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Faunistic and zoogeographic aspects of central Apennines centipede fauna (Chilopoda)

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SUMMARY

Sixty-seven species of centipedes (1 Scutigeromorpha, 31 Lithobiomorpha, 8 Scolopendromorpha, 27 Geophilomorpha) have been recorded in the area of peninsular Italy between the valleys of Ombrone and Foglia Rivers to the north and Volturno and Fortore Rivers to the south (Apenninic and Anti-Apenninic limestone ranges, hilly and flatlands areas along the Tyrrhenian and Adriatic coasts: nearly 52,700 km² wide). This number is equal to about the 42% of the total centipede species recorded in Italy (160) and to about the 14% of those present in Europe (486). The species recorded, apart from those excluded because of uncertain taxonomic identity (3 species) or introduced (2 species), belong to the following main chorotypes (pattern of distribution) of the western Palearctic fauna: chorotypes of species widely spread in the Holoarctic Region (4: W-Palearctic, 1 species; Sibero-European, 1 species; Centralasiatic-European, 1 species; Turano-European, 1 species), 6.5%; chorotypes of species more or less widely spread in Europe (26: European, 8 species; Centraleuropean, 7 species; S-European, 10 species; W-European, 1 species), 41.9%; chorotypes of species more or less widely spread in the Mediterranean countries (16: Mediterranean, 10 species; W-Mediterranean, 5 species; E-Mediterranean, 1 species), 25.8%; endemics (16: Italian, 1 species; Alpino-Apenninic, 2 species; W-Alpino-Apenninic, 1 species; Apenninic, 11 species; Tyrrhenian, 1 species), 25.8%. The Mediterranean geophilomorph centipede *Schendyla armata* (Brölemann, 1901), previously known in Italy from Sardinia and Tuscany, was recorded for the first time in central Italy.

INTRODUCTION

The central Apennines is one of the more explored and better studied areas in Italy from faunistic and zoogeographic points of view (Ruffo, 1957; AA.VV., 1971; Vigna Taglianti, 1980; Ruffo and Vigna Taglianti, 1988; Ruffo and Stoch, 2006). However, there has been insufficient research focused in this region about centipedes, a group of terrestrial arthropods of reliable faunistic, biogeographic and ecological interest (Zapparoli and Minelli, 2006). Only recently a catalogue of the species has been published (Zapparoli, 2006a) in which, besides offering a critical synthesis of the published information, is reported a conspicuous number of unpublished faunistic records. This catalogue, together with some recent

ecological and faunistic notes (Zapparoli, 2006b, 2007; Fanfani et al., 2006; Zapparoli and Peroni, 2007; Zapparoli and Biondi, 2007), provides therefore an up-to-date picture of the knowledge on the composition, the detailed distributions and the local habitat preferences of the centipede fauna of the area.

In contrast with other Italian geographic districts, such as the south-eastern Alps, the western Alps, the Ligurian Apennines, the Calabrian-Lucano Apennines and Sardinia, for which there exist relatively complete and modern faunistic and zoogeographic studies (Minelli, 1983, 1991; Minelli and Zapparoli, 1985, 1992; Zapparoli, 1986, 1989), the central Apennines still lacks a comprehensive analysis of the fauna. Therefore, the object of this paper is to provide a general view of the present knowledge on the centipede fauna of the central Apennines and its zoogeographic significance.

STUDY AREA

The area taken under investigation in this study is the part of peninsular Italy that lies between the Ombrone and Foglia Rivers, to the north, and the Volturno and Fortore Rivers, to the south; the Ombrone and Volturno Rivers flow into the Tyrrhenian Sea, and the Foglia and Fortore Rivers flow into the Adriatic Sea. This area, which is near 52,700 km^2 wide, corresponds to the central sector of the Apennines Province (Ruffo and Vigna Taglianti, 2002; Minelli et al., 2006), and it includes seven administrative regions: Umbria, Lazio, Abruzzo and Molise in their entirety, and parts of Marches, Tuscany and Campania.

