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R. Gerecke^a, F. Marrone^b, G. Sorgi^c, M. Dossena^d & F. Stoch^e

^a Institut für Evolution und Ökologie, Abteilung Evolutionsbiologie der Invertebraten, Universität Tübingen, Germany

^b Dipartimento di Scienze e Technologie Biologiche, Chimiche & Farmaceutiche, Università di Palermo, Italy

^c Dipartimento di Scienze Biologiche, Geologiche e Ambientale, Sezione di Biologia Animale, Università di Catania, Italy

^d Queen Mary School of Biological and Chemical Sciences, University of London, UK

^e Department of Life, Health & Environmental Sciences, University of L'Aquila, Italy

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The water mites (Acari: Hydrachnidia) of the standing waters of Corsica, Sardinia and Sicily: review and new data

R. GERECKE^{1*}, F. MARRONE², G. SORGI³, M. DOSSENA⁴, & F. STOCH⁵

¹Institut für Evolution und Ökologie, Abteilung Evolutionsbiologie der Invertebraten, Universität Tübingen, Germany, ²Dipartimento di Scienze e Tecnologie Biologiche, Chimiche & Farmaceutiche, Università di Palermo, Italy, ³Dipartimento di Scienze Biologiche, Geologiche e Ambientale, Sezione di Biologia Animale, Università di Catania, Italy, ⁴Queen Mary School of Biological and Chemical Sciences, University of London, UK, and ⁵Department of Life, Health & Environmental Sciences, University of L'Aquila, Italy

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Abstract

A compilation of our present knowledge of the water mites (Acari: Hydrachnidia) adapted to life in standing waters on the three large islands in the western Mediterranean (Corsica, Sardinia and Sicily) is provided. In addition to published data, this study deals with a rich volume of new material from recent field work, mostly deriving from intermittent ponds and pools, an extremely poorly investigated yet peculiar habitat type in the Mediterranean area. Species richness of water mites reported for the standing waters of the three islands amounts to 91 species. Out of the 47 species for which we present new distributional data, *Hydrachna incisa* Halbert, 1903, *Hydrachna leegei* Koenike, 1895, *Piersigia limophila* Protz, 1896, *Hydryphantes crassipalpis* Koenike, 1914 and *Piona laminata* (Thor, 1900) have not been recorded previously from the Mediterranean area. Most of these species were believed to have typical North European distributions. In addition to these, a further 13 species are recorded for the first time from the area covered. In total, 11 species are new for Italy, seven more are new for Sicily, three for Sardinia and seven for Corsica. Redescriptions are given of *Axonopsis complanata* (Müller, 1776) (*A. graeca*, nov. syn), *Brachypoda baderi* (reported for the first time after the original description from Abruzzo, Italy, synonymization with *B. mutila* rejected) and *B. mutila* (recorded for the first time outside Algeria with certainty). For each species, information is given on habitat preference and geographical distribution; the significance of the data is discussed under perspectives of zoogeography and nature protection. The completeness of our knowledge for the three investigated island is assessed using rarefaction curves and non-parametric estimators of species richness; while Sicily can be considered fairly well known, Corsica and Sardinia require further sampling to assess their water mite diversity.

Keywords: Water mites, diversity, standing waters, faunistics, threatened habitats

Introduction

Available knowledge on the diversity and distribution of certain “less charismatic” aquatic invertebrate groups is far from being satisfactory even in Europe; indeed, it has often been stressed that species distribution currently reflects taxonomists’ distribution (Ruffo & Stoch 2006). This scenario is further worsened by the so-called taxonomy crisis (Boero 2001), and there is an undeniable risk that much biological diversity might in fact disappear even before being known and described. Furthermore, certain geographical areas or habitat typologies are often overlooked due to historical, cultural or economical reasons; this is the case for the biota of the

smaller wetlands of the circum-Mediterranean countries which, in spite of its outstanding diversity and conservation value, has been nearly neglected till recent times (Alvarez Cobelas et al. 2005). This is unfortunate, as ponds and pools have been shown to contribute as much to the regional biodiversity of Mediterranean countries as rivers or lakes; they host a distinguishing fauna, and provide stepping-stones and increased connectivity between other freshwater habitats (Boix et al. 2012).

Notwithstanding their particular significance for understanding and investigating the ecology of inland water invertebrate assemblages (Smit & Van der Hammen 1992; Dohet et al. 2008), water mites

*Correspondence: R. Gerecke, Biesingerstr. 11, DE 72070 Tübingen, Germany. Tel: 0049 7071 49410. Email: reinhard.gerecke@uni-tuebingen.de

are not included in the “European Water Framework Directive” (Directive 2000/60/EC of the European Parliament). Updated faunal works and taxonomical keys for Northern and Central European faunas are nowadays available (Gerecke 2007, 2010), while our knowledge of the circum-Mediterranean fauna is to date unsatisfactory. We are thus aiming in this paper to contribute to fill this gap on the circum-Mediterranean water mite fauna, focusing on the lentic inland water bodies of the three larger western Mediterranean islands (Corsica, Sardinia and Sicily).

Materials and methods

Most samplings were carried out from 2004 to 2013. In addition, we add also earlier, unpublished data from collecting activities during the last two decades of the 20th century. Each sampled site was unambiguously identified through its WGS84 geographical coordinates; some notes on the habitat typology and hydroperiod of each sampling site were also recorded (Figure 1).

Invertebrate samples were collected using 150- μ m mesh-sized hand- and towing nets. The material from the 1980s and 1990s was sorted out in the field from the living material and stored in Koenike’s fluid; samples collected in the 21st

century were fixed *in situ* in 80% ethanol and sorted in the laboratory under a stereomicroscope. All material was stored in separate tubes; when necessary, selected specimens were dissected and slide-mounted as described by Davids et al. (2007). If no other bibliography is mentioned, species identification was based on K. Viets (1936), Lundblad (1956) and Gerecke (2007, 2010).

A total of about 1000 water mite specimens were studied. Several locations were investigated only once; others were visited several times as indicated in Table I.

Species were classified as standing water dwellers (lenitobionts) based on the presence of swimming setae. This rather simple character works surprisingly well and, in many cases, all members of selected genera are lenitobionts, while other genera include species that avoid standing waters. However, the following restrictions were necessary: in *Hydryphantes*, *H. handschini* Walter, 1925 and *H. armentarius* Gerecke, 1996, both characterized by very low numbers of swimming setae, have a clear preference for helocrenic springs (Gerecke 1996). They were therefore excluded from this paper, but a few new records of the latter are included, which was collected in some (groundwater dependent?) pools of the Nebrodi mountains (Sicily). In the

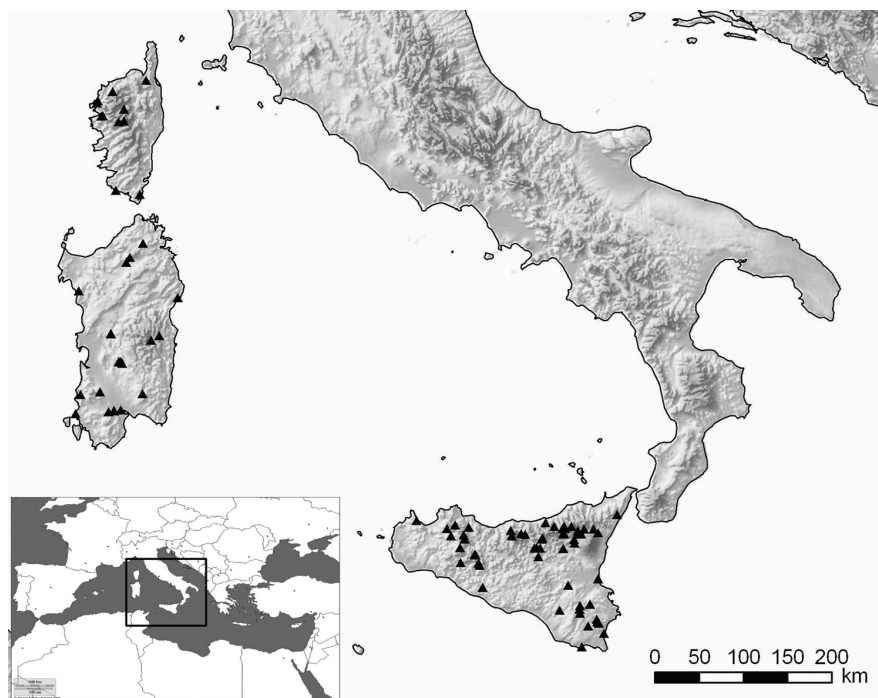


Figure 1. A map of the three largest western Mediterranean islands, showing the location of sites where new water mite material was collected.

genus *Arrenurus*, accounting for the highest number of water mites species restricted to standing waters in Europe, several species have evolved special adaptations for other types of aquatic habitats. We excluded therefore three spring-dwelling species (crenobionts: *A. fontinalis* K. Viets, 1920, *A. refractariolus* Biesiadka, 1978, and *A. scourfieldi* Soar, 1913) and four interstitial species (*A. corsicus* E. Angelier, 1951, *A. haplurus* K. Viets, 1925, *A. pygmaeus* E. Angelier, 1954 and *A. troglobius* E. Angelier, 1951), which are all recorded from the study area (Smit et al. 2000).

Sample-based rarefaction curves and non-parametric estimators of species richness were calculated to measure and compare sampling efficiency across sites. Analyses were done using the EstimateS software version 9.1.0 (<http://viceroy.eeb.uconn.edu/EstimateS>), which adopts the simple analytical formulas of Colwell et al. (2004) for accumulation curve and estimator calculation. Analyses were performed for each of the three islands.

The traditional methods of estimating overall species richness assume that all species are able, up to a certain limit, to colonize the whole area sampled; for this reason, analysis of similarities (ANOSIM: Clarke 1993) was used as a way to test statistically whether there was a significant difference between water mite assemblages in the sampling units of Corsica, Sardinia and Sicily. A presence/absence species × sites matrix was used and a Jaccard index was used to create a resemblance matrix. Subsequently, one-way ANOSIM was applied. The analyses were performed with the PRIMER v. 6.1 statistical package (Primer-E 2006) (Clarke & Gorley 2006).

Results

Species checklist

Ecological and biogeographical information for the 91 standing water-dwelling water mite species known from Corsica (41 species), Sardinia (39) and Sicily (70) is reported below. Out of the 47 species collected during this survey, 13 are recorded for the first time from the area covered. In total, 11 species are new to Italy, a further seven are new to Sicily, three are new to Sardinia, and seven are new to Corsica. Unpublished records are reported with a locality abbreviation (for details, see Table 1) and differentiated as (males/females/deutonymphs). If not otherwise indicated, information on habitat preference and geographical distribution is based on Gerecke (2007, 2010) and the Limnofauna Europaea update in <http://www.watermite.org>.

The species account follows the (super)family order in K.O.Viets (1987); genera and species are treated in alphabetical order. An asterisk (*) is given to species for which previously unstudied material is treated; two asterisks (**) mark species previously unrecorded from the Tyrrhenian islands.

Superfamily Hydrachnoidea

Family Hydrachnidae

1. *Hydrachna geographica* Müller, 1776

New record: Italy: Sicily, I 1543 (1/0/0).

Habitat and biology: temporary and permanent standing waters. Larvae parasitic in the subelythral space of large dytiscid beetles.

Distribution: Holarctic, rarely found in the Mediterranean.

Note: first record from Italy.

*2. *Hydrachna globosa* (De Geer, 1778)

New records: Italy: Sicily, I 1430 (1/0/0); I 1431 (0/1/0); I 1433 (1/2/0); I 1436 (0/0/1).

Published records: Sardinia, Sicily (Gerecke 1991).

Habitat and biology: oligo- to eutrophic standing waters. Larvae parasitic on water bugs.

Distribution: Palaearctic.

**3. *Hydrachna goldfeldi* Thor, 1916

New record: Italy: Sardinia, I 1390 (1/0/0).

