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Oribatid mite (Arachnida: Oribatida) coenoses from SW Sardinia*

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Abstract

Oribatid mite communities were investigated at five sites in SW Sardinia (Carbonia-Iglesias and Medio Campidano provinces) in three representative habitat types: holm oak (*Quercus ilex*) forest, cork oak (*Quercus suber*) forest and pineland (*Pinus radiata* and *P. pinaster*).

A total of 1,180 oribatid mite specimens, belonging to 67 different species, were extracted from soil samples. Significant differences in species diversity, abundance and Berger-Parker index of dominance were found among the different vegetation types throughout the sampling period, and non-metric multidimensional scaling (n-MDS) ordination confirmed a clear separation between the three coenoses, showing how oribatid assemblages are significantly affected by habitat evolution.

The faunistic knowledge of the oribatid mites of Sardinia is rather poor, the present research represents one of the first contributions for the main Sardinian island. Besides a majority of eurytopic and widespread species representing the main part of the edaphic communities in Mediterranean landscapes, some rare and characteristic species are recorded. They are remnants of the original populations of Sardinia and the western part of the Italian peninsula, resulting from the complex tectonic events that formed the western Mediterranean basin. Among these, *Belorchestes gebennicus* Grandjean, 1957 (Zetorchestidae), *Microppia minus longisetosa* Subías & Rodriguez, 1988, and *Pluritrichoppia insolita* Subías & Arillo, 1989 (Oppiidae) had never been collected in Italy, single individuals of *Oxyoppioides* and *Thamnacarus* probably belong to undescribed species, while *Brachychthonius hirtus* Moritz, 1976 (Brachychthoniidae), *Mongaillardia aeoliana* (Bernini, 1979) (Amerobelbidae), *Berniniella aeoliana* (Bernini, 1973), *Lauroppia similifallax* Subías & Minguez, 1986, *Ramusella* (*Ramusella*) *gyrata* (Mahunka & Paoletti, 1984) (Oppiidae) and *Ophidiotrichus oglasae* Bernini, 1975 (Oribatellidae) are new to the Sardinian fauna.

Key words: Oribatidae, soil fauna, faunistics, biogeography, population dynamics, Italy

Introduction

There is a vast diversity of organisms that live in the soil. Globally, the majority of these organisms are invertebrates that spend at least a portion of their life-cycle belowground (Wardle 2002; Cole *et al*. 2006). Identifying patterns and determinants of species richness is a major theme of community ecology and is of fundamental importance for the management and preservation of biological diversity. Traditionally, the study of these issues—the causes and ecological consequences of biological diversity—has had an aboveground focus (Lawton 1994), but zoologists and ecologists are increasingly turning their attention belowground where the majority of the earth's terrestrial organisms dwell (Wardle 2002). This surge of interest in soil biodiversity stems from the recognition that the organisms living belowground regulate major ecosystem processes such as organic matter turnover and nutrient mineralization, and that feedbacks between aboveground and belowground communities have a key role in governing ecosystem functioning (Bardgett *et*

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al. 1998; Hooper *et al.* 2000; van der Putten *et al*. 2001; Wardle 2002). Among microarthopods, oribatid mites (Arachnida) (Fig. 1), mainly living in the organic horizons of soil (Norton 1990) as saprophagous organisms (Behan-Pelletier 1999), are actively involved in the decomposition of organic matter, the circulation of nutrients and the formation and maintenance of soil structure (Norton 1985; Moore *et al.* 1988). Their diversity is high: about 10,000 species of oribatid mites have been described worldwide, from the Arctic to the Antarctic across the temperate, arid and tropical regions, with densities of up to 300,000 ind./m^2 (Norton 1990). Their abundance, species distribution and community structure depend on their reaction to biotic and abiotic environmental conditions, which show a spatial variation with latitude and within sites at the microsite level and are very sensitive to habitat evolution and to several kinds of disturbance, including chemical pollution by metals or synthetic products, land use, management, and fires (van Straalen 1998; Behan-Pelletier 1999; Fountain & Hopkin 2001; Henig-Sever *et al.* 2001; Lindo & Visser 2004; Migliorini *et al.* 2005a; Migliorini *et al.* 2005b).

In the last few years there has been great progress in understanding the role of oribatid mites as “indicator taxa” of soil quality, but unfortunately little is known about the composition and systematics of this group of organisms and about their faunistic assemblages and the spatial organisation of these communities in a lot of natural or semi-natural areas in Italy. In particular, data from Sardinian soils are very poor. In the present study the composition of oribatid mite communities from various forest habitats of SW Sardinia (Iglesiente) was described through their diversity, dominance structure and, central to the use of community-level characteristics as bioindicators, through knowledge of the taxonomy and autoecology of the collected species (Behan-Pelletier 1999; Migliorini *et al.* 2002).

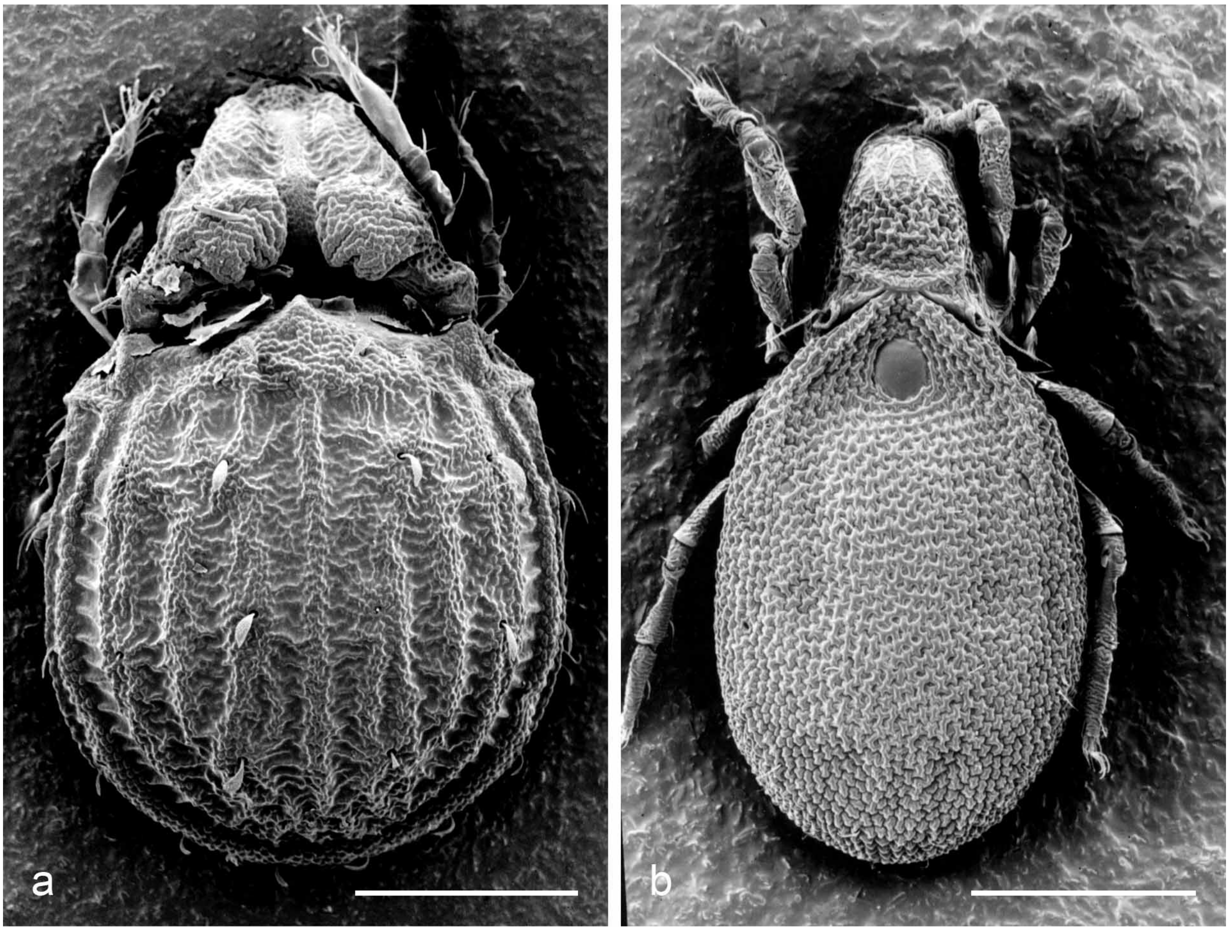

FIGURE 1. Oribatid mites from a cork oak woodland (Sardinia, Villacidro, Cucurru sa Rideli). **a.** *Carabodes tyrrhenicus* Salomone Avanzati, Baratti & Bernini, 2003, scale bar: 0.2 mm. **b.** *Passalozetes africanus* Grandjean, 1932, scale bar: 0.1 mm.