From an orographic point of view, three main parallel limestone mountain chains are generally recognized in this area. They run from north-west to south-east and are separated from one another by deep, wide valleys (Landi Vittorj, 1989). The more western chain is constituted, from the north to the south, by the Sabini (1,287 m), Prenestini (1,218 m), Simbruini (2,156 m), Ernici (1,951 m), and Cairo Mountains (1,669 m). The Reatini (2,213 m), Carseolani (1,803 m), Velino (2,487 m), Sirente (2,349 m) Mountains, as well as Marsicano Mountain (including the reliefs of the National Park of Abruzzo, 2,000-2,400 m) and the Matese Massif (2,050 m) are considered the central part of the system. The more oriental chain comprises the massifs of Nerone (1,525 m), Catria (1,701 m), Sibillini (2,476 m) and Laga (2,455 m) Mountains, as well as the Gran Sasso (2,912 m) and Maiella (2,795 m) Mountains. Along the Tyrrhenian coast, separated by the valley of the Sacco River, there are some modest limestone groups; commonly known as the Anti-Apennines, represented by the Lepini (1,536 m), Ausoni (1,090 m) and Aurunci (1,533 m) Mountains.

Besides the limestone reliefs of the central and the Anti-Apennines, this study also includes the mountain and hilly areas of volcanic origin along the Tyrrhenian side (from north to south: Amiata Mountain, 1,738 m; Tolfa, 616

m; Cimini, 1,053 m; Vulsini, 631 m and Sabatini Mountains, 612 m; Albani Hills, 949 m), as well as the coastal and sub-coastal plains separing each other these reliefs (the southern part of the Maremma, Maccarese, Castel Porziano, Castel Fusano, the Campagna Romana and the Pontina plain). Moreover, are taken in consideration the mainly marly-argillaceous and arenaceous-marly hilly reliefs of Miocenic and Pliocenic origin along the Adriatic side.

METHODS

The present faunistic and zoogeographic analyses were done based on the data published by Zapparoli (2006a), which the scientific nomenclature, the information on the general and local distribution and the local habitat preferences of the species were used as well as the main chorotypes (patterns of distribution) attributed according to Vigna Taglianti et al. (1992, 1999). The data reported in Zapparoli and Minelli (2006), Fanfani et al. (2006), Zapparoli (2006b, 2007), Zapparoli and Peroni (2007) and Zapparoli and Biondi (2007) were also considered; further records are detailed in the text. Available nomenclatural updating (Bonato and Minelli, 2008) are also considered. The introduced species (*Lamyctes emarginatus, Lithobius peregrinus*) and those of uncertain taxonomic identity (*Lithobius biporus, Schendyla aternana, S. viridis*) were excluded from the zoogeographic analysis.

The faunistic analysis was moreover carried out on the basis of the species distributions (presence/absence) in natural geographic units. These units, in some cases difficult to characterize by precise physical borders, were roughly defined and listed on an approximate geographic order from west to east and from north to south as follows (the abbreviations used in Tab. I and II are given in parentheses):

Tyrrhenian flat lands and mid-valley of Tevere River

1. Southern sector of Tuscan Maremma, including the hilly area near Scansano, the Uccellina Mountains, Argentario Mountain, and northern Lazio (Tuscia) (Mam): between the valley of the Ombrone River to the north, the valley of the Mignone River to the south, the Tyrrhenian Sea coast to west, the western slopes of Amiata, Vulsini and Vicani Mountains to the east and south.

2. the Campagna Romana, including the Latial Maremma, Maccarese, Castel Porziano, and Castel Fusano (Cam): the low Tevere River basin, from the confluence of the Farfa River to the Tyrrhenian Sea, between Soratte Mountain to the north, the southern and oriental slopes of the Sabatini Mountains to the north-west, the western and southern slopes of the Sabini, Tiburtini, Prenestini Mountains and of the Albani Hills to the east, and the Torto River to the south-east.