Habitat and biology: temporary and permanent standing waters. Larvae parasitic on water bugs of the families Nepidae and Notonectidae.

Distribution: Western Palaearctic; previously recorded only from scattered sites in Central, Western and Eastern Europe.

Note: first record from Italy.

**4. *Hydrachna incisa* Halbert, 1903

New records: Italy: Sardinia, I 1392 (0/1/0); Sicily, I 1546 (0/0/2).

Habitat and biology: standing waters. Life cycle unknown.

Distribution: Europe. Previously recorded from the British Isles, The Netherlands and Germany.

Note: first records from the Mediterranean area.

**5. *Hydrachna leegi* Koenike, 1895

Italy: Sicily, I 1410 (4/4/0); I 1420 (0/0/3); I 1421 (0/2/0); I 1422 (1/7/0); I 1423 (1/1/0); I 1437 (0/1/0); I 1441 (0/0/8); I 1442 (0/0/1); I 1444 (0/0/1); I 1445 (0/0/10); I 1455/3 (2/0/0).

Habitat and biology: temporary and permanent standing waters. Larvae parasitic on palpicorn water beetles (genera *Helophorus* and *Laccobius*).

Distribution: Palaearctic.

Note: first record from the Mediterranean area.

6. *Hydrachna processifera* Koenike, 1903

Published records: Sardinia, Sicily (Gerecke 1991), Sardinia (Davids et al. 2005).

Habitat and biology: temporary and permanent standing waters.

Distribution: Palaearctic.

***7. *Hydrachna skorikowi* (Piersig, 1900)**

New records: Italy: Sicily, I 1407 (0/1/0); I 1542 (0/1/0).

Published records: Sicily (Gerecke 1991).

Habitat and biology: most kinds of standing waters, also man-made lakes; in Sicily frequently in remnant pools of summer-dry streams at high salinity. The fact that this species was found only once in this investigation could indicate that the species avoids temporary standing waters. Larvae parasitic on water bugs of the family Corixidae. In Central Europe, hibernation as parasitic larva.

Distribution: Palaearctic, Asia.

***Hydrachna* sp.**

Records: Italy: Sardinia, I 1387 (0/0/1); Sicily, I 1413 (0/0/1).

Remark: deutonymphs could not be identified to species level.

Superfamily Eylaoidea**Family Eylaidae*****8. *Eylais extendens* (Müller, 1776)**

New records: Italy: Sicily, I 1408 (0/1/0); I 1413 (0/0/1); I 1454 (0/0/1); I 1455/1 (1/1/0); I 1455/2 (0/1/0).

Published records: Sicily (Gerecke 1991).

Habitat and biology: all types of standing and slowly flowing waters, but sensitive to high electrolyte concentrations. Larvae parasitic on adult water beetles of the families Haliplidae, Dytiscidae, Laccophilidae and Hydrophilidae.

Distribution: Western Palaearctic.

***9. *Eylais hamata* Koenike, 1897**

New records: Italy: Sicily: I 1393 (1/1/0); I 1410 (3/2/0); I 1413 (1/0/0); I 1418 (0/1/0); I 1419 (1/1/0); I 1421 (0/1/12); I 1422 (4/3/0); I 1423 (4/0/0); I 1424 (5/0/0); I 1426 (0/1/0); I 1440 (0/0/2); I 1441 (0/0/1); I 1442 (1/1/0); I 1446 (1/0/0); I 1455/1 (3/1/0); I 1455/3 (0/1/0); I 1455/4 (1/2/0); I 1469 (0/0/5); I 1547 (0/2/0).

Published records: Sicily (Gerecke 1991).

Habitat and biology: all types of small standing waters. Larvae parasitic on beetles of the families Dytiscidae and Helophoridae. A typical spring species, adults disappearing in early summer.

Distribution: Palaearctic.

****10. *Eylais planipons* Walter, 1924**

New records: France: Corsica, F 151 (1/0/0); Italy: Sardinia, I 1461 (1/0/0); I 1463 (2/1/0); I 1549 (1/0/

0); I 1550 (0/0/1); I 1551 (0/1/0); Sicily, I 1471 (1/0/0).

Habitat and biology: small ponds and ditches. Life cycle unknown.

Distribution: Mediterranean area, Iran.

Note: first record from Italy.

***Eylais* sp.**

Records: Italy: Sardinia, I 1390 (0/0/3); I 1391 (0/0/2); Sicily, I 1403 (0/1/0).

Remark: deutonymphs and a female could not be identified to species level.

Family Limnocharidae**11. *Limnochares aquatica* (Linnaeus, 1758)**

Published records: Corsica (Santucci 1965, 1971; Gerecke & Di Sabatino 2013), Sicily (Davids et al. 2005).

Habitat and biology: lakes and ponds, pools of shaded streams. Larvae parasitic on Heteroptera.

Distribution: Holarctic.

Family Piersigiidae****12. *Piersigia limophila* Protz, 1896**

New record: Italy: Sicily, I 1403 (0/1/0).

Habitat and biology: semiaquatic habitats at the border of marshes and swamps, in Sicily in a helocrenic spring area bordering a small lake. Larvae parasitic on beetles of the family Hydrophilidae (*Enochrus*).

Distribution: Holarctic. In Europe, previously recorded only from northern and eastern parts; recently discovered also in Central Europe, north of the Alps.

Note: first record from the Mediterranean area.

Superfamily Hydryphantoidea**Family Hydrodromidae*****13. *Hydrodroma despiciens* (Müller, 1776)**

New records: Italy: Sicily, I 1417 (2/7/0); I 1425 (1/1/0); I 1427 (0/1/0); I 1428 (2/0/0); I 1438 (1/0/0).

Published records: Corsica (Angelier 1954; Santucci 1965, 1971—uncertain records); Corsica, Sardinia, Sicily (Gerecke 1991).

Habitat and biology: standing waters, with a preference for little alkaline waters. Life cycle unknown.

Distribution: previously considered cosmopolitan, but many older records are in need of revision. The separation between *H. despiciens* and *H. pilosa* has been ascertained only recently (Wiles 1985; Gerecke 1991) and *H. reinhardi* Pešić 2002 was described as an additional species from pool habitats in the Central Mediterranean area.

***14. *Hydrodroma pilosa* Besseling, 1940**

New records: Italy: Sardinia, I 1462 (1/1/0); Sicily, I 1407 (0/1/0); I 1544 (0/1/0).

Published records: Sardinia, Sicily (Gerecke 1991).
Habitat and biology: standing waters and pools of streams, also in waters with elevated electrolyte concentration and high trophic levels (Gerecke 1991).
Larvae parasitic on Diptera (Chaoboridae, Chironomidae, Tipulidae) and Trichoptera.
Distribution: Western Palaearctic.

15. *Hydrodroma reinhardi* Pešić, 2002

Published records: Corsica, Sardinia (Pešić 2002; Gerecke & Di Sabatino 2013).
Habitat and biology: pools of streams. Life cycle unknown.
Distribution: central Italy, Corsica and Sardinia, Montenegro.

Family Hydryphantidae

16. *Diplodontus scapularis* Dugès, 1834

Published records: Sicily (Gerecke 1991).
Habitat and biology: small standing water bodies and pools of streams, halotolerant. Larvae parasitic on palpicorn water beetles.
Distribution: Mediterranean area, coastal areas of Northern France, The Netherlands and Germany.

17. *Diplodontus semiperforatus* Walter, 1925

Published records: Sicily (Gerecke 1991).
Habitat and biology: small standing water bodies and pools of streams, also at very high electrolyte concentrations. Larvae parasitic on palpicorn water beetles.
Distribution: Mediterranean area, Sahara.

18. *Georgella koenikei* Maglio, 1906

Published record: Corsica (Angelier 1954).
Habitat and biology: small standing water bodies. Life cycle unknown.
Distribution: presence in the area questionable and in need of being confirmed. Ascertained records from the French Alps and Lombardia (Italy) only (Di Sabatino et al. 2009).

***19. *Hydryphantes* (s. str.) *armentarius* Gerecke, 1996**

New records: Italy: Sicily, I 1403 (0/1/11); I 1435 (0/2/0); I 1449 (1/0/0); I 1451 (0/1/0).
Published records: Sicily (Gerecke 1996).
Habitat and biology: crenobiont. Often in weakly flowing farmland rheohelocrenes. Life cycle unknown.
Distribution: central Mediterranean area.

****20. *Hydryphantes* (s. str.) *crassipalpis* Koenike, 1914**

New record: Italy: Sicily, I 1427 (0/1/1).
Habitat and biology: permanent and temporary standing waters. Life cycle unknown.
Distribution: Palaearctic. The detection of this species in Turkey (Özkan 1988) and the new record

given here suggest that, in the SW Palaearctic, this species could be much more widely distributed than previously known.

Note: first record from the Mediterranean area.

***21. *Hydryphantes* (s. str.) *dispar* (Schaub, 1888)**

New records: Italy: Sicily, I 1425 (0/1/0); I 1428 (1/0/0); I 1429 (0/0/1); I 1433 (0/0/1).
Published records: Sardinia, Sicily (Gerecke 1996).
Habitat and biology: permanent and temporary pools and ditches. Larvae parasitic on Diptera of the family Ephydriidae.
Distribution: Palaearctic.
Note: only rarely found in the Mediterranean area.

22. *Hydryphantes* (*Polyhydryphantes*) *flexuosus* Koenike, 1885

Published record: Sicily (Gerecke 1996).
Habitat and biology: standing waters and pools of higher order streams, halotolerant. Life cycle undescribed.
Distribution: Palaearctic.

23. *Hydryphantes* (s. str.) *parmulatus* Koenike, 1912

Published record: Sicily (Gerecke 1996).
Habitat and biology: temporary pools. Life cycle undescribed.
Distribution: Central-Western Europe, Mediterranean area, rare.

24. *Hydryphantes* (s. str.) *placationis* Thon, 1899

Published records: Corsica (Angelier 1954), Sicily (Gerecke 1996).
Habitat and biology: temporary pools. Life cycle undescribed.
Distribution: Central-Western Europe, Mediterranean area, rare.

***25. *Hydryphantes* (s. str.) *ruber* (Geer, 1778)**

New records: Italy: Sicily, I 1403 (0/0/1); I 1416 (0/1/0); I 1436 (1/2/2); I 1437 (0/3/9); I 1438 (0/2/3); I 1441 (8/6/0); I 1443 (2/4/0); I 1444 (4/5/1); I 1445 (6/18/0); I 1446 (1/4/1); I 1448 (1/4/5); I 1449 (0/6/6); I 1450 (0/2/4); I 1451 (1/1/0); I 1452 (0/0/1); I 1453 (3/34/15); I 1454 (0/0/1).

Published records: Sardinia (Costa 1884), Sicily (Gerecke 1996).

Habitat and biology: temporary and permanent standing waters, limnocrenes. Larvae parasitic on Diptera (family Culicidae – uncertain association, only 19th century bibliographic data).

Distribution: Holarctic (? – North American records are questionable). Widespread in Europe. The record from Sardinia stems from a time when the species was not well defined, but presence of the species is well possible.

***Hydryphantes* sp.**

Record: Sicily, I 1439 (0/0/1).

Remark: deutonymph could not be identified to species level.

***26. *Parathyas barbiger* (K. Viets, 1908)**

New record: Italy: Sicily, I 1416 (1/1/0).

Published record: Sicily (Gerecke 1996).

Habitat and biology: temporary vernal pools. Larvae parasitic on Diptera of the families Culicidae, Limoniidae and Tipulidae.

Distribution: Holarctic.

***27. *Parathyas palustris* (Koenike, 1912)**

New record: Italy: Sicily, I 1403 (0/2/0).

Published records: Corsica (Gerecke 1996).

Habitat and biology: this species is on the habitat preference borderline of the species treated in this paper, with records both from helocrenes, but mostly in Northern Europe, also from forest swamps. The site from which the new record derives is a groundwater-influenced small lake. Larvae parasitic on Diptera of the families Chironomidae and Limoniidae.

Distribution: Holarctic.