Material and methods

The research was carried out in Sardinia in the framework of a large-scale project (*cf.* Mason *et al.* 2006) and data were collected at five different sites in the Marganai and Montimannu region-owned forests (in the provinces of Carbonia-Iglesias and Medio Campidano, respectively) in the Iglesiente region (Fig. 2), where three representative habitats were defined: holm oak (*Quercus ilex*) forest, cork oak (*Q. suber*) forest and an artificial pineland (*Pinus radiata* and *P. pinaster*) (Tab. 1). Five 400 m^2 experimental plots (20 x 20 m in size) with a homogeneous vegetation structure were selected and four dates were chosen for sampling and coded with letters: 25.III.2006 (a), 24.V.2006 (b), 18.VII.2006 (c) and 15.XI.2006 (d).

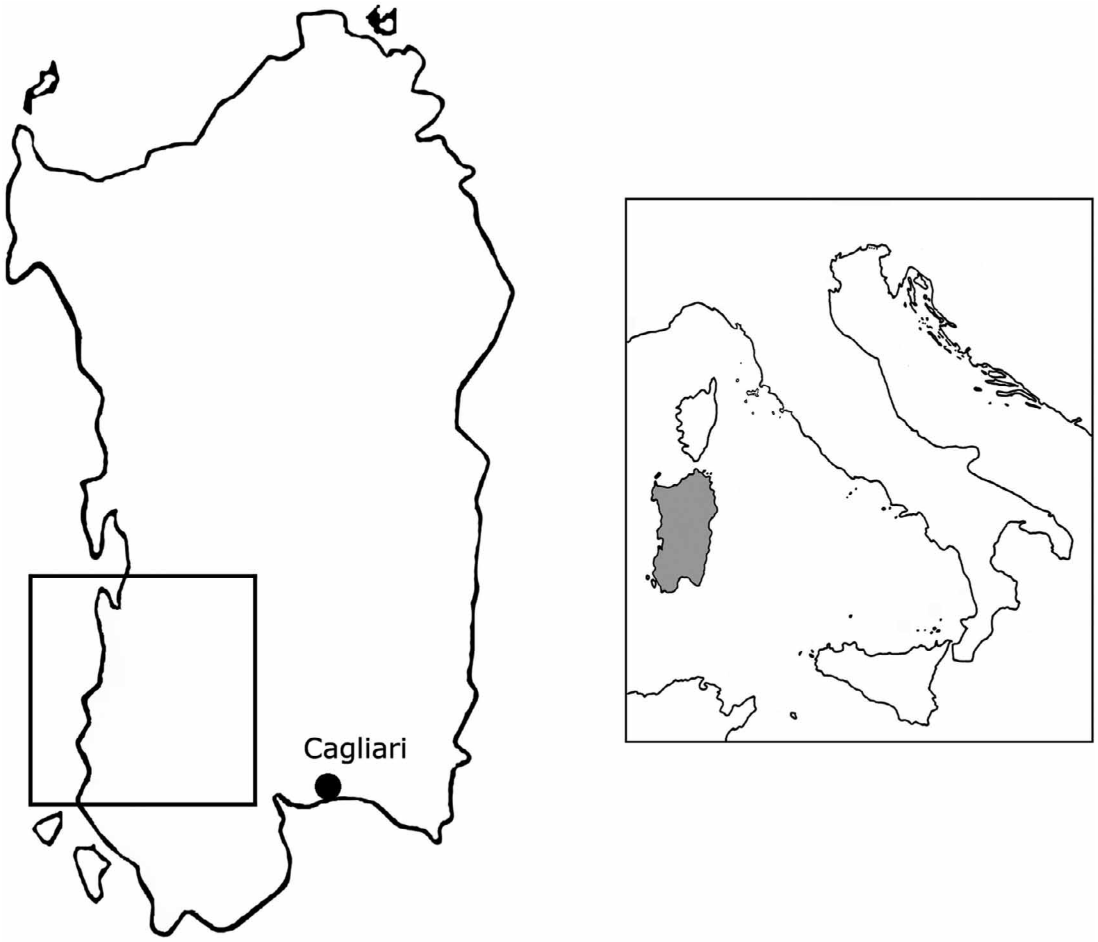

FIGURE 2. Location of study sites.

During each session, five 250 ml soil cores (6 x 6 x 7 cm) were randomly collected from the soil organic horizon at each site for a total of 40 replicates. Soil samples were collected by M. Bardiani. D. Whitmore and P. Cerretti of the Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana", Verona (CNBFVR) and then transported to the Department of Evolutionary Biology of the University of Siena, where oribatid mites were extracted using a modified Berlese–Tullgren apparatus for 15 days and preserved in 75% ethanol. Adult individuals were identified to species using a stereoscopic microscope and counted. Samples and individuals are preserved in Bernini's Collection of the Department of Evolutionary Biology, University of Siena.

A list of all collected species was produced following the systematic order of the check-list of the Italian fauna (Bernini *et al.* 1995) and the Fauna Europaea online database (Niedbala 2004). For each species, the following information is given: a) the most recent useful reference for identification; b) sampling site code as defined by the CNBFVR (see Tab. 1), followed by date(s) of collection and number(s) of collected individuals (in brackets); c) geographic distribution; d) brief notes. The following references were used to define geographic distributions and ecological traits of species: Karppinen and Krivolutsky (1982), Balogh and Mahunka (1983), Golosova *et al.* (1983), Karppinen *et al.* (1986), Karppinen *et al.* (1987), Marshall *et al.* (1987), Fujikawa *et al.* (1993), Perez-Iñigo (1993, 1997), Subías and Gil-Martin (1997), Subías and Arillo (2001), Subías (2004), Weigmann (2006). Chorotypes and related codes were given according to Vigna Taglianti *et al*. (1993, 1999).

TABLE 1. Brief description of sampling sites.

Code	LOCALITY (province)	COMMUNE	ALTITUDE metres a.s.l.	LAT. & LONG. ZONE	UTM Est	UTM Nord	Vegetation type
C02	P.ta Serra Pirastu (Carbonia-Iglesias)	Iglesias	656	32S	463237	4355678	Cork oak
C08	Valle Oridda (Carbonia-Iglesias)	Domusnovas	595	32S	466970	4362400	Pineland
C44	Conca Margiani (Carbonia-Iglesias)	Iglesias	700	32S	462635	4356866	Holm oak
C72	P.ta Planotzara (Carbonia-Iglesias)	Domusnovas	309	32S	465718	4356515	Holm oak
C75	Cuccuru sa Rideli (Medio Campidano)	Villacidro	550	32S	471451	4359295	Cork oak

Numbers of species (S) and individuals (N), and the Berger-Parker index (Bpi) (Berger & Parker 1970) of oribatid mites were used to investigate community composition, relative abundance and dominance of the zoocoenoses. When the ecology of a biological community is structured by some dominant environmental factors there is an uneven distribution of species abundances, with a large proportion of rare to very rare species and a small number of species with high sample densities (May 1975; Magurran 1988). Caruso and Migliorini (2006), studying stability-diversity relationships in Mediterranean oribatid mite coenoses, reformulated the geometric series as a model able to describe this kind of distribution of abundances. The new formulation of the geometric model can be easily linked to the Berger-Parker index (Berger & Parker 1970; Caruso *et al.* 2007) indicating that this index, which accounts for the dominance of the most abundant species over the summed abundance of all species in the assemblage, is significantly affected by environmental conditions (Noti *et al*. 2003), reaching highest values in areas with strong physical disturbance due to agricultural management, but also in naturally stressed and fragmented ecosystems.