3. Pontina Plain, including Circeo Mountain (Ppo): from the Torto River to the north-west to the valley of the Amaseno River to the south-east, from the slopes of the Albani Hills and the Lepini Mountains to the north and north-east, to the Tyrrhenian Sea to the south-west and south.

4. Mid-Tevere River basin, including the Chiana Valley, the area of Trasimeno Lake, and the Martani, Amerini and Soratte Mountains (Tev): from Sansepolcro to the north, to the confluence of the Farfa River to the south, between the oriental slopes of Amiata, Vulsini, Cimini and Vicani Mountains to the west and the western slopes of the Umbrian-Marchigian Apennines and the valley of the Nera River to the east.

Volcanic sectors of the Tyrrhenian coast

5. Amiata Mountain (Ami), including the Civitella, Labbro, and Cetona Mountains and the adjacent reliefs: between the valley of the Orcia River to the north, the valley of the Ombrone River to west, the Maremma to the south, and the Chiana Valley and the Paglia River to the east.

6. Vulsini Mountains (Vul): between the valley of the Paglia River (including Rufeno Mountain) to the north, the valley of the Fiora River to the north-west, the northren Lazio (Tuscia) to the south, and the valley of the Tevere River to the east.

7. Cimini and Vicani Mountains (Cim): between the valley of the Vezza River to the north, the valley of the Mignone and Biedano Rivers to the west, the valley of the Treia River to the south, and the valley of the Tevere River to the east.

8. Tolfa Mountains (Tol): between the valley of the Mignone River to the north-east and to the north-west, and the Tyrrhenian Sea to the west and the south.

9. Sabatini Mountains (Sba): the hilly reliefs around the Bracciano, Martignano and Monterosi Lakes, including Baccano valley, between the valley of the Treia River to the north, the Tolfa Mountains to the west, the Campagna Romana to the south and the valley of the Tevere River to the east.

10. Albani Hills (Alb): between the Campagna Romana to the north and to the west, the Lariano and Valmontone saddle to the south-east and the Pontina plain to the south and the south-east.

Anti-Apennines

11. Lepini Mountains (Lep): between the Lariano and Valmontone saddle to the north-west, the Pontina plain to the south-west, the valley of the Amaseno River to the south-east, and the valley of the Sacco River to the north-east.

12. Ausoni-Aurunci Mountains (Aus): between the Latina Valley (Sacco and Liri Rivers) to the north, the valley of the Amaseno River to the north-west and west, the Tyrrhenian Sea to the south, and the valley the Garigliano River to the east.

Western Apennines chains

13. Sabini, Cornicolani, Lucretili, Carseolani Mountains, and Cicolano (Sbi): between the valley of the Nera River to the north-west, the valley of the Tevere River and the Campagna Romana to the south-west, the valley of the Aniene River to the south-east, and the valley of the Salto and Velino Rivers to the north-east.

14. Prenestini and Ruffi Mountains: between the valley of the Aniene River to the north and to the east, the Campagna Romana to the west, and the Albani Hills and valley of the Sacco River to the south.

15. Simbruini-Ernici Mountains (Ern): between the high valley of the Aniene River to the north-west, the Sacco River to the west and to the south, and the Liri River to the east.

16. Cairo Mountain (Cai): between the valley of the Melfa River to the north-west and the west, the valley of the Liri River to the south, the valley of the Volturno River to the east, and the Mollarino and the Chiaro Rivers to the north-east and the north.

Central Apennines chains

17. Reatini Mountains (Rea): between the Nera River to the north and north-west and the valley of the Velino River to the south-west and south-east.

18. Velino-Sirente (Vel): between the valley of the Velino River to the north-west, the valley of the Sagittario River to the south-east, the valley of the Aterno River to the north-east, and the valley of the Salto River to the south-west; Nuria Mountain is also included in this sector.