Note: first record from Sicily.

28. *Pseudohdryphantes parvulus* (K. Viets, 1908)

Published records: Corsica (Gerecke & Di Sabatino 2013); Sardinia (Gerecke 1991).

Habitat and biology: standing waters and pools of streams. Life cycle unknown.

Distribution: Central and Southern Europe; extremely rare.

Superfamily Lebertioidea**Family Lebertiidae****29. *Lebertia pilosa* Maglio, 1924**

Published record: Corsica (Gerecke 2009).

Habitat and biology: standing waters and pools of streams. Life cycle unknown.

Distribution: Europe, scattered records.

30. *Lebertia porosa* Thor, 1900

Published records: Corsica (Angelier 1954; Santucci 1965, 1971; Giudicelli 1970; Gerecke 2009; Gerecke & Di Sabatino 2013); Sicily (Ferrito 1994); Sardinia, Sicily (Gerecke 2009).

Habitat and biology: standing waters, pools and slow flowing sectors of streams. Larvae parasitic on chironomid Diptera.

Distribution: Western Palearctic, widespread.

Family Oxidae**31. *Oxus longisetus* (Berlese, 1885)**

Published record: Corsica (Angelier 1954).

Habitat and biology: standing waters. Life cycle unknown.

Distribution: Europe, widespread.

****32. *Oxus ovalis* (Müller, 1776)**

New records: France: Corsica, F 23 (0/1/0); F 88 (1/1/0); Italy: Sardinia, I 373 (0/3/0); I 381 (1/1/0); Sicily, I 4 (0/1/0); I 100 (2/3/0); I 312 (0/1/0).

Habitat and biology: standing waters. Life cycle unknown.

Distribution: Western Palearctic.

****33. *Oxus setosus* (Koenike, 1898)**

New records: France: Corsica, F 42e (0/1/0); Italy: Sicily, I 36 (1/2/0); I 98 (4/1/0); I 100 (0/1/0); I 192 (0/1/0); I 193 (3/2/0); I 534 (1/1/0).

Habitat and biology: standing waters, pool areas of streams. Life cycle unknown.

Distribution: Palearctic, widespread.

Family Teutoniidae**34. *Limnolegeria longiseta* Motaş, 1928**

Published records: Sicily (Gerecke 1991).

Habitat and biology: cold lakes, pools of shaded streams. Life cycle unknown.

Distribution: Mediterranean, a few scattered areas.

***35. *Teutonia cometes* (Koch, 1837)**

New record: Italy: Sardinia, I 1464 (0/0/1).

Published records: Corsica (Angelier 1954; Santucci 1965, 1971; Gerecke 1991; Gerecke & Di Sabatino 2013); Sardinia, Sicily (Gerecke 1991).

Habitat and biology: cold lakes, in the Mediterranean pools of shaded streams, limnocrenes.

Distribution: Palearctic.

Family Limnesiidae**36. *Limnesia acuminata* Walter, 1925**

Published records: Sardinia, Sicily (Gerecke 1991).

Habitat and biology: standing waters, pools of higher order streams. Life cycle unknown.

Distribution: west Mediterranean area.

37. *Limnesia arevaloi arevaloi* K. Viets, 1918

Published records: Sicily (Gerecke 1991).

Habitat and biology: small standing waters, also in fountains and temporary ponds, pools of low order streams. Life cycle unknown.

Distribution: west Mediterranean area.

38. *Limnesia arevaloi ambulatoria* Gerecke, 1991

Published records: Corsica, Sardinia (Gerecke 1991).

Habitat and biology: small standing waters, pools of low order streams. Life cycle unknown.

Distribution: Corsica, Sardinia, endemic.

39. *Limnesia fulgida* Koch, 1836

Published records: Corsica (Angelier 1954).
Habitat and biology: larger and smaller permanent standing waters.
Distribution: Palaearctic.

***40. *Limnesia maculata* (Müller, 1776)**

New record: France: Corsica, F 153 (3/8/2). Italy: Sicily, I 1412 (4/1/1).
Published records: Sicily, Sardinia (Gerecke 1991).
Habitat and biology: permanent standing waters, pools of larger streams. Larvae parasitic on Diptera of the family Chironomidae.
Distribution: Palaearctic.
Note: first record from Corsica.

41. *Limnesia manubriata* Walter, 1928

Published records: Sicily (Gerecke 1991).
Habitat and biology: smaller standing waters, pools of streams.
Distribution: Africa south of Sahara, Mediterranean area.

42. *Limnesia marmorata* Neuman, 1870

Published records: Sardinia ('*L. maculata*' partim Gerecke 1991).
Habitat and biology: larger and smaller permanent standing waters.
Distribution: Europe. Detailed distribution unclear due to long-term taxonomic confusion with *L. maculata*. Based on the revision of Van Haaren and Tempelman (2009), specimens published as *L. maculata* from Lago Baratz (Sardinia, I 351, Gerecke 1991) represent *L. marmorata*.

43. *Limnesia walteri* Migot, 1926

Published records: Corsica (Angelier 1954; Gerecke & Di Sabatino 2013), Sardinia, Sicily (Gerecke 1991).
Habitat and biology: smaller standing waters, pools of streams.
Distribution: Africa south of Sahara, Mediterranean area.

Superfamily Hygrobatoidae**Family Hygrobatidae****44. *Hygrobatas longipalpis* (Hermann, 1804)**

Published records: Corsica (Angelier 1954; Gerecke 1991; Gerecke & Di Sabatino 2013); Sardinia, Sicily (Gerecke 1991).
Habitat and biology: standing waters, pools of higher order streams. Larvae parasitic on Diptera (preferably Chironomidae, also Culicidae and Chaoboridae).
Distribution: Holarctic.

45. *Hygrobatas longiporus* Thor, 1898

Published records: Corsica (Angelier 1954; Giudicelli 1970; Santucci 1971; Gerecke 1991; Gerecke & Di Sabatino 2013); Sardinia, Sicily (Gerecke 1991); Sicily (Ferrito 1994).
Habitat and biology: standing waters, pools of higher order streams. Without a parasitic larval stage.
Distribution: Palaearctic.

46. *Hygrobatas trigonicus* Koenike, 1895

Published records: Corsica (Angelier 1954; Santucci 1971).
Habitat and biology: standing waters, pools of higher order streams. Larvae parasitic on chironomid diptera.
Distribution: Western Palaearctic.

Family Pionidae***47. *Piona alpicola* Neuman, 1880**

New records: Italy: Sicily, I 1496 (0/1/0); I 1500 (0/1/0); I 1501 (0/4/0); I 1502 (2/2/0); I 1504 (0/1/0).
Published record: Corsica (Smit & Gerecke 2010).
Habitat and biology: permanent standing waters. Larvae parasitic on Diptera of the family Chironomidae.
Distribution: Holarctic.
Note: first record from Sicily.

****48. *Piona carnea* (Koch, 1836)**

New records: France: Corsica, F 156 (5/7/2). Italy: Sicily, I 1406 (0/6/0); I 1409 (2/6/3); I 1427 (0/1/0); I 1439 (1/0/0); I 1466 (1/0/0); I 1467 (1/2/0).
Habitat and biology: permanent standing waters, in Central Europe often in shaded habitats. Larvae parasitic on Diptera of the family Chironomidae.
Distribution: Holarctic.
Note: first records from Corsica and Sicily.

***49. *Piona coccinea* (Koch, 1836)**

New records: Italy: Sicily, I 1414 (0/2/0).
Published records: Sicily (Gerecke 1991).
Habitat and biology: permanent standing waters. Larvae parasitic on Diptera of the family Chironomidae.
Distribution: Holarctic.

50. *Piona conglobata* (Koch, 1836)

Published record: Sicily (Moniez 1889).
Habitat and biology: permanent standing waters. Larvae parasitic on Diptera of the family Chironomidae.
Distribution: Holarctic.

****51. *Piona damkoehleri* K. Viets, 1930**

New record: Italy: Sardinia, I 1389 (1/2/0).
Habitat and biology: standing waters. Life cycle unknown.

Distribution: Mediterranean area. Known from a few sites only.

Note: first record from Italy.

****52. *Piona laminata* (Thor, 1900)**

New records: Italy: Sardinia, I 1548 (0/1/0); Sicily, I 1448 (0/1/0).

Habitat and biology: permanent standing waters. Life cycle unknown.

Distribution: Previously recorded from Northwestern, Central, Northern and Eastern Europe – often confused with *P. ambigua* (Piersig, 1894).

Note: first record from the Mediterranean.

Remark: a species with diagnostic characters restricted to the female, and therefore probably often confused with *P. nodata* (of which it was first described as a subspecies). Wainstein (1976) ranked it at species level.

***53. *Piona nodata* (Müller, 1776)**

New records: Italy: Sardinia, 1389 (0/2/0); I 1465 (0/2/0); Sicily, I 1403 (0/1/0); I 1545 (0/17/0).

Published records: Sicily (Gerecke 1991).

Habitat and biology: permanent standing waters. Larvae not parasitic.

Distribution: Holarctic.

Note: first record from Sardinia.

****54. *Piona rotundooides* (Thor, 1897)**

New records: France: Corsica, F 154 (0/1/0); F 155 (0/1/0); F 156 (1/0/0).

Habitat and biology: permanent standing waters, preferably in larger water bodies. Life cycle unknown.

Distribution: widespread in Europe, but in the Mediterranean area previously only recorded from northern Italy (Lombardia, Piemonte, Ramazzotti 1947; Nocentini 1963).

Note: first record from Corsica.

55. *Piona variabilis* (Koch, 1836)

Published records: Corsica (Angelier 1954).

Habitat and biology: permanent standing waters. Life cycle unknown.

Distribution: Palearctic.

***Piona* sp.**

New records: Italy: Sicily, I 269 (0/0/11); I 1413 (0/0/1).

Remark: deutonymph not identifiable to species level.

***56. *Pionopsis lutescens* (Herrmann, 1804)**

New records: Italy: Sardinia, I 1388 (0/2/0); Sicily, I 1437 (0/2/0); I 1438 (0/1/0); I 1468 (1/0/0); I 1544 (0/1/0).

Published records: Sicily (Gerecke 1991).

Habitat and biology: permanent standing waters. Larvae parasitic on chironomid Diptera.

Distribution: Palearctic.

Note: first record from Sardinia.

Family Unionicolidae

57. *Neumania elliptica* Walter, 1925

Published records: Corsica (*'N. vietsi'*, Angelier 1954); Corsica, Sardinia, Sicily (Pešić et al. 2007).

Habitat and biology: pools of streams. Life cycle unknown.

Distribution: west Mediterranean area.

****58. *Neumania limosa* (Koch, 1836)**

New record: France: Corsica, F 156 (0/16/0).

Habitat and biology: permanent standing waters of various size. Life cycle unknown.

Distribution: widespread in Europe.

Note: first record from Corsica.

59. *Neumania spinipes* (Müller, 1776)

Published records: Sicily (Gerecke 1991).

Habitat and biology: permanent standing waters of various size. Life cycle unknown.

Distribution: widespread in Europe.

60. *Neumania uncinata* Walter, 1927

Published records: Corsica, Sardinia, Sicily (Pešić et al. 2007).

Habitat and biology: permanent standing waters of various size. Life cycle unknown.

Distribution: Southern and Central Europe.

61. *Unionicola aculeata* (Koenike, 1890)

Published record: Sardinia (Gerecke 1991).

Habitat and biology: permanent standing and slowly flowing waters. Larvae parasitic on chironomid midges; postlarval stages for transformation and oviposition associated with molluscs.

Distribution: widespread in Europe.

***62. *Unionicola crassipes* (Müller, 1776)**

New records: Italy: Sicily, I 1411 (1/10/0); I 1415 (0/9/0).

Published record: Sardinia (Gerecke 1991).