Densities and species numbers of oribatid mites and Berger-Parker index values were analysed by a one-way ANOVA to detect differences between sampling sites and vegetation types. A Duncan multiple range test at $p<0.05$ was used to locate significant differences identified by one-way ANOVA. Prior to ANOVA, data were tested ($p<0.05$) for normality and homogeneity of variance, and in the case of violation of statistical assumptions a $\log(x+1)$ transformation was applied to data. The STATISTICA® package (StatSoft) was used for statistical analyses.

A species sample matrix, utilizing the original mean abundance of oribatid mites collected in the sites during the research, was constructed and used to calculate a similarity matrix using the Bray–Curtis similarity index (Bray & Curtis 1957; Clarke & Warwick 1994). The ordination technique of nonmetric multidimensional scaling (n-MDS) (Kruskal & Wish 1978) was applied to the similarity matrices to describe the community patterns (Clarke & Warwick 1994). This ordination is well suited to soil fauna, since it is recommended for non-normal, discontinuous or aggregated data (Clarke & Warwick 1994). It is mainly a ranking method based on relative rather than absolute values, and the geometric distance among points in the two-dimensional ordination plot simply reflects the distance among samples measured by the similarity or dissimilarity index (Cox & Cox 1994). The STRESS index, based on Kruskal's STRESS formula, was calculated for each n-MDS ordination to assess how well (or poorly) a particular configuration reproduces the observed distance matrix. STRESS values between 0.05 and 0.2 were considered good (Clarke & Warwick 1994). The SIMPER procedure, which stands for 'Similarity Percentages', was used to determine which species are most responsible for the differences between sites. PRIMER 5 package (Clarke & Warwick 1994) was used to perform these analyses.

List of species

Eniochthoniidae

1. *Eniochthonius minutissimus* (Berlese, 1903)

Eniochthonius minutissimus: Weigmann 2006, 105, fig. 54c–e.

Material examined. C75: 15.XI.2006 (1).

Geographic distribution. Cosmopolitan.

Notes. Typical thermophilous woodland element.

Cosmochthoniidae

2. *Cosmochthonius lanatus* (Michael, 1885)

Cosmochthonius lanatus: Weigmann 2006, 98–99, fig. 50b.

Material examined. C75: 18.VII.2006 (3).

Geographic distribution. Cosmopolitan.

Notes. Typical element of xeric habitats.

3. *Phyllozetes emmae* (Berlese, 1910a)

Phyllozetes emmae: Balogh & Mahunka 1983, 96, pl. 44f.

Material examined. C75: 18.VII.2006 (4).

Geographic distribution. Cosmopolitan.

Notes. Thermophilous element.

Sphaerochthoniidae

4. *Sphaerochthonius splendidus* (Berlese, 1904)

Sphaerochthonius splendidus: Weigmann 2006, 100, fig. 52c.

Material examined. C02: 25.III.2006 (17); **C08**: 25.III.2006 (2); 24.V.2006 (1); **C44**: 18.VII.2006 (3); **C72**: 15.XI.2006 (1); **C75**: 24.V.2006 (1); 18.VII.2006 (6).

Geographic distribution. Cosmopolitan.

Notes. Ubiquitous species typical in open grassland and thermophilous habitats.

Protoplophoriidae

5. *Bursoplophora tyrrhenica* Bernini, 1983

Bursoplophora tyrrhenica: Bernini 1983, 49–56, figs I a-c, II a-d, III a-f.

Material examined. C75: 24.V.2006 (1); 18.VII.2006 (12); 15.XI.2006 (2).

Geographic distribution. Tyrrhenian. Reported from the Tuscan Archipelago (Montecristo Island, Giglio Island), Argentario (Tuscany), Sardinia (near Cala Gonone and Guspini), Corsica (Orasi), Campania ("Castel Volturno" Nature Reserve (Caserta province)) and Sicily (Aeolian islands (Salina island)).

Notes. Xerophilous element.

Brachychthoniidae

6. *Brachychthonius hirtus* Moritz, 1976

Brachychthonius hirtus: Weigmann 2006, 72–73, fig. 37f.

Material examined. C02: 25.III.2006 (1).

Geographic distribution. European.

Notes. Species previously collected in Italy only at the "Pietraporciana" Nature Reserve (Siena province, Tuscany), and which seems to be typical of mesophilous woodlands (Migliorini *et al*. 2002).

7. *Liochthonius strenzkei* Forsslund, 1963

Liochthonius strenzkei: Weigmann 2006,78, 85, fig. 41a–b.

Material examined. C08: 25.III.2006 (1).

Geographic distribution. Holarctic.

Notes. Thermophilous element of forest soils.

8. *Poecilochthonius italicus* (Berlese, 1910a)

Poecilochthonius italicus: Weigmann 2006, 87, fig. 45b–d.

Material examined. C75: 18.VII.2006 (2).

Geographic distribution. Holarctic.

Notes. Thermophilous element.

9. *Sellnickochthonius immaculatus* (Forsslund, 1942)

Sellnickochthonius immaculatus: Weigmann 2006, 89, 94, fig. 46 e–f.

Material examined. C44: 18.VII.2006 (2); **C72**: 15.XI.2006 (3).

Geographic distribution. Holarctic.

Notes. *Sellnickochthonius immaculatus* seems to be a mesophilous element.

Steganacaridae

10. *Steganacarus* (*Steganacarus*) *carusoi* Bernini & Avanzati, 1989

Steganacarus (*Steganacarus*) *carusoi*: Bernini & Avanzati 1989b, 70–74, figs 18–23; 24–26.

Material examined. C02: 25.III.2006 (1).

Geographic distribution. W-Mediterranean.

Notes. *Steganacarus (S.) carusoi* seems to prefer thermophilous woodlands.

11. *Steganacarus* (*Tropacarus*) *brevipilus* (Berlese, 1923)

Steganacarus (*Steganacarus*) *brevipilus*: Niedbala 1992, 163, Pls 145 N–R, 146 A–E.

Material examined. C44: 18.VII.2006 (5); **C72**: 15.XI.2006 (1); **C75**: 15.XI.2006 (1).

Geographic distribution. W-Palaearctic. This species seems to be widely distributed in Mediterranean countries; the only reasonably ascertained gaps are in Spain and the westernmost Maghrebian regions (Morocco) (Bernini & Avanzati 1989a).

Notes. Typical element of thermophilous woodlands.

Euphthiracaridae

12. *Rhysotritia ardua* (C.L. Koch, 1841)

Rhysotritia ardua: Weigmann 2006, 133, fig. 68c.

Material examined. C02: 25.III.2006 (2); **C75**: 15.XI.2006 (4).

Geographic distribution. Cosmopolitan.

Notes. Typical element of thermophilous woodlands.

Lohmanniidae

13. *Thamnacarus* Grandjean sp.

Material examined. C02: 25.III.2006 (1).

Notes. This specimen probably belongs to an undescribed species. Similar specimens, not yet described, have been collected in xeric habitats of the Tuscan Archipelago (Tuscany), the southern part of the Siena province (Tuscany) (Migliorini *et al*. 2002) and from "Castel Volturno" Nature Reserve (Campania, Caserta province) (Migliorini *et al*. 2005a).

Nanhermanniidae

14. *Nanhermannia nana* (Nicolet, 1855)

Nanhermannia nana: Weigmann 2006, 159, 162, fig. 83a–d.

Material examined. C44: 18.VII.2006 (1).

Geographic distribution. Cosmopolitan.

Notes. Typical woodland element.

Hermanniellidae

15. *Hermanniella granulata* (Nicolet, 1855)

Hermanniella granulata: Weigmann 2006, 169–170, fig. 89f.

Material examined. C44: 18.VII.2006 (2).

Geographic distribution. Palaearctic.

Notes. Typical woodland species.

Gymnodamaeidae

16. *Arthrodamaeus mediterraneus* Subías, Arillo & Subías, 1997

Arthrodamaeus mediterraneus: Subías, Arillo & Subías 1997, 300–301, figs 2–3.