19. Marsicano Mountain and adjacent reliefs of the National Park of Abruzzo (Mar): the high valley of the Sangro River.

20. The Matese Massif (Mat): between the valley of the Cavaliere, Rio and Biferno Rivers to the north, the valley of the Volturno River to the west and south-west, the valley of the Calore River to the south, and the valley of the Tammaro River to the east; the Sannio Mountains were also included in this sector.

Oriental Apennines chains

21. Umbrian-Marchigian Apennines (Umb): between the valley of Foglia River to the north and the valley of Chienti River to the south, including Subasio Mountain and the reliefs north-east of Spoleto.

22. Sibillini Mountains (Sib): between the valley of the Chienti River to the north and the valley of the Tronto River to the south.

23. Laga Mountains: between the valley of the Tronto River to the north and the valley of the Vomano River to the south; Campli and Fiori Mountains were included in this sector.

24. Gran Sasso (Sas): between the valley of the Vomano River to the north, the valley of the Aterno River to the west, and the valley of the Pescara River to the south.

25. Maiella (Mai): between the valley of the Pescara River to the north, the valley of the Gizio River to the west, and the valley of the Sangro River to the south; Morrone Mountain was also included in this sector.

Hilly Adriatic sector

26. Hills of the Adriatic site, including Conero Mountain (Adr): from the valley of the Foglia River to the north to the valley of the Fortore River to the south, from the eastern slopes of the oriental Apennines chains (Umbrian-Marchigian Apennines, Sibillini and Laga Mountains, the Gran Sasso, and Maiella) to the Adriatic sea coast.

RESULTS

Faunistic analysis

In the studied area 67 species of centipedes were found: 1 Scutigeromorpha, 31 Lithobiomorpha, 8 Scolopendromorpha, and 27 Geophilomorpha. Two species were introduced (*Lamyctes emarginatus*, *Lithobius peregrinus*), and three are of uncertain taxonomic status (*Lithobius biporus*, *Schendyla aternana*, *S. viridis*). The geophilomorph schendylid *Schendyla armata* (Brölemann, 1901) recorded in Lazio for the first time (province of Viterbo, surroundings of Tuscania, *Quercus suber* forest, 42°25'29" N, 11°54'20" E, 13.IV.2006, S. Pieri leg., 1 specimen, M. Zapparoli det., collection M. Zapparoli) must to be added to the 67 species already reported in Zapparoli (2006a) except *Stenotaenia linearis* C.L. Koch, 1835 (= *Geophilus linearis* C.L. Koch, 1835 not present in Central Italy according to Bonato and Minelli (2008). The list of species, each with the geographic sectors in which it is found and its assigned chorotype indicated, is reported in Tab. I.

Overall there is a relatively rich centipede fauna in the studied area, whose number of species corresponds to 41.9% of those reported in Italy (160; Zapparoli and Minelli, 2006) and to 13.8% of those present in Europe (486; Zapparoli and Minelli, 2006). Such richness also emerge from comparisons with other areas that differ in their geographic extension, environmental heterogeneity and degree of faunistic knowledge, both Apenninic, like Ligurian Apennines, Tuscan-Emilian Apennines, the southern Apennines, with 50-60 species (Chelazzi, 1970; Minelli and Zapparoli, 1985; Zapparoli, 1986; Zapparoli and Minelli, 2006), and Alpine, like the south-eastern Alps and the western Alps, both with 76 species, and the Ligurian Alps, with 52 species (Minelli and Zapparoli, 1985, 1992; Zapparoli, 1989; Minelli, 1991). Moreover, the number of reported species is higher than that of Sardinia and Sicily (49 and 47 respectively: Foddai et al., 1995, 1996; Zapparoli and Minelli, 2006).