Habitat and biology: permanent standing waters and lentic areas of streams. Deutonymphs and adults inhabiting sponges and therefore bound to equilibrated conditions in nutrient-rich, but well oxygenated waters. Larvae parasitic on Diptera of the family Chironomidae. Under Mediterranean climate conditions, this species is obviously very rare and was not found during a large-scale inventory of Sicilian streams 1985/86 (Gerecke 1991).

Distribution: Holarctic.

Note: first record from Sicily. The detection of two populations of *Unionicola crassipes* highlights the significance of the Nature Reserves of "Ficuzza" and "Zingaro" as refuges for threatened or rare, stenocious species.

63. *Unionicola gracilipalpis* (K. Viets, 1908)

Published record: Sardinia (Gerecke 1991).

Habitat and biology: permanent standing and slowly flowing waters. Larvae parasitic on chironomid midges; postlarval stages for transformation and oviposition associated with spongillids.

Distribution: widespread in Europe, not reported from Iberian peninsula.

***64. *Unionicola minor* (Soar, 1900)**

New record: France: Corsica, F 156 (13/27/2).

Published record: Corsica (Angelier 1954); Sardinia (Gerecke 1991).

Habitat and biology: permanent standing and slowly flowing waters. Larvae parasitic on chironomid midges; postlarval stages for transformation and oviposition associated with spongillids.

Distribution: widespread in Europe except for Scandinavia.

Family Aturidae****65. *Axonopsis complanata* (Müller, 1776)**

Axonopsis graeca Pešić & Smit 2012, nov. syn.

New record: Italy: Sardinia, I 373 (1/0/0).

Material compared: The Netherlands, Slikkendam, coll. Besseling 898 (1/0/0).

Habitat and biology: previously known from permanent standing waters only, in the Mediterranean area also in pools of streams.

Description: colour dark blue with a whitish-yellow transverse line. Idiosoma length/width 430/320, dorsal shield 430/280 μm , at anterior margin broadly fused to ventral shield. Dorsal furrow (Figure 2c) with two free slit organs, in the anterior and central part respectively, and two elongated glandular

palettelets in the posterior part; a third slit organ fused to posterior margin of anterior glandular platelet. Tips of Cx-I pointed, on level of frontal margin (Figure 2a). Length/height IV-L-4-6, 80/27, 90/27, 95/25; number of swimming setae: II-L-4, 1, II-L-5, 3; III-L-4, 2; III-L-5, 3; IV-L-4, 3, IV-L-5, 3. Gnathosoma stout, mouth opening terminal, length 80 μm . Palp: Figure 2b; P-1 centrally narrowed, with one dorsal seta; P-2 ventral margin straight, dorsal margin strongly convex, P-3 ventral margin weakly concave, dorsal margin curved, P-4 ventral margin slightly inflated in proximal part, distally equally narrowed, ventral setae (one long, one short) in distal third. P-5 slender, with three claws, two strong, ventral, one short, dorsal; length/height P-1, 23/24; P-2, 52/45; P-3, 27/30; P-4, 80/28; P-5, 28/14 μm . Remarks: since its early description from Denmark, *Axonopsis complanata* has been recorded from standing waters over a wide geographical range in Central and Northern Europe, including the perialpine lakes of northern Italy (Largaiolli 1907, 1910; Ramazzotti 1947; Nocentini 1960, 1979). However, as often in the earliest described water mites, little attention has been paid to a careful description of their diagnostic features. The specimen from Sardinia agrees from all points of view with the male from The Netherlands studied in comparison; the measurements agree with the few data available from bibliography. Furthermore, apart from differences in shape of the genital field, which are typical in the genus, the female described under the name *Axonopsis graeca* Pešić and Smit 2010 (in Pešić et al. 2010) from the island of Lesbos (Greece) is in perfect agreement with our descriptions given above. Obviously, *A. graeca* is a junior synonym of *A. complanata*.

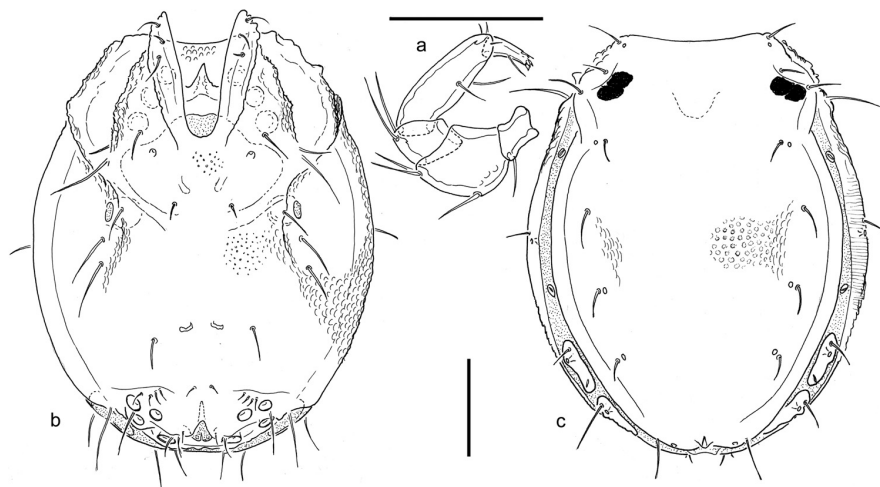


Figure 2. *Axonopsis complanata*, specimen from coll. Besseling (The Netherlands). a, palp; b, venter; c, dorsum. Scale bars: 100 μm .

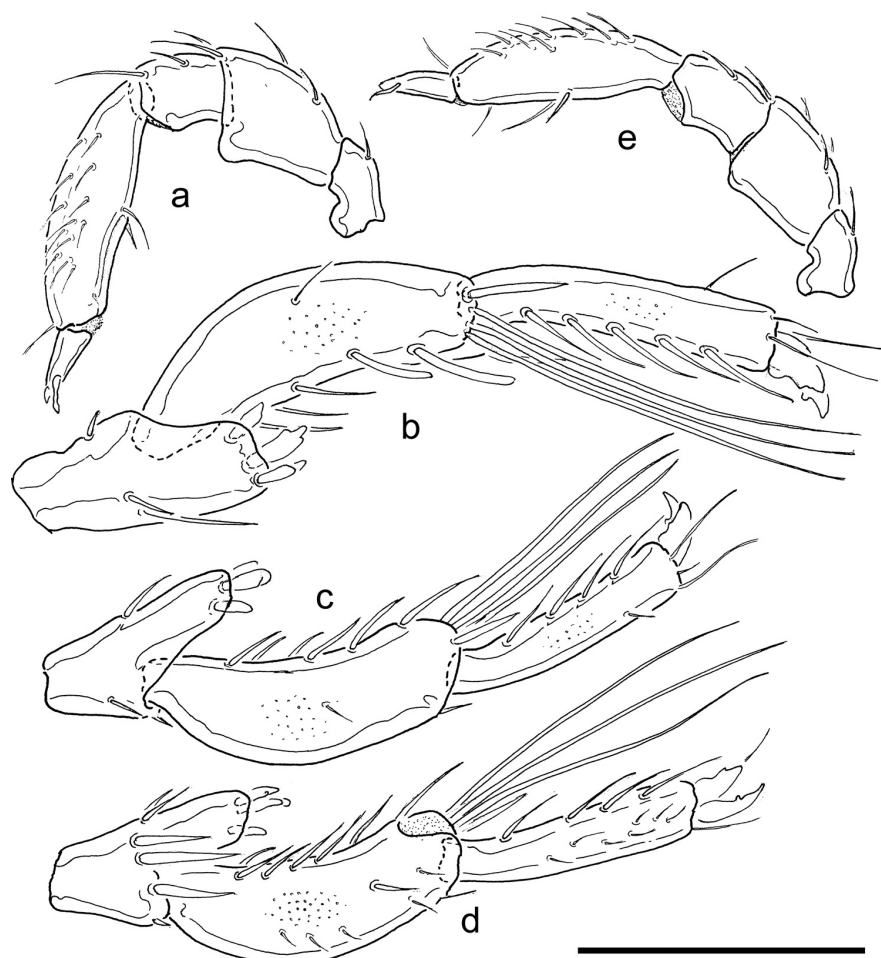


Figure 3. *Brachypoda baderi*, appendages; a–d, male; a, palp; b–c, male IV-L-4-6 anterior, two different specimens; d, male IV-L-4-6 posterior; e, female palp. Scale bar: 100 μ m.

Distribution: Europe; rare in the Mediterranean area. Note: first record from Sardinia.

****66. *Brachypoda baderi* Di Sabatino & Cicolani 1990**

Rejected synonymy: *Brachypoda mutila* (Pešić et al. 2006) – see discussion of *B. mutila*.

New records: France, Corsica, F 92 (1/4/0), Italy, Sardinia, I 378 (1/6/0); I 381 (0/2/0); I 383 (1/2/0), I 389 (0/5/0), I 849 (0/6/0); I 1155 (1/0/0), I 1162 (1/0/0); Sicily, I 1 (0/1/0); I 165 (1/1/0), I 166 (0/2/0), I 177 (0/1/0), I 308 (0/1/0), I 318 (0/8/0).

Description: colour yellow with a minor anterior, and a large posterior, dark violet mark. Excretory pore on dorsal shield, near posterior margin, directed posterodorsally. Tips of Cx-I distanced from frontal margin. Number of swimming setae: II-L-4, 1–2, II-L-5, 2–4; III-L-4, 2–3; III-L-5, 3–4; IV-L-5, 3. Palp relatively

slender (L/H ratio P-2, 1.4–1.7; P-3, 1.20–1.4; P-4, 3,3–3, 9), P-1 curved, with one dorsal seta; P-2 ventral margin slightly concave, distally forming a blunt projection, dorsal margin convex, P-3 ventral margin concave, dorsal margin convex, P-4 proximally narrow, in the centre, near the insertion of two setae slightly elevated to form an obtuse projection near the insertion of the stronger ventral seta, a finer seta laterally on a further blunt elevation; distolaterally a fine peg seta, distoventrally a hair-like seta; dorsal margin equally convex, with several fine setae; P-5 slender with a long and strong ventral, and a fine dorsal claw. Male: Idiosoma posteriorly with obtuse lateral angles, length/width 400–450/320–360; IV-L-4–6: Figures 3b–d; IV-L-4 with three stout setae (two of them slightly bifurcated) on a prominent ventral extension; IV-L-5 length/height 118–127/39–44

(ratio 2.9–3.1), bowed, with scattered ventral setae, two of them in distal part flattened, in lateral view appearing truncated; IV-L-6 length/height 104–112/21–23 (ratio 4.8–5.3), short and slightly curved, ventrally with a line of longer setae; claws modified as given in Figures 3b–d; gonopore and flanking acetabula directed posteroventrally, distance tip Cx-I-gonopore 329–342 µm; excretory pore and flanking glandularia embedded in the ventral shield posterior to genital field. Gnathosoma length 75–81 µm; chelicera length 99–105 µm, length/height ratio 2.5–3.3, basal segment/claw ratio 1.8–1.9. Palp: Figure 3a; length/height P-1, 29–31/16–18; P-2, 49–52/30–37; P-3, 30–32/23–24; P-4, 81–89/23–35; P-5, 29–30/9 µm. Female: Idiosoma length/width 491–563/392–432, distance tip Cx-I-gonopore 383–450 µm. Excretory pore platelet fused to posterior margin of dorsal shield. Length/height IV-L-5–6, 99–115/18–22, 81–95/17–18. Gnathosoma length 81–94 µm. Palp: Figure 3e; length/height P-1, 31–35/18–20; P-2, 51–60/33–40; P-3, 32–36/24–29; P-4, 85–91/22–28; P-5, 30–31/9–10 µm.

Remark: our measurements confirm that most specimens of *Brachypoda baderi* can be distinguished from *B. mutila* in both sexes by the more slender shape of the palp. Females differ furthermore in the excretory platelet fused to the dorsal shield (separate in *B. mutila*), males in the blunt posterolateral edges of idiosoma and a different shape and setation of IV-L-4–6.