Material examined. C44: 18.VII.2006 (1); **C72**: 15.XI.2006 (1); **C75**: 24.V.2006 (1); 18.VII.2006 (1); 15.XI.2006 (1).

Geographic distribution. W-Mediterranean.

Notes. Typical element of Mediterranean habitats, able to tolerate mesophilous conditions.

Pheroliodidae

17. *Licnoliodes andrei* Grandjean, 1931

Licnoliodes Andrei: Grandjean 1931, 234–241, figs 4–5.

Material examined. C08: 25.III.2006 (2); **C75**: 24.V.2006 (23); 18.VII.2006 (23); 15.XI.2006 (12).

Geographic distribution. Palaearctic.

Notes. *Licnoliodes andrei* seems to be typical in soils rich in humus and organic matter.

Licnodamaeidae

18. *Licnodamaeus pulcherrimus* (Paoli, 1908)

Licnodamaeus pulcherrimus: Pérez-Iñigo 1970, 266–267, fig. 24.

Material examined. C02: 25.III.2006 (1); **C44**: 18.VII.2006 (2); **C72**: 15.XI.2006 (14); **C75**: 18.VII.2006 (5).

Geographic distribution. Palaearctic.

Notes. Typical element of xerophilous habitats.

Licnobelbidae

19. *Licnobelba latiflabellata* (Paoli, 1908)

Licnobelba latiflabellata: Pérez-Iñigo 1997, 71–73, fig. 17.

Material examined. C72: 15.XI.2006 (5).

Geographic distribution. W-Palaearctic.

Notes. Element of thermophilous woodlands.

Damaeidae

20. *Metabelbella interlamellaris* Pérez-Iñigo, 1987

Metabelbella interlamellaris: Pérez-Iñigo 1987, 211–212, fig. 28.

Material examined. C44: 18.VII.2006 (1); **C75**: 18.VII.2006 (3); 15.XI.2006 (1).

Geographic distribution. W-Mediterranean.

Notes. Element of thermophilous woodlands.

Cepheidae

21. *Cepheus pegazzanoae* Bernini & Nannelli, 1982

Cepheus pegazzanoae: Pérez-Iñigo 1987, 193, 197, fig. 71d.

Material examined. C44: 18.VII.2006 (1).

Geographic distribution. S-European.

Notes. Typical woodland species.

Microzetidae

22. *Microzetes adansoni* (Lions, 1966)

Nellacarus adansoni: Lions 1966, 795–807, figs 1–4.

Material examined. C75: 15.XI.2006 (1).

Geographic distribution. S-European.

Notes. *Microzetes adansoni* seems related to humus and litter of forest soils.

Amerobelbidae

23. *Amerobelba decedens* Berlese, 1908

Amerobelba decedens: Pérez-Iñigo 1997, 172–174, fig. 61.

Material examined. C08: 25.III.2006 (1).

Geographic distribution. Palaearctic.

Notes. Xero-thermophilous element.

24. *Mongaillardia aeoliana* (Bernini, 1979)

Amerobelba aeoliana: Bernini 1979a, 257–265, figs 1–4.

Material examined. C75: 18.VII.2006 (1); 15.XI.2006 (1).

Geographic distribution. Tyrrhenian. Italian endemism: the only previous citation of this species was from the Aeolian islands (Sicily).

Notes. According to the original description, samples were collected in a *Quercus ilex* woodland.

Damaeolidae

25. *Fosseremus laciniatus* (Berlese, 1905)

Fosseremaeus laciniatus: Weigmann 2006, 217, fig. 114a–c.

Material examined. C02: 25.III.2006 (3); **C44**: 18.VII.2006 (2); **C72**: 15.XI.2006 (2).

Geographic distribution. Cosmopolitan.

Notes. This ubiquitous element seems to prefer xeric conditions.

Eremaeidae

26. *Eueremaeus granulatus* (Mihelčič, 1955)

Eueremaeus granulatus: Pérez-Iñigo, 1997, 161–164, figs 57a–c.

Material examined. C44: 18.VII.2006 (4); **C75**: 24.V.2006 (2).

Geographic distribution. Holarctic.

Notes. In Europe this euryoecious species was collected only in Spain and in the Tavolara Archipelago (Sardinia).

Zetorchestidae

27. *Belorchestes gebennicus* Grandjean, 1957

Belorchestes gebennicus: Pérez-Iñigo 1997, 209–211, figs 78a–c.

Material examined. C75: 15.XI.2006 (1).

Geographic distribution. W-Mediterranean.

Notes. First citation for Italian soils. Until now *Belorchestes gebennicus* had been collected only in Spain and France. This species seems to prefer open areas.

28. *Zetorchestes falzonii* Coggi, 1898

Zetorchestes falzonii: Krisper 1984, 331–350, figs 1–10.

Material examined. C72: 15.XI.2006 (3).

Geographic distribution. Palaearctic.

Notes. Typical woodland species.

29. *Zetorchestes grandjeani* Krisper, 1987

Zetorchestes grandjeani: Pérez-Iñigo 1997, 215, fig. 80a–b.

Material examined. C72: 15.XI.2006 (3).

Geographic distribution. Palaearctic.

Notes. Typical woodland species.

Carabodidae

30. *Carabodes arduinii* Valle, 1955

Carabodes arduinii: Baratti & Bernini, 1994, 256–261, figs 27–46.

Material examined. C75: 24.V.2006 (1).

Geographic distribution. W-Mediterranean, excluding the westernmost regions (Morocco and western Spain).

Notes. Muscicolous species.

31. *Carabodes tyrrhenicus* Salomone, Avanzati, Baratti & Bernini, 2003

(Fig. 1a)

Carabodes tyrrhenicus: Salomone, Avanzati, Baratti & Bernini 2003, 126–130, figs 3–4.

Material examined. C75: 24.V.2006 (1).

Geographic distribution. Tyrrhenian. *Carabodes tyrrhenicus* has been collected from the Sicilian Channel (Pantelleria island), the Aeolian islands (Sicily), Corsica and the Tuscan Arcipelago. This species seems to be the most common *Carabodes* species in Sardinia.

Notes. *Carabodes tyrrhenicus* is usually found in humus and litter, but also in moss on the ground and on rocks.

Tectocepheidae

32. *Tectocepheus sarekensis* Trägårdh, 1910

Tectocepheus sarekensis: Weigmann 2006, 255–257, fig. 137d–f.

Material examined. C08: 24.V.2006 (1); **C44**: 18.VII.2006 (5); **C72**: 15.XI.2006 (1); **C75**: 24.V.2006 (1).

Geographic distribution. Cosmopolitan.

Notes. In Mediterranean ecosystems, species belonging to the genus *Tectocepheus* Berlese are known to be dominant in disturbed soils.

33. *Tectocepheus velatus* (Michael, 1880)

Tectocepheus velatus: Weigmann 2006, 255-257, fig. 137a–c.

Material examined. C02: 25.III.2006 (2); **C08**: 24.V.2006 (1); **C44**: 18.VII.2006 (29); **C72**: 15.XI.2006 (24); **C75**: 24.V.2006 (8); 18.VII.2006 (6).

Geographic distribution. Cosmopolitan.

Notes. See above species.

Oppiidae

34. *Berniniella aeoliana* (Bernini, 1973)

Oppia aeoliana: Bernini 1973, 395–399, figs. 12 a–c.

Material examined. C75: 15.XI.2006 (5).

Geographic distribution. W-Mediterranean. *Berniniella aeoliana* has been collected from the Aeolian islands (Sicily), the Tuscan archipelago, Corsica and Algeria.

Notes. Xerophilous element.

35. *Berniniella bicarinata* (Paoli, 1908)

Berniniella bicarinata: Subías & Arillo 2001, 144, 153–154, fig. 51b.

Material examined. C08: 25.III.2006 (1); **C75**: 24.V.2006 (2).

Geographic distribution. Palaearctic.

Notes. This species seems to prefer woodlands.

36. *Dissorhina ornata* (Oudemans, 1900)

Dissorhina ornata: Subías & Arillo 2001, 126–128, fig. 44a–b.