The central Apennines is without a doubt one of the most intensely studied areas even in the rest of the Mediterranean basin, especially considering findings in much wider and ecologically more varied regions. For example, 50 species are known in the Iberian Peninsula (Zapparoli, unpublished data; probably an underestimated value) and 123 species in Anatolia (Zapparoli, 1999). The number of species reported in the studied area is very close to that estimated for Maghreb (70: Zapparoli, unpublished data) and it is two to three times higher than that of the Middle East (20-30: Zapparoli, unpublished data). These two areas, however, are still not well known, and are also not well suited for a consistent fauna of these arthropods, which mostly prefer forest habitats. The centipede fauna of the central Apennine region is less diverse than that of continental Greece (86: Zapparoli, 2002), of Bulgaria (105: Stoev, 2002) and of the former Yugoslavia (about 150: Kos, 1992; Stoev, 1997); these areas are also larger and ecologically more varied.

The number of species recorded in the individual geographic districts in which the studied area was divided (Tab. I) is highly heterogeneous. This is partially due to the different extension and environmental diversification of the areas, and in part to the various degrees of knowledge available for each. The greatest numbers of species have been recorded in the Campagna Romana (42) and in the mid-valley of Tevere River (41), in spite of the relative environmental uniformity and the extensive anthropic disturbance of these two areas. The more vast extension and the continual surveying to which these areas have been subjected since the second half of the 1800s may account for this result. Considerably fewer species have been observed in other flatland areas, such as the Tuscan Maremma (26) and the Pontina plain (25), which are ecologically monotone and anthropized but much less geographically extended.

A significant number of species are also present in the hilly territories of volcanic origin along the Tyrrhenian side (e.g. Cimini and Vicani Mountains: 39 species) as well as in the mountains areas of Anti-Apennines (e.g. Lepini Mountains: 39) and Apennines (e.g. Simbruini-Ernici Mountains: 37; Gran Sasso: 36; Sabini Mountains: 35, Matese: 36, Laga Mountains: 34). All of these regions are undoubtedly less wide but ecologically more evenly diversified and very well studied, especially in recent years. These values contrast with the lower values observed in some adjacent hilly and mountain areas, such as the Prenestini Mountains (28), the Ausoni-Aurunci Mountains (32), the Tolfa Mountains (28), and the Sabatini Mountains (22).

On the other hand, other mountain sectors, such as the Sibillini, Reatini, Cairo and Amiata Mountains, which are equally significant and have extension and habitat heterogeneity similar to that of the above mentioned districts, are

Tab. I - List of Chilopoda in the central Apennines and patterns of distribution of the species (chorotypes sensu Vigna Taglianti et al., 1993, 1999). For each species presence (+) in the different geographic sectors is indicated, see text for the abbreviations. Abbreviations of pattern of distribution and endemics species* are listed alphabetically: ALAP = Alpino-Apenninic*; ALWA = W-Alpino-Apenninic*; APPE = Apenninic*; CAE = Centralasiatic-European; CEU = Centraleuropean; EME = E-Mediterranean; EUR = European s. str.; ITAL = Italian*; MED = Mediterranean s. str.; SEU = S-European; SIE = Sibero-European; TUE = Turanic-European; TYRR = Tyrrhenian*; WEU = W-European; WME = W-Mediterranean; WPA = W-Palearctic