The only further known species of the subgenus *Hemibrachypoda*, *B. modesta* Koenike, 1911 from Northern Germany, was described from a single female. A male from northern Bavaria attributed to that species by K.O. Viets (1955), in shape of IV-L (all distal setae on IV-L-4 shortened and stout, IV-L-5 slender) and palp (P-4 slender), is very similar to *B. baderi*. The questions if *B. baderi* is present also north of the Alps, and which are the diagnostic features of *B. modesta*, require further study based on more populations from Central Europe.

Habitat and biology: in lentic areas of streams.

Distribution: previously known only from the type locality in Abruzzo (Italy), Central Mediterranean.

Note: first records from Corsica, Sardinia and Sicily.

****67. *Brachypoda mutila* Walter, 1928**

New records: France: Corsica: F 48 (0/2/0); Italy: Sicily, I 37 (1/2/0); I 46 (0/2/0); I 98 (3/10/0), I 132 (2/6/0); I 133 (7/4/0); I 168 (4/0/0); I 177 (0/1/0); I 188 (1/0/0); I 193 (2/0/0); I 214 (0/1/0); I 250 (1/0/0); I 323 (0/1/0); I 544 (0/1/0); I 552 (2/5/0); I 563 (1/0/0); I 1067 (0/2/0); I 1076c (0/1/0).

Description: colour not reported, probably similar to *B. baderi*. Excretory pore with sexual difference. Tips of Cx-I and number of swimming setae as in *B.*

baderi. Palp relatively stout (L/H ratio P-2, 1.2–1.4; P-3, 1.1–1.3; P-4, 3.0–3.5), in setation and shape of segments similar to *B. baderi*, but P-2 ventral margin nearly straight and ventral setae on P-4 more distally. Male: idiosoma length/width 450–495/360–369, distance tip Cx-I-gonopore 360–396 µm. IV-L-4–6: Figure 4a–c; IV-L-4 three different setae (one fine and longer flanked by two stout setae, one thicker, the other thinner; IV-L-5 length/height 138–148/31–35 (ratio 4.0–4.8), only weakly curved and with subparallel dorsal and ventral margins, with numerous normal, not flattened, ventral setae; IV-L-6 length/height 129–135/21–23 (ratio 5.9–6.5), weakly curved, slender, ventrally with a line of longer setae; gnathosoma length 81–99 µm. Palp: Figure 4d–e; length/height P-1, 33–35/20–21; P-2, 56–58/41–43; P-3, 30–35/26–29; P-4, 87–94/25–30; P-5, 28–29/20 µm. Female: idiosoma length/width 540–554/383–423, distance tip Cx-I-gonopore 419–441 µm. Length/height IV-L-5–6, 112–115/22–23, 84–92/16–20; gnathosoma length 90–98 µm. Palp: Length/height P-1, 34–35/20–21; P-2, 58–60/43–45; P-3, 32–36/28–29; P-4, 83–87/26–29; P-5, 28–30/10–12 µm.

Remarks: the holo- and paratype from Algeria agree with the specimens from the Tyrrhenian islands in setation and proportions except for their slightly minor size (as is found also in a single female from Southern Spain, E 110). In particular, the holotype male shows the same differentiation of the apical setae on IV-L-4 and agrees in the slender shape and setation of IV-L-5. Males of populations under the name *B. mutila* from Crimea (Tuzovskij 1978, including also the reared larval stage) and Turkey (Pešić et al. 2006), recently assigned by Esen et al. (2013) to *B. orientalis* Pešić & Esen, 2013, differ from typical *B. mutila* in: (1) apical setae on the extension of IV-L similar to each other in size and shape, all short and peg-like, and (2) IV-L-5 thickened and with more curved dorsal margin, more similar to *B. baderi*, ventral setae shorter, in proximal part peg-like. As the shape of male IV-L-4–6 and their setae is obviously less variable than assumed by Pešić et al. (2006), there is no justification for their proposal to synonymize *B. baderi* with *B. mutila*.

Habitat and biology: in lentic areas of streams.

Distribution: west Mediterranean area.

Note: first records from Corsica and Sicily.

Superfamily Arrenuroidea

Family Mideopsidae

***68. *Mideopsis roztoczensis* Biesiadka & Kowalik, 1979**

Published records: Corsica (“*M. orbicularis*” Angelier 1954; Santucci 1965, 1971); Sicily (“*M. orbicularis*”

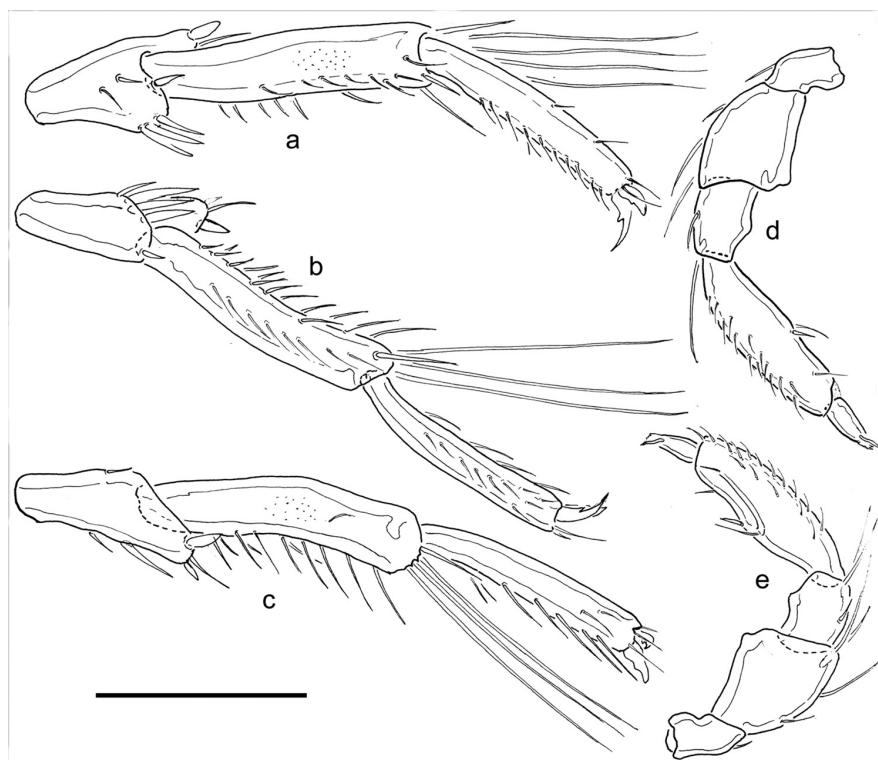


Figure 4. *Brachypoda mutila* male, appendages. **a-b**, IV-L-4-6 anterior, two different specimens; **c**, male IV-L-4-6 posterior; **d**, palp medial; **e**, palp lateral. Scale bar: 100 μ m.

Ferrito 1994); Corsica, Sardinia, Sicily (Smit et al. 2000); Corsica (Gerecke & Di Sabatino 2013).

Habitat and biology: pools of streams. Life cycle unknown.

Distribution: Western, Central and Southern Europe. For a long time confused with *M. orbicularis* (Müller, 1776), a species preferably living in larger standing waters. All records under this name from the area covered refer to *M. roztoczensis* (Smit et al. 2000).

Family Momoniidae

69. *Momonium falcipalpis* Halbert, 1906

Published records: Sicily (Gerecke 1991).

Habitat and biology: lakes, ponds, pools of streams. Life cycle unknown.

Distribution: Palearctic, rare scattered records.

Family Arrenuridae

70. *Arrenurus* (s.str.) *abbreviator* Berlese, 1888

Published records: Corsica (Angelier 1954); Sicily (Smit et al. 2000).

Habitat and biology: small lakes, ditches, ponds. Larvae parasitic on Odonata (Zygoptera).

Distribution: Western Palearctic.

71. *Arrenurus* (s.str.) *batillifer* Koenike, 1896

Published records: Sicily (Smit et al. 2000).

Habitat and biology: lentic habitats of various types, sensitive to eutrophication. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palearctic.

**72. *Arrenurus* (s.str.) *bicuspidator* Berlese, 1885

New record: Italy: Sicily, I 1428 (2/2/0).

Habitat and biology: lakes, ponds. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palearctic.

Note: first record from Sicily.

73. *Arrenurus* (*Micruracarus*) *bipapillosus* Halbert, 1911

Published records: Corsica (Gerecke & Di Sabatino 2013); Corsica, Sicily (Smit et al. 2000).

Habitat and biology: lakes, ponds, remnant pools of temporary streams. Life cycle unknown.

Distribution: Western Palearctic.

*74. *Arrenurus* (s.str.) *bruzellii* Koenike, 1885

New records: Italy: Sicily, I 1411 (2/2/0); I 1428 (10/4/0); I 1470 (0/1/0).

Published records: Sicily (Smit et al. 2000).

Habitat and biology: lakes, ponds; disappears at elevated eutrophication. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palaearctic.

75. *Arrenurus* (s.str.) *claviger* Koenike, 1885

Published record: Corsica (Smit et al. 2000).

Habitat and biology: lakes, ponds, sensitive to eutrophication. Larvae parasitic on Odonata (Zygoptera). Distribution: Western Palaearctic.

****76. *Arrenurus* (s.str.) *compactus* Piersig, 1894**

New records: Italy: Sicily, I 1425 (0/25/0); I 1426 (0/8/0); I 1427 (23/30/0); I 1428 (1/4/0); I 1429 (0/3/0); I 1433 (1/0/0); I 1436 (0/3/0); I 1437 (0/3/0); I 1438 (0/9/0); I 1439 (4/0/0); I 1441 (1/4/0); I 1443 (0/3/0); I 1445 (0/2/0); I 1447 (0/2/1).

Habitat and biology: small, oligotrophic, often acidic standing waters. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palaearctic.

Note: first records from Sicily.

***77. *Arrenurus* (s.str.) *cuspidator* (Müller, 1776)**

New records: Italy: Sicily, I 1411 (9/10/0); I 1425 (0/3/0); I 1427 (3/3/0); I 1428 (1/0/0); I 1439 (15/13/0); I 1440 (2/0/0); I 1441 (1/1/0); I 1442 (0/1/0); I 1444 (0/4/0); I 1445 (1/2/0); I 1451 (0/3/0).

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds, remnant pools of temporary streams. Larvae parasitic on Odonata (Zygoptera).

Distribution: Western Palaearctic.

***78. *Arrenurus* (s.str.) *cuspidifer* Piersig, 1894**

New records: Italy: Sicily, I 1497 (0/1/0); I 1498 (1/2/0); I 1499 (0/1/0).

Published records: Corsica (Angelier 1954); Sardinia, Sicily (Smit et al. 2000).

Habitat and biology: ponds, remnant pools of temporary streams, tolerant to eutrophication, also in slightly brackish water. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palaearctic.

79. *Arrenurus* (*Megaluracarus*) *cylindratus* Piersig, 1896

Published records: Corsica, Sardinia, Sicily (Smit et al. 2000).

Habitat and biology: ponds with groundwater influence, pools of springs and low order streams. Life cycle unknown.

Distribution: Europe.

80. *Arrenurus* (*Micruracarus*) *detruncatus* (C. & E. Angelier, 1953)

Published record: Corsica (Angelier 1954).

Habitat and biology: recorded from pools in a stream and an oxbow pond. Life cycle unknown.

Distribution: French Pyrenees, Corsica.

81. *Arrenurus* (s.str.) *distans* Walter, 1927

Published records: Sicily (Smit et al. 2000).

Habitat and biology: lakes, temporary and permanent ponds. Life cycle unknown.

Distribution: west Mediterranean area, Iran, rare.

82. *Arrenurus* (s.str.) *furcillatus* K. Viets, 1930

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds and ditches. Larvae parasitic on Odonata (Zygoptera).

Distribution: Western Palaearctic. Scattered records from the Mediterranean area, Central Europe, Caucasus and Asia Minor, rare.

***83. *Arrenurus* (*Megaluracarus*) *globator* (Müller, 1776)**

New records: Italy: Sicily, I 1439 (0/1/0); I 1441 (2/0/0); I 1471 (0/1/0).