Material examined. C02: 25.III.2006 (3); **C75**: 24.V.2006 (15); 15.XI.2006 (15).

Geographic distribution. Holarctic.

Notes. This species seems to prefer woodlands.

37. *Lauroppia similifallax* Subías & Minguez, 1986

Lauroppia similifallax: Subías & Arillo 2001, 133–134, fig. 46b.

Material examined. C02: 25.III.2006 (2); **C44**: 18.VII.2006 (5); **C72**: 15.XI.2006 (5); **C75**: 24.V.2006 (1); 15.XI.2006 (8).

Geographic distribution. S-European.

Notes. Species previously collected in Italy only at the "Pietraporciana" and "Lucciolabella" Nature Reserves (Siena province, Tuscany) (Migliorini *et al.* 2002). It seems to be a forest element. Due to its small size, *Lauroppia similifallax* lives deep in the soil (Subías & Arillo 2001).

38. *Medioppia media* (Mihelčič, 1956)

Medioppia media: Subías & Arillo 2001, 102–104, fig. 35a–b.

Material examined. C08: 25.III.2006 (6).

Geographic distribution. Mediterranean.

Notes. Xerophilous element.

39. *Medioppia subpectinata* (Oudemans, 1900)

Medioppia subpectinata: Subías & Arillo 2001, 101–102, fig. 34d.

Material examined. C08: 25.III.2006 (2); **C44**: 18.VII.2006 (2); **C72**: 15.XI.2006 (15); **C75**: 15.XI.2006 (1).

Geographic distribution. Holarctic.

Notes. Typical element of thermophilous woodlands.

40a. *Microppia minus minus* (Paoli, 1908)

Microppia minus minus: Subías & Arillo 2001, 115–117, fig. 40a–b.

Material examined. C02: 25.III.2006 (32); **C44**: 18.VII.2006 (73); **C72**: 15.XI.2006 (2); **C75**: 24.V.2006 (3); 15.XI.2006 (3).

Geographic distribution. Cosmopolitan.

Notes. *Microppia minus minus* is one of the commonest elements of all Mediterranean soils.

40b. *Microppia minus longisetosa* Subías& Rodriguez, 1988

Microppia minus longisetosa: Subías & Arillo 2001, 117–118, fig. 40c.

Material examined. C75: 24.V.2006 (4).

Geographic distribution. Cosmopolitan.

Notes. First citation for Italian soils. Details of the distribution of *M. minus longisetosa* are poorly known. Until now, *M. minus longisetosa* had been collected only in Spain, where it was collected together with *M. minus minus* by Subías and Rodriguez (1988) and in Argentina. The small size and similar shape of the sensillum has probably generated errors in past determinations of both subspecies. Although the collected specimens seem to correspond to the original description given by Subías and Rodriguez (1988) and by Subías and Arillo (2001), further investigations in order to evaluate taxonomic status of both entities will be the subject of a future research.

41. *Oppia denticulata* (G. Canestrini & R. Canestrini, 1882)

Oppia denticulata: Subías & Arillo 2001, 185–186, fig. 64a–b.

Material examined. C44: 18.VII.2006 (2); **C72**: 15.XI.2006 (8).

Geographic distribution. Palaearctic.

Notes. Typical element of thermophilous woodlands.

42. *Oppiella* (*Oppiella*) *nova* (Oudemans, 1902)

Oppiella (*Oppiella*) *nova*: Subías & Arillo 2001, 135–136, fig. 47a.

Material examined. C02: 25.III.2006 (5); **C08**: 24.V.2006 (2); **C44**: 18.VII.2006 (25); **C72**: 15.XI.2006 (11); **C75**: 15.XI.2006 (5).

Geographic distribution. Cosmopolitan.

Notes. This species seems to be one of the commonest elements of thermophilous woodlands.

43. *Oxyoppioides* Subías & Minguez sp.

Material examined. C44: 18.VII.2006 (1).

Notes. This specimen probably belongs to an undescribed species. The single specimen collected does not allow to carry out its description.

44. *Pluritrichoppia insolita* Subías & Arillo, 1989

Pluritrichoppia insolita: Subías & Arillo 2001, 182–184, fig. 63a–b.

Material examined. C08: 25.III.2006 (7).

Geographic distribution. W-Mediterranean.

Notes. This species is here firstly recorded for Italy. Until now, *Pluritrichoppia insolita* was considered an Iberian endemic and had been collected only in Sierra Nevada (South of Spain) in mesophilous habitats.

45. *Ramusella* (*Ramusella*) *gyrata* (Mahunka & Paoletti, 1984)

Bioppia gyrata: Mahunka & Paoletti, 1984, 112, figs 1–4.

Material examined. C44: 18.VII.2006 (2).

Geographic distribution. S-European. Until now *Ramusella gyrata* had been collected only in Northern Italy (Venetia region, Venezia province, Caorle).

Notes. This species was collected in open areas.

Quadroppiidae

46. *Quadroppia pseudocircumita* Minguez, Ruiz & Subías, 1985

Quadroppia pseudocircumita: Subías & Arillo 2001, 83–84, figs 28a–b.

Material examined. C02: 25.III.2006 (2); **C44**: 18.VII.2006 (2); **C72**: 15.XI.2006 (2).

Geographic distribution. Holarctic.

Notes. *Quadroppia pseudocircumita* seems to be a mesophilous element.

Suctobelbidae

47. *Suctobelba* Paoli spp.

Material examined. C08: 24.V.2006 (1).

Notes. The doubtful taxonomic status of this genus does not allow the discrimination of several species referable to it.

48. *Suctobelbella* Jacot spp.

Material examined. C02: 25.III.2006 (1); **C08**: 25.III.2006 (4); 24.V.2006 (3); **C75**: 24.V.2006 (3); **C44**: 18.VII.2006 (15); **C72**: 15.XI.2006 (2); **C75**: 18.VII.2006 (4); 15.XI.2006 (9).

Notes. The doubtful taxonomic status of this genus does not allow the discrimination of several species referable to it.

Cymbaeremaeidae

49. *Cymbaeremaus cymba* (Nicolet, 1855)

Cymbaeremaus cymba: Pérez-Iñigo 1997, 92–94, fig. 26a–b.

Material examined. C75: 24.V.2006 (1).

Geographic distribution. Palaearctic.

Notes. *Cymbaeremaus cymba* is an arboricolous species.

50. *Scapheremaeus reticulatus* (Berlese, 1910b)

Scapheremaeus reticulatus: Balogh 1943: 32, pl. VI, fig. 4.

Material examined. C08: 25.III.2006 (1).

Geographic distribution. European.

Notes. Species of thermophilous woodlands.

Micreremidae

51. *Micreremus brevipes* (Michael, 1888)

Micreremus brevipes: Weigmann 2006, 333, Abb. 177a–c.

Material examined. C02: 25.III.2006 (32); **C44**: 18.VII.2006 (73); **C72**: 15.XI.2006 (2); **C75**: 24.V.2006 (3); 15.XI.2006 (3).

Geographic distribution. Cosmopolitan.

Notes. *Micreremus brevipes* seems to be an arboricolous species.

Licneremaeidae

52. *Licneremaus licnophorus* (Michael, 1882)

Licneremaeus licnophorus: Pérez-Inigo 1993, 64, fig. 21a–b.

Material examined. C75: 24.V.2006 (1); 18.VII.2006 (1).

Geographic distribution. Holarctic.

Notes. *Licneremaeus licnophorus* is a typical thermophilous element of Mediterranean soils.

Passalozetidae

53. *Passalozetes africanus* Grandjean, 1932
(Fig. 1b)

Passalozetes africanus: Pérez-Iñigo 1993, 50, fig. 16a–c.

Material examined. C08: 25.III.2006 (1); **C75**: 24.V.2006 (11); 18.VII.2006 (6).

Geographic distribution. Palaearctic.

Notes. Typical thermophilous element of Mediterranean soils.

Oribatulidae

54. *Oribatula tibialis* (Nicolet, 1855)

Oribatula tibialis: Pérez-Iñigo 1993, 230–231, fig. 83a–b.

