families.

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