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds and lakes. Larvae with a wide host spectrum, including adult Diptera of the families Chironomidae, Culicidae and Dixidae and larval Coleoptera of the families Dytiscidae and Gyrinidae.

Distribution: Palaearctic.

84. *Arrenurus* (s.str.) *latus* Barrois & Moniez, 1887

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds, remnant pools of temporary streams, tolerant to eutrophication and elevated electrolyte contents. Larvae parasitic on Diptera (Chaoboridae, Chironomidae, Culicidae).

Distribution: Western Palaearctic.

85. *Arrenurus* (*Micruracarus*) *novus* George, 1884

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds, remnant pools of temporary streams, tolerant to eutrophication and terrestrialization, but not supporting total dessication. Life cycle unknown.

Distribution: Western Palaearctic to Afrotropical.

***86. *Arrenurus* (s.str.) *papillator* (Müller, 1776)**

New record: Italy: Sardinia, I 1390 (1/0/0).

Published records: Sicily (Smit et al. 2000).

Habitat and biology: character species of temporary ponds, also in brackish habitats, deutonymphs and adults capable to survive drought in humid sediments. Larvae parasitic on Odonata (Zygoptera and Anisoptera).

Distribution: Palaearctic.

Note: first record from Sardinia.

***87. *Arrenurus* (s.str.) *radiatus* Piersig, 1894**

New record: Italy: Sicily, I 1403 (0/1/0).

Published records: Corsica (Angelier 1954); Sicily (Smit et al. 2000).

Habitat and biology: ponds, pools in slowly running waters. Larvae parasitic on Odonata (Zygoptera).

Distribution: Palaearctic.

***88. *Arrenurus* (s.str.) *robustus* Koenike, 1894**

New record: Italy: Sicily, I 1428 (1/0/0).

Published records: Corsica (Angelier 1954); Sicily (Smit et al. 2000).

Habitat and biology: ponds, pools in slowly running waters. Larvae parasitic on Odonata (Zygoptera).

Distribution: Western Palaearctic.

***89. *Arrenurus* (s.str.) *rodrigensis* Lundblad, 1954**

New records: Italy: Sicily, I 1426 (0/1/0); I 1427 (1/2/0); I 1428 (5/6/0); I 1429 (0/1/0); I 1435 (0/4/0); I 1440 (0/0/1); I 1443 (0/2/0); I 1445 (0/2/0).

Published records: Sardinia, Sicily (Smit et al. 2000).
Habitat and biology: ponds, small lakes, pools of running waters. Larvae parasitic on Odonata (Zygoptera).

Distribution: Mediterranean area.

90. *Arrenurus* (*Truncaturus*) *stecki* Koenike, 1894

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds, ditches, semiaquatic habitats (quagfens). Life cycle unknown.

Distribution: Western Palaearctic.

***91. *Arrenurus* (s.str.) *virens* Neuman, 1880**

New record: Italy: Sicily, I 1440 (2/0/0).

Published records: Sicily (Smit et al. 2000).

Habitat and biology: ponds, ditches, lentic areas of high order streams. Larvae parasitic on Odonata (Zygoptera).

Distribution: Western Palaearctic.

***Arrenurus* sp.**

New Records: Italy: Sicily, I 1427 (0/0/66); I 1428 (0/0/3); I 1434 (0/8/0); I 1439 (0/0/11).

Females and deutonymphs not identifiable to species level.

Statistical analysis

In spite of the high number of sampling sites, the rarefaction curves did not reach the asymptote in Corsica and Sardinia, while the sampling efficiency was higher and accurate in Sicily (Figure 5). The estimated number of species, calculated using the classical Chao2 equation and the non-parametric incidence based estimator (ICE), gave similar results, demonstrating that sampling effort was insufficient in

Corsica and Sardinia, where approximately 50% or less of total estimated species richness was collected; the steepness of the curves, including uniques (i.e. species present in a single site) indicates that the number of species is probably underestimated even applying Chao2 and ICE correction, and cannot be assessed accurately using the data in hand. On the contrary, the knowledge of Sicilian water mites seems quite accurate, and the curves tend to converge towards an asymptote, which is around 70 species.

The investigated water mite assemblages from the three islands (Corsica, Sardinia and Sicily) investigated in ponds, pools and lakes during the present research (47 species) were not statistically different (ANOSIM, 9999 permutations, Global $R = 0.055$, $p = 0.995$). Pairwise differences between islands were never significant; Corsica and Sardinia ($r = 0.236$, $p = 0.064$) slightly differed from each other, while both were subsets of the well-sampled Sicily (Corsica – Sicily, $r = 0.095$, $p = 0.223$, Sardinia – Sicily, $r = -0.095$, $p = 0.933$). Average similarities between sampled sites within Corsica (6.49), Sardinia (11.32) and Sicily (6.34) were extremely low, indicating a high heterogeneity between sites. The low within-islands similarities in water mite assemblages in standing waters, as well as the absence of statistically significant between-islands differences, may be due to a random distribution of the species pools among sites independently of their geographical location. The inadequacy of the sampling effort performed in Corsica and Sardinia, analyzed above, may influence the accuracy of these results.

Discussion

Due to their complex life cycle with a larval stage selectively bound to specific insect host taxa, water mites are particularly sensitive to environmental change and therefore important indicators in nature conservation (e.g. Martin & Gerecke 2009). During the past few decades, intense investigation has improved our knowledge of the water mite fauna of the Mediterranean but, with the exception of a study by Valdecasas and Camacho (1986) in the Sierra de Guadarrama (Spain), interest has been focussed mostly on running waters and spring habitats. In part, this bias was induced by the observation that water mites restricted to these habitats tend to have smaller distribution areas (e.g. Smit et al. 2000; for aquatic beetles see Ribera 2000) and were therefore considered more interesting from a zoogeographical point of view. This tendency is confirmed also by the results of our statistical analysis. The results may be influenced by a sampling bias of the different habitat types, and must be taken with caution, but they suggest that standing water species colonize wider distribution areas, which

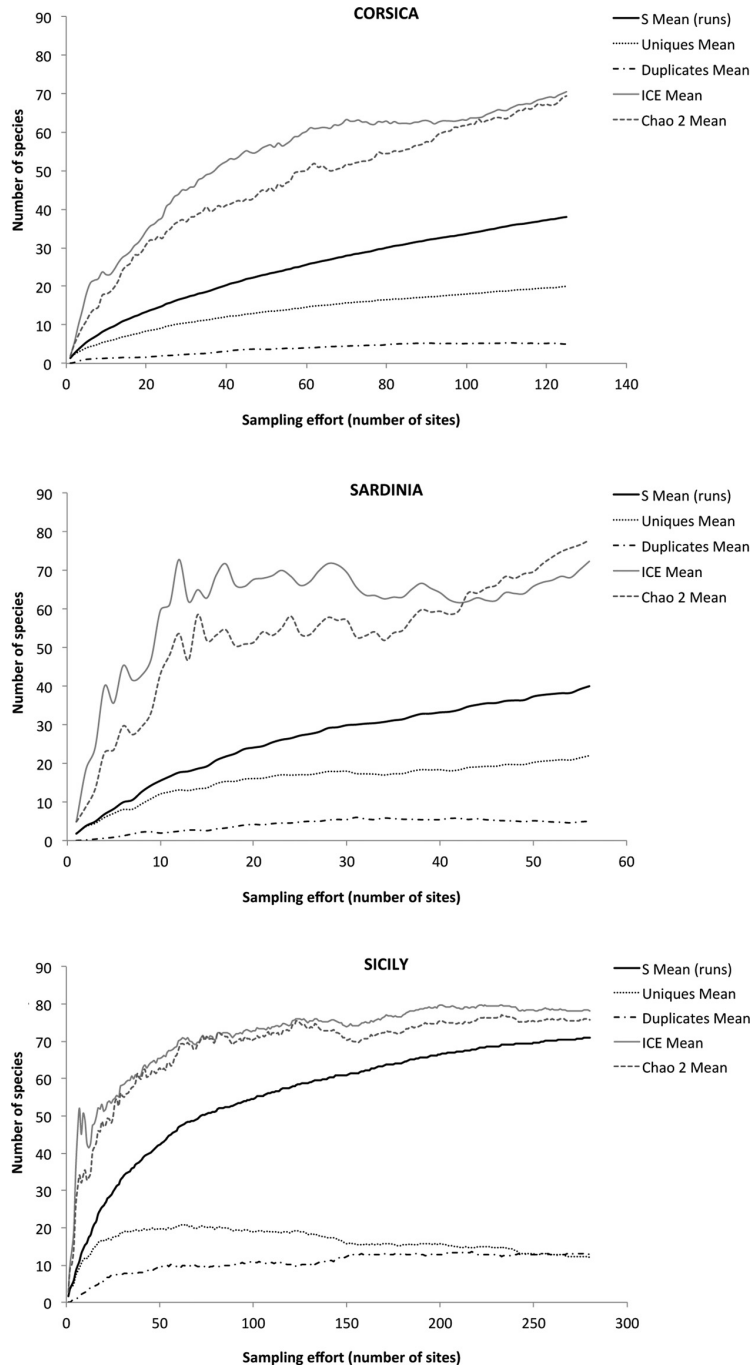


Figure 5. Species rarefaction curves for water mites in the three islands (S) and estimated species richness using Chao2 and incidence based estimator (ICE) non-parametric estimators for increasing sampling effort; uniques (i.e. number of species present in a single site) and duplicates (i.e. species present in two sites) are reported as well.

often include extended parts of the West Palaearctic, occasionally the whole Palaearctic or even the Holarctic. As noted by Boix et al. (2012), due to high

rates of dispersal via phoresis and intensive habitat connectivity, the western Mediterranean area offers a large potential for species distribution.

However, in a preliminary study for a red list of the European water mites, Gerecke and Lehmann (2005) reported that the highest numbers of taxa with scattered distributions, or species which were not recorded for more than 50 years, were found among inhabitants of small standing waters and temporary ponds. Habitats of this type, typical elements in the natural and traditional agricultural landscapes around the Mediterranean, were in sharp decline during the last few decades, and their rate of extinction was dramatic due to reclamation, groundwater management, transformation of natural pools into water reservoirs, and changes in precipitation frequency and intensity (Zacharias & Zamparas 2010; C er ghino et al. 2014). Consequently, the water mite fauna described herein, including the numerous species documented for the first time from the Mediterranean islands, must be considered at high risk of extinction at a population level: it is not the species as a whole which is endangered, but its genetic diversity, which is expressed by the presence of isolated local populations on the investigated islands.

Our data derive from a variety of projects with different aims and which were conducted with different methodologies; the fauna of Sicily is documented in much detail (a transverse line of low collecting site density crossing the centre of the island in a SW–NE direction is due to elevated electrolyte concentration in inland waters caused by evaporite outcrops), while records from Corsica and Sardinia are rather scattered and the faunal scenario is quite incomplete. For this reason, it is not surprising that attempts at a statistical analysis of distribution patterns or zoogeographical gradients were unsuccessful.