Material examined. C02: 25.III.2006 (6); **C08**: 25.III.2006 (1); 24.V.2006 (7); **C44**: 18.VII.2006 (2); **C75**: 24.V.2006 (25); 18.VII.2006 (50); 15.XI.2006 (24).

Geographic distribution. Holarctic.

Notes. Ubiquitous element of Mediterranean soils.

55. *Zygoribatula propinqua* (Oudemans, 1902a)

Zygoribatula propinqua: Pérez-Iñigo 1993, 226, fig. 80c.

Material examined. C08: 24.V.2006 (1).

Geographic distribution. *Zygoribatula propinqua* seems to have a Palaearctic distribution.

Notes. *Zygoribatula propinqua* seems to be an arboricolous species.

Scheloribatidae

56. *Hemileius initialis* (Berlese, 1908)

Hemileius initialis: Pérez-Iñigo 1993, 267–268, fig. 94b–c.

Material examined. C75: 24.V.2006 (8); 18.VII.2006 (4); 15.XI.2006 (24).

Geographic distribution. Cosmopolitan.

Notes. Ubiquitous element.

57. *Scheloribates pallidulus* (C.L. Koch, 1841)

Scheloribates pallidulus: Pérez-Iñigo 1993, 257, fig. 91a.

Material examined. C02: 25.III.2006 (12); **C08**: 25.III.2006 (18); **C44**: 18.VII.2006 (34); **C72**: 15.XI.2006 (5); **C75**: 24.V.2006 (10); 18.VII.2006 (1); 15.XI.2006 (112).

Geographic distribution. Cosmopolitan.

Notes. *Scheloribates pallidulus* is a typical element of xeric and open areas but frequently it can also be collected in moister conditions.

Chamobatidae

58. *Chamobates borealis* (Trägårdh, 1902)

Chamobates borealis: Pavlitshenko 1994, 76, fig. 73.

Material examined. C08: 25.III.2006 (12); 24.V.2006 (27); **C44**: 18.VII.2006 (32); **C75**: 24.V.2006 (37); 15.XI.2006 (1).

Geographic distribution. Holarctic.

Notes. *Chamobates borealis* is a woodland element.

59. *Chamobates subglobulus* (Oudemans, 1900)

Chamobates subglobulus: Pérez-Iñigo 1993, 170, fig. 63c.

Material examined. C02: 25.III.2006 (2); **C08**: 25.III.2006 (1); **C75**: 24.V.2006 (25); 18.VII.2006 (1); 15.XI.2006 (40).

Geographic distribution. European.

Notes. Xerophilous element.

Ceratozetidae

60. *Ceratozetes laticuspidatus* Menke, 1964

Ceratozetes laticuspidatus: Pérez-Iñigo 1993, 195, fig. 70d.

Material examined. C72: 15.XI.2006 (4); **C75**: 15.XI.2006 (6).

Geographic distribution. S-European.

Notes. *Ceratozetes laticuspidatus* is common in thermophilous habitats.

Mycobatidae

61. *Punctoribates punctum* (C.L. Koch, 1839)

Punctoribates punctum: Pavlitshenko 1994, 75, fig. 54.

Material examined. C75: 18.VII.2006 (3).

Geographic distribution. Cosmopolitan.

Notes. *Punctoribates punctum* is typical in open grassland and is a dominant species in disturbed soils.

Phenopelopidae

62. *Eupelops subexutus* (Berlese, 1916)

Eupelops subexutus: Bernini 1973, 444–451, figs 29a–d, 30a–e.

Material examined. C08: 24.V.2006 (1).

Geographic distribution. S-European.

Notes. *Eupelops subexutus* seems to prefer xeric conditions.

Oribatellidae

63. *Ophidiotrichus oglasae* Bernini, 1975

Ophidiotrichus oglasae: Bernini 1975, 484–489, figs 17a–f, 18a.

Material examined. C44: 18.VII.2006 (1).

Geographic distribution. Tyrrhenian. Italian endemism: the only previous citation of this species was from the Tuscan Archipelago (Montecristo Island).

Notes. According to the original description, samples were collected in humus and litter of *Quercus ilex*.

Achipteriidae

64. *Achipteria coleoptrata* (Linnaeus, 1758)

Achipteria coleoptrata: Pérez-Iñigo 1993, 129, fig. 48c.

Material examined. C72: 15.XI.2006 (23).

Geographic distribution. Holarctic.

Notes. *Achipteria coleoptrata* seems to prefer grasslands.

Galumnidae

65. *Acrogalumna longipluma* (Berlese, 1904)

Acrogalumna longiplumus: Pérez-Iñigo 1993, 97, fig. 33B.

Material examined. C75: 24.V.2006 (5); 15.XI.2006 (6).

Geographic distribution. Cosmopolitan.

Notes. Little is known of the biology of this species even if it seems to prefer woodland sites.

66. *Allogalumna alamellae* (Jacot, 1935)

Allogalumna alamellae: Pérez-Iñigo 1993, 94, fig. 32B.

Material examined. C02: 25.III.2006 (1); **C08**: 25.III.2006 (1); **C75**: 24.V.2006 (2).

Geographic distribution. S-European.

Notes. *Allogalumna alamellae* seems to prefer mossy habitats.

67. *Galumna tarsipennata* Oudemans, 1914

Galumna tarsipennatum: Pérez-Iñigo 1993, 78–79, fig. 25c.

Material examined. C75: 15.XI.2006 (1).

Geographic distribution. Palaearctic.

Notes. *Galumna tarsipennata* is a ubiquitous species.

Faunistic results

During the present research 67 different species were extracted from soil samples, a relatively low number with respect to data from other Italian woodland sites, but the standardization of the experimental design did not allow for a greater number of species to be collected.

Unfortunately, the faunistic knowledge on oribatid mites for Sardinia is very limited, so it was impossible to compare the collected zoocoenoses with older data. In “Arachnida Acari - Checklist delle specie della fauna italiana” (Bernini *et al*. 1995) only 173 species were cited from the Sardinian islands and the more recent studies by Avanzati *et al.* (2003), with a revision of *Amerus troisii* (Berlese, 1883) (Ameridae), and Salomone *et al.* 2003, with a description of a new species of *Carabodes* (Carabodidae) add two other species to the list. These bibliographic data, together with the species identified in the present work, bring the total of species recorded from the Sardinian islands to 193.

Eurytopic and widespread species dominate the oribatid mite assemblages in this part of the provinces of Carbonia-Iglesias and Medio Campidano, but some rare and characteristic taxa are recorded (see Appendix 1). Noteworthy is the finding of three rare taxa never collected in Italy: *Belorchestes gebennicus*, *Microppia minus longisetosa*, and *Pluritrichoppia insolita*. The specimens of *Oxyoppioides* and *Thamnacarus* probably belong to undescribed species, but the single individuals collected for each taxon do not allow for their correct description.

Overall diversity and dominance

A total of 1,180 oribatid mites were extracted from soil samples (see Appendix 1). The total number of taxa (S) collected per site ranged from a minimum of 10 in C08b to a maximum of 27 in C44c. Oribatid mite mean abundance was highest at site C44 in July (51.4±37.8) and lowest at site C08b (9±6.1), while the Berger-Parker dominance index ranges between 0.36±0.2 in cork oak forest (C75c) and 0.6±0.29 in pineland (C08a) (Table 2). In general, *Quercus ilex* woodlands showed highest mean values of richness and abundance while highest mean values of dominance were measured in pineland.

TABLE 2. Site codes used in statistical and multivariate analyses: C08 = Pineland; C44 and C72 = Holm oak; C02 and C75 = Cork oak; sampling dates: a = 25.III.2006; b = 24.V.2006, c = 18.VII.2006; d = 15.XI.2006; mean ± standard deviation values relative to number of species (S) abundance (N) and Berger-Parker's index (BPi) at different sites.

COD	S	N	Bpi
C02a	5.4±3.85	18.8±18.73	0.38±0.23
C08a	4.8±3.27	12.4±11.33	0.6±0.29
C08b	3.8±1.3	9±6.12	0.57±0.17
C44c	10.4±3.85	51.4±37.78	0.45±0.11
C72d	8.8±2.28	47.8±18.38	0.54±0.1
C75b	9±2.64	38.2±30.72	0.36±0.05
C75c	6.8±3.03	27.2±14.34	0.49±0.23
C75d	10±2.34	31.2±8.84	0.36±0,2

One-way ANOVA analysis revealed significant differences in mean oribatid mite species diversity among sites ($F_{(4, 35)}=5.52$; $p<0.01$) and vegetation types ($F_{(2, 37)}=7.81$; $p<0.01$). The Duncan multiple range test detected significant differences ($p<0.05$) between the Valle Oridda pineland (C08) and the other sites. The average abundance of oribatids differed significantly among the coenoses ($F_{(2, 37)}=9.3$; $p<0.001$) and localities ($F_{(4, 35)}=5.04$; $p<0.01$). The Duncan test highlighted significant differences among the pineland and holm oak stands (C72 and C44) and among the P.ta Serra Pirastu cork oak woodland (C02) and holm oak sites (C02 and C75). Analysis of variance on mean values of the Berger-Parker index showed differences between coenoses ($F_{(2, 37)}=3.69$; $p<0.05$) and post-hoc test identified such differences to be between the cork oak forests and the pineland.

Multivariate analysis

Non-metric MDS ordination detected a clear separation between *Quercus suber*, *Q. ilex* and *Pinus* woodlands, showing well-defined clusters (Fig. 3). The SIMPER procedure, used to examine the contribution of each species to similarities among assemblages, showed how ubiquitous species such as *Oribatula tibialis* (32.65%) and the xerophilous *Chamobates subglobulus* (10.70% contribution) dominate the *Quercus suber* woodland assemblage, together with mesophilous species such as *Licnoliodes andrei* (15.93% contribution). The ubiquitous *Scheloribates pallidulus* (36.96% contribution), *Tectocepheus velatus* (26.09% contribution) and *Oppiella* (*O.*) *nova* (11.96% contribution) were dominant in *Quercus ilex* woodlands. The less heterogeneous pineland showed only *Chamobates borealis*, which with an 85.71% contribution represented the key-species in oribatid mite assemblages in pineland

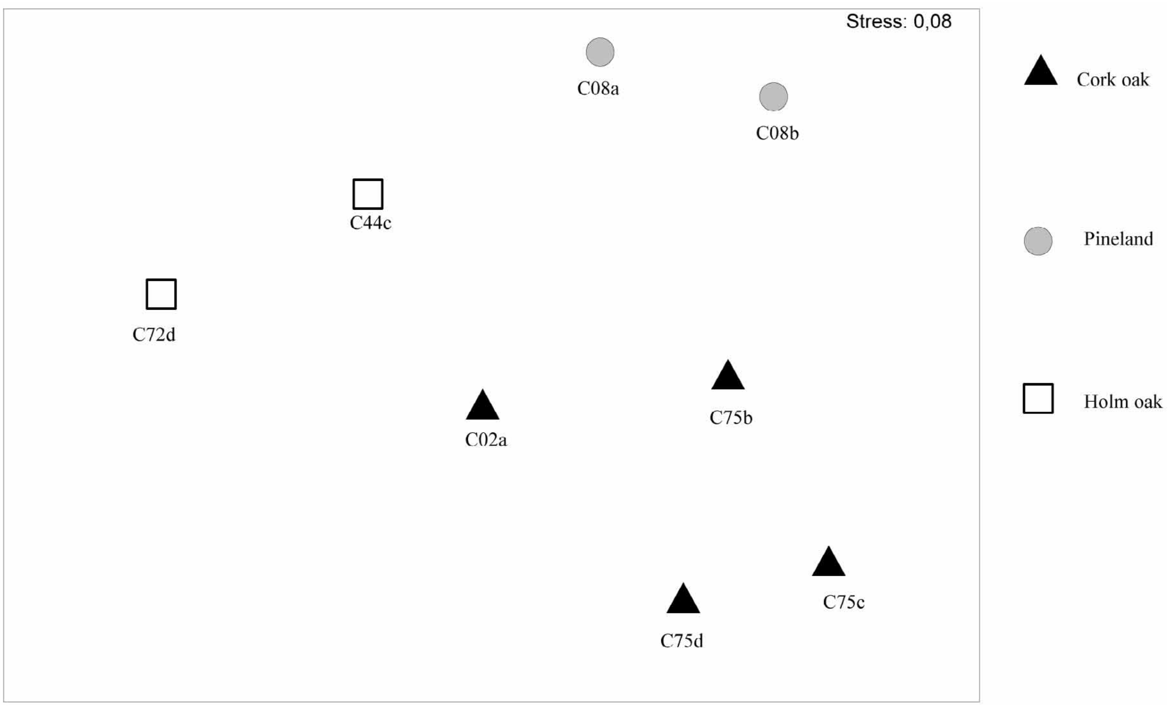

FIGURE 3. n-MDS ordination based on oribatid mite species abundance data from experimental areas. C08 = Pineland; C44 and C72 = Holm oak; C02 and C75 = Cork oak; sampling dates: a = 25.III.2006; b = 24.V.2006, c = 18.VII.2006; d = 15.XI.2006.

Discussion

Faunistic studies are important for better understanding evolutionary processes and managing ecosystems. Animals constitute complex communities, rich in species, which are the result of historical and biogeographical events and current ecological factors. The ecological information content of each species, the distribution of certain taxa or the unexpected presence of a species in a certain area provide indications about the quality of the environment by reflecting the characteristics and evolution of the habitat (Cancela da Fonseca 1991; Bergman *et al.* 1998). Although most of the collected species belong to the eurytopic and widespread contingent, functionally important species were not overlooked during the present research. The presence of xero-thermophilous taxa such as *Bursoplophora tyrrhenica*, *Eupelops subexutus*, woodland species such as *Steganacarus carusoi*, *Arthrodamaeus mediterraneus*, *Metabelbella interlamellaris*, *Lauroppia similifallax* and the muscicolous *Carabodes arduinii*, *C. tyrrhenicus* and *Allogalumna alamellae*, all typical of Spain, Maghreb, northern Sicily and western Italy, suggest a common ancient western origin of the species (Bernini 1979b) as the result of the complex tectonic events related to the Oligocenic detachment of the Corso–Sardinian microplate from the Iberian plate and its subsequent rotation towards the Italian peninsula (*cf*. Ketmaier *et al.* 2006). Rare entities were also collected: *Belorchestes gebennicus*, *Microppia minus longisetosa* and *Pluritrichoppia insolita* had never been found in Italy before; *Mongaillardia aeoliana* was known only from the Aeolian islands (Sicily), *Ophidiotrichus oglasae* was known only from Montecristo Island (Tuscan Archipelago) and *Brachychthonius hirtus* and *Ramusella* (*R*) *gyrata* were known only from continental Italy.

Results of n-MDS ordination indicate that the community structure of the soil fauna in the study area is able to clearly discriminate the investigated sites. Small portions of the territory with different vegetational, environmental and microclimatic characteristics were characterised by distinct edaphic populations showing a mixture of ‘common’ and ‘rare’ species. Soil fauna is generally sensitive to habitat evolution; however, sensitivity varies considerably among groups (Maraun & Scheu 2000) and oribatid mite numbers and dominance fluctuate considerably until a stable community has developed (Webb 1994; Lamoncha & Crossley 1998). The presence of species with great adaptive capabilities and high reproductive rates (Usher *et al.* 1982) such as the forest generalists *Microppia minus*, *Oppiella* (*O.*) *nova* and *Chamobates borealis*, and the ubiquitous *Tectocepheus sarekensis*, *T. velatus*, *Oribatula tibialis* and *Scheloribates pallidulus* take advantage of the frequent changes in the environment and of the availability of trophic niches. Their populations recover as the forest regenerates and coexist together with a large quantity of mesophilous, muscicolous and woodland species such as *Brachychthonius hirtus*, *Sellnickochthonius immaculatus*, *Licnoliodes andrei*, *Carabodes arduinii* and *C. tyrrhenicus*, all sensitive to certain moisture contents. The simplification in species composition and the drop in population density, related to the increase in dominance ascertained in the pineland, seem to demonstrate a clear difference between natural and artificial woodlands, the former representing buffer sites where environmental extremes have the least effect (Vreeken-Buijs *et al.* 1998). Within the more stable habitats, oribatid mites showed a high specific diversity with abundances well-distributed across the single species, whereas the pineland showed a reduced number of species and the presence of highly dominant oribatids such as *Chamobates borealis*.