A series of interesting results emerges, concerning topics which deserve to be highlighted in future research:

1. With five species recorded for the first time from the Mediterranean area, and, in addition, six first records for Italy, seven for Sicily, three for Sardinia and seven for Corsica, our new results are an important contribution to a more complete knowledge of the biodiversity in the area. For several species, the southern distribution limit is considerably extended (e.g. members of the family Piersigiidae appeared so far restricted to Northwestern, Northern and Central Europe with a southern limit in the German pre-Alps, Gerecke et al. 2011). Our data suggest that intense investigations in upper montane areas on the islands will produce records of additional species previously believed to be restricted to Central and Northern Europe. At our present state of knowledge, the standing water mite fauna under the cold-temperate climate in Southern Europe is not characterized by own endemic elements, but represents a “diluted northern fauna”. However, such isolated outposts at the border of distribution areas are of particular biogeographical interest. Standing water habitats in mountain forests and subalpine meadows are refugial habitats for the remnants of a highly threatened relict fauna that has probably just disappeared from several parts of the Mediterranean.
2. In the western Mediterranean, pool areas of permanent streams and residual pools of temporary running waters are often the only refugial areas suitable for the survival of limnic water mite species. The fact that many species, known from lakes and ponds in Central and Northern Europe, in the south are recorded exclusively from streams is most probably not the consequence of a local stenotopy, but simply the result of a large-scale destruction of suitable standing water habitats. In this context, ‘suitable’ means that the water should be unpolluted, available year-round and with a stable or only slightly changing water level or, if temporary, with diversified riparian sediment structures allowing the survival of mites and/or their hosts under wet conditions (Wiggins et al. 1980; Gerecke 1991). Where such kinds of habitat disappeared from the landscape, the importance of streams increased under the aspects of nature conservation: here, a responsible water management becomes crucial for the survival of pond water fauna in oasis-like refugial habitats in summer dry streams. For instance, the fact that standing water-dwelling species of the genera *Brachypoda*, *Hygrobatas* and *Lebertia* on the western Mediterranean islands have so far been found exclusively in streams is probably best explained by the lack of other suitable habitats at middle and low elevations.
3. The data assembled herein, with a total of 91 species, collected during a variety of investigations with different aims, where water mite collection was often a marginal aspect, highlight the important contribution of this taxonomic group to the diversity of lakes, ponds, ditches and pools in the Mediterranean area. In the study area, from a proper research project covering the maximum possible diversity of habitats, and following a well-defined field work protocol, we would expect a further significant increase of our knowledge on water mite diversity, especially in the more incompletely known Corsican and Sardinian areas.

Table I. Water mites of the three largest western Mediterranean islands; list of the new collecting sites. Codes within brackets refer to Italian provinces.

Corsica:

- F 23, Sartène, Roccapina, F. Ortolo/P. de l'Ortolo, 26.09.1991, stream, pool, permanent, 20 m, 41.508526°N, 8.911489°E, R. Gerecke
 F 42 e, Calacuccia (Calvi), Galeria, Fango, foce, 02.02.1991, stream, pool, permanent, 1 m, 42.418226°N, 8.659089°E, R. Gerecke
 F 48, Porto catchment, collecting site uncertain, stream, pool, permanent, Schwoerbel et al.
 F 88, Porto (2B), Rau d'Enova N Crête d'Andatone, 08.06.1993, stream, pool, permanent, 390 m, 42.268178°N, 8.731540°E, R. Gerecke
 F 92, Galéria (2B), Rau de Tavulaghju NE Pinzu di I Corbi, 11.06.1993, stream, pool, permanent, 150 m, 42.397712°N, 8.644751°E, R. Gerecke
 F 151, Tre Padule de Suartone, Padule Maggiore (C001), 12.03.2008, swamp, temporary, 101 m, 41.464722°N, 9.233056°E, F. Marrone & F. Stoch
 F 153, Lac de Creno, 11.07.2013, lakelet, permanent, 1310 m, 42.205139°N, 8.945610°E, F. Marrone & F. Stoch
 F 154, Calacuccia, Artificial lake, 11.07.2013, lake, permanent, 775 m, 42.330264°N, 9.021253°E, F. Marrone & F. Stoch
 F 155, M. Rotondo, Lac de Melo, 12.07.2013, lakelet, permanent, 1711 m, 42.213227°N, 9.023543°E, F. Marrone & F. Stoch
 F 156, Oletta, Lac de Padule, 14.07.2013, lakelet, permanent, 62 m, 42.627269°N, 9.326795°E, F. Marrone & F. Stoch

Sardinia:

- I 369, Sarcidano (OR), Laconi, Riu Bidissariu, 19.05.1986, stream, 700 m, 39.875399°N, 9.093235°E, R. Gerecke
 I 373, Sant'Antonio di Gallura (OT), Riu Piatu, 23.05.1986, stream, pool, permanent, 220 m, 40.966050°N, 9.277864°E, R. Gerecke
 I 378, Tempio Pausania (OT), M.te Limbara, Lu Colbu spring stream upstr. Giagone, 25.05.1986, stream, pool, permanent, 450 m, 40.82648°N, 9.1008°E, R. Gerecke
 I 381, Villanova Monteleeone (SS), R.Lacanu/S.S.292, 28.05.1986, stream, pool, permanent, 400 m, 40.48272°N, 8.41597°E, R. Gerecke
 I 383, Villacidro (VS), M. Linas P.S.Miali, C.Coxinas, 30.05.1986, stream, pool, permanent, 650 m, 39.45669°N, 8.7036°E, R. Gerecke
 I 389, Dolianova (CA), Dolianova R.Lassini/Str.S.Nicolò Gerrei, 01.06.1986, stream, pool, permanent, 800 m, 39.43875°N, 9.26146°E, R. Gerecke
 I 849, Óschiri, Stream at S.S. 392 to Tempio Pausania, km 9 VI, right affluent, 09.05.1996, pool near water cistern, permanent, 40.4618°N, 9.0309°E, Pusch
 I 1155, Talána (OG), M. Telemula. Rio de Ficarba, 13.09.1991, stream, pool, permanent, 700 m, 40.02369°N, 9.48635°E, R. Gerecke
 I 1162, Gennargentu (NU), Vallada Tedderi/Bacu s'Argiolas, 15.09.1991, stream, pool, permanent, 800 m, 39.97904°N, 9.38062°E, R. Gerecke
 I 1387, Abbasanta (OR), Scolina di S'Arenazu (S012), 10.03.2008, ditch, temporary, 220 m, 40.044444°N, 8.846111°E, F. Marrone & F. Stoch
 I 1388, Abbasanta (OR), Stagno di S'Arenazu (S014), 10.03.2008, pond, permanent, 243 m, 40.051389°N, 8.846667°E, F. Marrone & F. Stoch
 I 1389, Orosei (NU), Stagno agricolo di Orosei (S020), 11.03.2008, reservoir, permanent, 71 m, 40.411944°N, 9.736389°E, F. Marrone & F. Stoch
 I 1390, Gesturi (VS), Stagno di S'Ala de Mengianu (S027), 13.03.2008, reservoir, permanent, 570 m, 39.761944°N, 8.952500°E, F. Marrone & F. Stoch
 I 1391, Gesturi (VS), Paule di S'Ala de Mengianu (S028), 13.03.2008, pond, temporary, 568 m, 39.761111°N, 8.950556°E, F. Marrone & F. Stoch
 I 1461, Uta (CA), Pozza 1 di c.da San Tommaso (S034), 08.03.2010, pond, temporary, 1 m, 39.270520°N, 8.977919°E, F. Marrone, F. Maxia & F. Stoch
 I 1462, Uta (CA), Stagno di Guardia Lada (S038), 08.03.2010, reservoir, permanent, 38 m, 39.263685°N, 8.886654°E, F. Marrone, F. Maxia & F. Stoch
 I 1463, Uta (CA), Pozza di Guardia Lada (S039), 08.03.2010, pool, temporary, 38 m, 39.264425°N, 8.887039°E, F. Marrone, F. Maxia & F. Stoch
 I 1464, Siliqua (CA), Pozza 3 di Isca de su Casteddu (S042), 08.03.2010, pool, temporary, 83 m, 39.253238°N, 8.819919°E, F. Marrone, F. Maxia & F. Stoch
 I 1465, Portoscuso (CI), Buca de Flumini (S058), 10.03.2010, swamp, temporary, 55 m, 39.232243°N, 8.387627°E, F. Marrone, F. Maxia & F. Stoch
 I 1548, Fluminimaggiore (CI), Piscina morta (S060), 10.03.2010, pond, astatic, 66 m, 39.428508°N, 8.447328°E, F. Marrone, F. Maxia & F. Stoch
 I 1549, Gesturi (VS), Paule Oromeo (S025), 12.03.2010, pond, temporary, 584 m, 39.745131°N, 8.996657°E, F. Marrone, F. Maxia & F. Stoch
 I 1550, Gesturi (VS), Paule Bartili, 13.03.2008, pond, temporary, 575 m, 39.765975°N, 8.976299°E, F. Marrone & F. Stoch
 I 1551, Siliqua (CA), Isca de Su Casteddu 2 (S041), 08.03.2010, pond, temporary, 79 m, 39.253277°N, 8.820794°E, F. Marrone, F. Maxia & F. Stoch

Sicily:

- I 1, Noto (SR), Fiume Manghisi at Mulino Papa, 20.04.1985, stream, pool, permanent, 390 m, 36.98763 N, 15.02809°E, R. Gerecke
 I 4, Iblei, Eloro (SR), Foce Stampace, 21.04.1985, stream, pool, permanent, 1 m, 36.836287 N, 15.102175°E, R. Gerecke
 I 36, Fiume di Ferro (CT) at bridge S.S. 417 01.05.1985, stream, pool, permanent, 90 m, 37.345389 N, 14.694432°E, R. Gerecke
 I 37, Iblei (SR), T.Sta.Chiana/ponte S.S.287, 02.05.1985, stream, pool, permanent, 300 m, 36.94255 N, 15.05054°E, R. Gerecke
 I 46, Marineo (PA), Fiume Eleuterio, 30.05.1985, stream, pool, permanent, 250 m, 38.20846 N, 13.40264°E, R. Gerecke
 I 98 (= I 37), Iblei (SR), T.Sta.Chiana/ponte S.S.287, 13.07.1985, stream, pool, permanent, 300 m, 36.94255 N, 15.05054°E, R. Gerecke
 I 100, Iblei, Noto (SR), S.M. La Scala, stream 15.07.1985, stream, pool, permanent, 301 m, 36.956639°N, 15.031067°E, R. Gerecke
 I 132, Fiumedinisi (ME), Fiume Fiumedinisi (upstr. Fiumedinisi), 12.08.1985, stream, pool, permanent, 220 m, 38.03263°N, 15.37033°E, R. Gerecke
 I 133, Randazzo (CT), Fiume Alcantara (upstr. Randazzo), 20.08.1985, stream, pool, permanent, 810 m, 37.90701°N, 14.93743°E, R. Gerecke
 I 165, Isnello (PA), Torrente Isnello (upstr. Isnello), 11.09.1985, stream, pool, permanent, 600 m, 37.93838°N, 13.99911°E, R. Gerecke
 I 166, Isnello (PA), Torrente Isnello (Portella Colla), 11.09.1985, stream, pool, permanent, 1300 m, 37.87987°N, 14.00786°E, R. Gerecke
 I 168, S. Mauro Castelverde (PA), Torrente Grosso (at C. Parissi), 12.09.1985, stream, pool, permanent, 350 m, 37.8866°N, 14.17949°E, R. Gerecke
 I 177, Castelbuono (PA), Vallone dei Mulini, 14.09.1985, stream, pool, permanent, 350 m, 37.89975°N, 14.12816°E, R. Gerecke
 I 188, Moio Alcantara (ME), Fiume Alcantara, 25.09.1985, stream, pool, permanent, 525 m, 37.89936°N, 15.0563°E, R. Gerecke
 I 192, Iblei, Avola antica (SR), F. Manghisi in Cava Grande 28.09.1985, stream, pool, permanent, 80 m, 36.957811°N, 15.163689°E, Gerecke
 I 193, Noto (SR), Torrente Tellesimo / Cava Nobile, 29.09.1985, stream, pool, permanent, 190 m, 36.92134°N, 14.91299 E, R. Gerecke
 I 214, Bronte (CT), Fiume Simeto at Ponte Passo Paglia, 27.10.1985, stream, pool, permanent, 465 m, 37.77122°N, 14.80186 E, R. Gerecke
 I 250, Iblei (SR), Sortino. Cava Grande/Contr.Foresta, 22.11.1985, stream, pool, permanent, 450 m, 37.14086°N, 14.94933 E, R. Gerecke
 I 269, M. Moarda (PA), fountain pool near Plla. del Pozzillo, 13.03.1986, pond, permanent, 900 m, 38.019592°N, 13.293826 E, Gerecke
 I 308, Iblei (SR), Giarratana. F.Irminio, 13.04.1986, stream, pool, permanent, 530 m, 37.05645°N, 14.81836 E, R. Gerecke
 I 312, Iblei, M. Lauro (SR), F. Irminio, spring of the stream, 14.04.1986, stream, pool, permanent, 770 m, 37.118729°N, 14.819359 E, R. Gerecke
 I 318, Iblei (RG), M.Lauro, Vallone Donninga, 15.04.1986, stream, pool, permanent, 750 m, 37.13578°N, 14.8238 E, R. Gerecke
 I 323, Nicosia (EN), Fiume di Sperlinga, upstream of the confluence with Torrente Fiumetto, 18.04.1986, stream, pool, permanent, 550 m, 37.74305°N, 14.35871 E, R. Gerecke
 I 534 (= I 1) Iblei, Noto (SR), F. Manghisi at bridge S.S. 287, 11.11.1986 stream 390 m, 36.98763°N, 15.02809 E, R. Gerecke
 I 544, Noto (SR), Fiume Manghisi, 01.12.1986, stream, pool, permanent, 390 m, 36.98763°N, 15.02809 E, R. Gerecke
 I 552, Sortino (SR), Cava Grande (C.da Foresta), 30.08.1987, stream, pool, permanent, 450 m, 37.14086°N, 14.94933 E, R. Gerecke

(Continued)

Table I. (Continued).

I 563 , Caronia (ME), Fiume Caronia / Torrente Marchina, 11.09.1987, stream, pool, permanent, 150 m, 37.99586°N, 14.44762 E, R. Gerecke
I 1067 , Pedagoggi (SR), T. Gelso, 09.05.1990, stream, pool, permanent, 600 m, 37.102954°N, 14.561398 E, D'Urso&Gerecke
I 1076c , Bronte (CT), Fiume Troina (at Serravalle), 18.04.1989, stream, pool, permanent, 540 m, 37.80772°N, 14.8012 E, Ferrito
I 1392 , Cerami (EN), Stagno 2 di C.le del Contrasto (EN008), 18.03.2008, pond, temporary, 1100 m, 37.847105°N, 14.396224 E, F. Marrone
I 1393 , Cesarò (ME), Stagno dei Tricotteri (ME036), 18.03.2008, pond, permanent, 1480 m, 37.935781°N, 14.673703 E, F. Marrone
I 1403 , Nicosia (EN), M. Sambuchetti, Laghetto 3, sorgente ripariale, 17.05.2009, spring, pool, 1300 m, 37.831856°N, 14.390648 E, R. Gerecke
I 1406 , Burgio (AG), Stagno di Piano Inisitati (AG049), 04.04.2009, reservoir, permanent, 800 m, 37.636341°N, 13.333241 E, F. Marrone
I 1407 , Aragona (AG), Stagno 13 delle Macalube (AG063), 15.04.2007, pond, temporary, 274 m, 37.374359°N, 13.601428 E, F. Marrone
I 1408 , Aragona (AG), Stagno 17 delle Macalube (AG068), 15.04.2007, pond, temporary, 279 m, 37.374933°N, 13.598978 E, F. Marrone
I 1409 , Cammarata (AG), Stagno di Monte Cammarata (AG073), 19.03.2009, reservoir, permanent, 907 m, 37.602327°N, 13.574582 E, F. Marrone
I 1410 , Cesarò (ME), Stagno di c.da Buffali (ME044), 04.05.2008, pond, temporary, 1252 m, 37.872255°N, 14.676383 E, F. Marrone
I 1411 , Corleone (PA), Laghetto 1 di Coda di Riccio (PA120), 21.08.2008, reservoir, permanent, 876 m, 37.872286°N, 13.400995 E, F. Marrone
I 1412 , Corleone (PA), Laghetto 2 di Coda di Riccio (PA121), 21.08.2008, reservoir, permanent, 870 m, 37.873333°N, 13.398449 E, F. Marrone
I 1413 , Castronovo di Sicilia (PA), Stagno 4 di Monte Carcaci (PA135), 14.01.2009, reservoir, permanent, 1035 m, 37.711324°N, 13.517373 E, F. Marrone
I 1414 , Pozzallo (RG), Pantano Maganuco (RG006), 31.01.2008, swamp, temporary, 0 m, 36.717912°N, 14.815730 E, F. Marrone
I 1415 , Castellammare del Golfo (TP), Pozzo di c.da Puzziddi (TP092), 01.02.2004, well, permanent, 361 m, 38.086447°N, 12.795241 E, F. Marrone
I 1416 , Cesarò (ME), Mt. Soro 7, 22.04.2004, pond, temporary, 1420 m, 37.943908°N, 14.675652 E, G. Sorgi
I 1417 , Randazzo (CT), Casa Mangioni, 14.11.2003, pond, permanent, 1035 m, 37.895292°N, 14.855569 E, G. Sorgi
I 1418 , Cesarò (ME), C.da Cicogna, 07.04.2004, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1419 , Cesarò (ME), C.da Cicogna, 16.06.2004, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1420 , Cesarò (ME), C.da Cicogna, 06.12.2004, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1421 , Cesarò (ME), C.da Cicogna, 21/04/200, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1422 , Cesarò (ME), C.da Cicogna, 05.05.2005, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1423 , Cesarò (ME), C.da Cicogna, 07.06.2005, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1424 , Cesarò (ME), C.da Cicogna, 16.06.2004, pond, temporary, 1303 m, 37.877312°N, 14.666323 E, G. Sorgi
I 1425 , Cesarò (ME), Mt. Soro 1, 15.05.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1426 , Cesarò (ME), Mt. Soro 1, 16.06.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1427 , Cesarò (ME), Mt. Soro 1, 16.07.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1428 , Cesarò (ME), Mt. Soro 1, 23.08.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1429 , Cesarò (ME), Mt. Soro 1, 23.08.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1430 , Cesarò (ME), Mt. Soro 1, 16.09.2004, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1431 , Cesarò (ME), Mt. Soro 1, 07.06.2005, pond, permanent, 1547 m, 37.943370°N, 14.684265 E, G. Sorgi
I 1433 , Caronia (ME), Pizzo della Battaglia, 08.07.2004, pond, temporary, 960 m, 37.953641°N, 14.556116 E, G. Sorgi
I 1434 , S.Fratello (ME), P.lla Calacudera, 15.05.2004, pond, permanent, 1520 m, 37.926299°N, 14.664175 E, G. Sorgi
I 1435 , S.Fratello (ME), P.lla Calacudera, 28.08.2005, pond, permanent, 1520 m, 37.926299°N, 14.664175 E, G. Sorgi
I 1436 , Cesarò (ME), Mt. Soro 2, 22.04.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1437 , Cesarò (ME), Mt. Soro 2, 13.05.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1438 , Cesarò (ME), Mt. Soro 2, 16.06.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1439 , Cesarò (ME), Mt. Soro 2, 16.07.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1440 , Cesarò (ME), Mt. Soro 2, 25.10.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1441 , Cesarò (ME), Mt. Soro 2, 06.12.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1442 , Cesarò (ME), Mt. Soro 2, 06.12.2004, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1443 , Cesarò (ME), Mt. Soro 2, 05.05.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1444 , Cesarò (ME), Mt. Soro 2, 05.05.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1445 , Cesarò (ME), Mt. Soro 2, 05.05.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1446 , Cesarò (ME), Mt. Soro 2, 07.06.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1446a , Cesarò (ME), Mt. Soro 2, 07.06.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1447 , Cesarò (ME), Mt. Soro 2, 14.07.2005, pond, permanent, 1776 m, 37.928872°N, 14.696967 E, G. Sorgi
I 1448 , Bronte (CT), Serra del Re, 28.05.2005, pond, temporary, 1708 m, 37.943647°N, 14.779752 E, G. Sorgi
I 1449 , Bronte (CT), Serra del Re, 28.05.2005, pond, temporary, 1708 m, 37.943647°N, 14.779752 E, G. Sorgi
I 1450 , Cesarò (ME), Mt. Soro 3, 28.04.2005, pond, temporary, 1600 m, 37.925566°N, 14.669581 E, G. Sorgi
I 1451 , Cesarò (ME), Mt. Soro 4, 05.05.2005, pond, temporary, 1602 m, 37.925764°N, 14.669883 E, G. Sorgi
I 1452 , Cesarò (ME), Mt. Soro 5, 22.04.2004, pond, temporary, 1625 m, 37.924995°N, 14.674932 E, G. Sorgi
I 1453 , Cesarò (ME), Mt. Soro 5, 28.04.2005, pond, temporary, 1625 m, 37.924995°N, 14.674932 E, G. Sorgi
I 1454 , Cesarò (ME), Mt. Soro 6, 28.04.2005, pond, temporary, 1630 m, 37.924356°N, 14.674825 E, G. Sorgi
I 1455 , Monti Sicani, undet. site, F. Marrone
I 1466 , Sperlinga (EN), Stagno di Sperlinga (EN012), 04.12.2010, pond, permanent, 958 m, 37.748247°N, 14.315637 E, F. Marrone
I 1467 , Troina (EN), Stagno di Troina (EN015), 06.03.2011, pond, temporary, 775 m, 37.721722°N, 14.658032 E, F. Marrone
I 1468 , Leonforte (EN), Stagno di Leonforte (EN021), 19.03.2011, reservoir, permanent, 551 m, 37.657315°N, 14.330789 E, F. Marrone
I 1469 , Corleone (PA), Invaso dell'Arcera (PA181), 01.11.2010, reservoir, temporary, 596 m, 37.916334°N, 13.391135 E, F. Marrone
I 1470 , Gangi (PA), Stagno di Monte Zimmara (PA184), 04.11.2010, Pond, 1065 m, 37.746139°N, 14.286702 E, F. Marrone
I 1471 , Monreale (PA), Stagno 1 di Borgo Schirò (PA192), 06.12.2011, reservoir, permanent, 433 m, 37.913124°N, 13.230271 E, F. Marrone
I 1496 , Catania (CT), Irrigation pond DNA1, 18.03.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1497 , Catania (CT), Irrigation pond DNA1, 18.03.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1498 , Catania (CT), Irrigation pond DNA1, 24.05.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena

(Continued)

Table I. (Continued).

I 1499, Catania (CT), Irrigation pond DNA1, 23.06.2009, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1500, Catania (CT), Irrigation pond DNA2, 18.03.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1501, Catania (CT), abandoned irrigation pond with <i>Typha latifolia</i> DNB1, close to the river estuary, 24.05.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1502, Catania (CT), abandoned irrigation pond with <i>Typha latifolia</i> DNB1, close to the river estuary, 18.03.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1504, Catania (CT), abandoned irrigation pond with <i>Typha latifolia</i> DNB1, close to the river estuary, 18.03.09, reservoir, permanent, 3 m, 37.393583°N, 15.073725 E, M. Dossena
I 1542, Castronovo di Sicilia (PA), Margio di Carcaciotto (PA141), 15.09.2009, swamp, permanent, 967 m, 37.706153°N, 13.528355 E, F. Marrone
I 1543, Corleone (PA), Pantano di c.da Cangina (PA155), 13.09.2009, swamp, temporary, 774 m, 37.790536°N, 13.334666 E, F. Marrone
I 1544, S. Giuseppe Iato (PA), Stagno dello Jato (PA177), 07.03.2010, reservoir, permanent, 315 m, 37.986027°N, 13.180797 E, F. Marrone & F. Stoch
I 1545, Randazzo (CT), Pantano Gurridda (CT002), 28.12.2009, pond, temporary, 856 m, 37.857713°N, 14.899007 E, F. Marrone
I 1546, Castiglione di Sicilia (CT), Pantano di c.da Pantano (CT013), 23.12.2009, swamp, temporary, 623 m, 37.861714°N, 15.111560 E, F. Marrone
I 1547, Maletto (CT), Sciare di S. Venera (CT014), 23.12.2009, pond, temporary, 866 m, 37.858999°N, 14.860570 E, F. Marrone

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