Although results are only indicative and a large number of factors must be considered in their interpretation, such as evolution of woodlands, anthropic gradient, rare species, the significance of such rarity, etc., the present data indicate that: a) oribatid mites collected in this part of SW Sardinia maintain part of their original faunistic composition as a result of the geological evolution of the Mediterranean basin; b) habitat differences significantly affect species composition and population dynamics of the oribatid mite coenoses of the pineland seemed more simplified with respect to those of the natural woodlands.

Both these considerations are of interest and deserve further investigation in order to evaluate the evolution of woodlands in Sardinia.

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APPENDIX 1. Oribatid mite taxa collected from different habitats in the Carbonia-Iglesias and Medio Campidano provinces. Columns 2–8 give the number of individuals for each site (C08 = pineland; C44, C72 = *Quercus ilex* woodlands; C02, C75 = *Quercus suber* woodlands) and sampling dates (a= 25.III.2006; b= 24.V.2006, c= 18.VII.2006; d= 15.XI.2006) ; column 10 (Distr) reports the chorotype of each species according to the nomenclature of Vigna-Taglianti *et al.* (1993, 1999): COS = Cosmopolitan; EUR = European; HOL = Holarctic; MED = Mediterranean; PAL = Palaearctic; SEU = S-European; TYRR = Tyrrhenian; WME = W-Mediterranean; WPA = W-Palaearctic. The last column (Ecol) refers to the autoecological properties of the taxa: ARB = arboricolous species; GRA = grassland species; MES = mesophilous species; MUS = muscicolous species; THER = thermophilous species; THER.WOOD = thermophilous woodland species; UBI = ubiquitous species; WOOD = woodland species; XER = xerophilous species.

	C02a	**C08a**	**C08b**	**C44c**	**C72d**	**C75b**	**C75c**	**C75d**	**Distr.**	**Ecol**
ENIOCHTHONIIDAE										
Eniochthonius minutissimus								1	COS	THER.WOOD
COSMOCHTHONIIDAE										
Cosmochthonius lanatus							3		COS	XER
Phyllozetes emmae							4		COS	THER
SPHAEROCHTHONIIDAE										
Sphaerochthonius splendidus	17	2	1	3	1	1	6		COS	UBI
PROTOPLOPHORIIDAE										
Bursoplophora tyrrhenica						1	12	2	TYRR	XER
BRACHYCHTHONIIDAE										
Brachychthonius hirtus	1								EUR	MES
Liochthonius strenzkei		1							HOL	THER
Poecilochthonius italicus							2		HOL	THER
Sellnickochthonius immaculatus	1								HOL	MES
STEGANACARIDAE										
Steganacarus (*S.*) *carusoi*				2	3				WME	THER.WOOD
Steganacarus (*T.*) *brevipilus*				5	1			1	WPA	THER.WOOD
EUPHTHIRACARIDAE										
Rhysotritia ardua	2							4	COS	THER.WOOD
LOHMANNIIDAE										
Thamnacarus sp.	1									
NANHERMANNIIDAE										
Nanhermannia nana				1					COS	WOOD
HERMANNIELLIDAE										
Hermanniella granulata				2					PAL	WOOD
GYMNODAMAEIDAE										
Arthrodamaeus mediterraneus				1	1	1	1	1	WME	WOOD
PHEROLIODIDAE										
Licnoliodes andrei		2				23	23	12	PAL	MES
LICNODAMAEIDAE										
Licnodamaeus pulcherrimus	1			2	14		5		PAL	XER

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APPENDIX 1 (continued)

	C02a	C08a	C08b	C44c	C72d	C75b	C75c	C75d	Distr.	Ecol
LICNOBELBIDAE										
Licnobelba latiflabellata					5				WPA	THER.WOOD
DAMAEIDAE										
Metabelbella interlamellaris				1			3	1	WME	THER.WOOD
CEPHEIDAE										
Cepheus pegazzanoae				1			1		SEU	WOOD
MICROZETIDAE										
Microzetes adansoni								1	SEU	WOOD
AMEROBELBIDAE										
Amerobelba decedens		1							PAL	THER
Mongaillardia aeoliana							1	1	TYRR	THER.WOOD
DAMAEOLIDAE										
Fosseremus laciniatus	3			2	2				COS	XER
EREMAEIDAE										
Eueremaeus granulatus				4		2			HOL	XER
ZETORCHESTIDAE										
Belorchestes gebennicus								1	WME	XER
Zetorchestes falzonii					3				PAL	WOOD
Zetorchestes grandjeani				3					PAL	WOOD
CARABODIDAE										
Carabodes arduinii						1			WME	MUS
Carabodes tyrrhenicus Fig. 1a								2	TYRR	MUS
TECTOCEPHEIDAE										
Tectocepheus sarekensis			1	5	1	1			COS	UBI
Tectocepheus velatus	2		1	29	24	8	6		COS	UBI
OPPIIDAE										
Berniniella aeoliana								5	WME	XER
Berniniella bicarinata		1				2			PAL	THER.WOOD
Dissorhina ornata	3					15		15	HOL	WOOD
Lauroppia similifallax	2			5	5	1		8	SEU	WOOD
Medioppia media		6							MED	XER
Medioppia subpectinata		2		2	15			1	HOL	THER.WOOD
Microppia minus minus	32			73	2	3		3	COS	UBI
Microppia minus longisetosa						4			COS	XER
Oppia denticulata				2	8				PAL	THER.WOOD
Oppiella (*O.*) *nova*	5		2	25	11			5	COS	THER.WOOD
Oxyoppioides sp.				1						
Pluritrichoppia insolita		7							WME	MES
Ramusella (*R.*) *gyrata*				2					SEU	GRA

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APPENDIX 1 (continued)

	C02a	C08a	C08b	C44c	C72d	C75b	C75c	C75d	Distr.	Ecol
QUADROPPIIDAE										
Quadroppia pseudocircumita	2			2	2				HOL	MES
SUCTOBELBIDAE										
Suctobelba sp.		1								
Suctobelbella sp.	1	4	3	15	2	3	4	9		
CYMBAEREMAEIDAE										
Cymbaeremaus cymba						1			PAL	ARB
Scapheremaeus reticulatus		1							EUR	THER.WOOD
MICREREMIDAE										
Micreremus brevipes			1						COS	ARB
LICNEREMAEIDAE										
Licneremaus licnophorus						1	1		HOL	THER
PASSALOZETIDAE										
Passalozetes africanus Fig. 1b		1				11	6		PAL	THER
ORIBATULIDAE										
Oribatula tibialis	6	1	7	2		25	50	24	HOL	UBI
Zygoribatula propinqua			1						PAL	XER
SCHELORIBATIDAE										
Hemileius initialis						8	4		COS	UBI
Scheloribates pallidulus	12	18		34	112	10	1	5	COS	XER
CHAMOBATIDAE										
Chamobates borealis		12	27	32		37		1	HOL	WOOD
Chamobates subglobulus	2	1				25	1	40	EUR	XER
CERATOZETIDAE										
Ceratozetes laticuspidatus					4			6	SEU	THER
MYCOBATIDAE										
Punctoribates punctum							3		COS	UBI
PHENOPELOPIDAE										
Eupelops subexutus			1						SEU	XER
ORIBATELLIDAE										
Ophidiotrichus oglasae				1					TYRR	THER.WOOD
ACHIPTERIIDAE										
Achipteria coleoptrata					23				HOL	GRA
GALUMNIDAE										
Acrogalumna longipluma						5		6	COS	WOOD
Allogalumna alamellae	1	1				2			SEU	MUS
Galumna tarsipennata								1	PAL	UBI