Geographic sectors / species	chorotypes	MAM	CAM	PPO	TEV	AMI	VUL	CIM	TOL	SBA	ALB	LEP	AUS	SIB	PRE	ERN	CAI	REA	VEL	MAR	MAT	UMB	SIB	LAG	SAS	MAI	ADR
Scutigeromorpha (1)																											
1. *Scutigera coleoptrata* (Linnaeus, 1758)	MED	+	+	+	+	–	+	+	+	+	+	+	+	+	+	+	+	–	–	–	–	–	–	+	+	+	+
Lithobiomorpha (31)																											
2. *Lamyctes emarginatus* (Newport, 1844)	–	+	+	–	–	–	–	+	–	–	+	–	–	+	–	–	–	–	–	+	–	–	–	–	+	–	+
3. *Eupolybothrus fasciatus* (Newport, 1845)	SEU.APPE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4. *E. grossipes* (C.L. Koch, 1847)	CEU	–	–	–	–	+	+	–	+	–	+	+	–	+	–	+	+	–	+	+	+	+	+	+	+	+	–
5. *E. imperialis* (Meinert, 1872)	SEU.APPE	+	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	–	–	+
6. *E. nudicornis* (Gervais, 1837)	WME	–	+	–	+	–	+	+	–	–	+	–	+	+	+	+	+	–	+	+	+	+	+	+	+	+	+
7. *Lithobius aleator* Verhoeff, 1925	SEU.APPE	–	+	+	+	–	–	+	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	+	–	–	–
8. *L. biporus* Silvestri, 1894	–	+	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	+
9. *L. calcaratus* C.L. Koch, 1844	WEU	+	+	+	+	–	+	+	+	–	+	–	–	+	+	–	+	+	+	+	+	+	+	+	+	+	+
10. *L. cassinensis* Verhoeff, 1925	SEU.APPE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
11. *L. castaneus* Newport, 1844	SEU	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
12. *L. erythrocephalus* C.L. Koch, 1847	EUR	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	+	+	–	–	+	+	+	+
13. *L. forficatus* (Linnaeus, 1758)	EUR	+	+	+	+	+	+	+	+	+	+	–	+	+	+	–	+	+	+	+	+	+	+	+	–	+	
14. *L. infossus* Silvestri, 1894	WME.TYRR	–	+	–	+	–	+	+	–	–	–	+	+	+	+	+	–	+	–	+	+	+	+	+	+	–	+
15. *L. lapidicola* Meinert, 1872	CEU	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
16. *L.* sp. cfr. *lucifugus* L. Koch, 1862	CEU.APPE	–	+	–	–	+	+	+	–	–	–	+	–	–	–	+	–	–	+	–	–	+	–	+	+	+	–
17. *L. macilentus* L. Koch, 1862	CEU	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
18. *L. melanops* Newport, 1845	EUR	–	+	–	–	–	–	+	–	+	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	–
19. *L. micropodus* Matic, 1980	SEU	–	+	–	+	–	+	+	+	+	–	+	+	+	–	+	+	–	+	–	+	+	–	+	+	–	–
20. *L. microps* Meinert, 1868	EUR	–	+	+	+	+	+	+	+	–	+	+	+	–	+	+	–	–	+	–	–	+	–	+	+	–	+
21. *L. minellii* Matic and Darabantzu, 1971	SEU.APPE	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	+	+	+	+	
22. *L. mutabilis* L. Koch, 1862	CEU	–	+	–	–	–	–	–	–	+	–	+	–	+	–	–	–	–	+	+	–	–	+	–	–	–	
23. *L. nocellensis* Verhoeff, 1943	SEU.APPE	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
24. *L. pasquinii* Matic, 1967	SEU.APPE	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	–	–
25. *L. peregrinus* Latzel, 1880	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–	+
26. *L. piceus* L. Koch, 1862	CEU	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
27. *L. punctulatus* C.L. Koch, 1847	SEU	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–
28. *L. romanus* Meinert, 1872	SEU.APPE	+	+	–	+	–	+	+	+	–	–	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–
29. *L. sphinx* (Verhoeff, 1942)	SEU.ALAP	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	+	–	–	–	+
30. *L. tricuspis* Meinert, 1872	CEU	–	+	–	–	+	+	+	+	–	+	+	+	+	+	+	–	–	+	+	+	+	+	+	+	+	–
31. *L. tylopus* Latzel, 1882	SEU.APPE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+	–	+	+	+	+
32. *Pleurolithobius patriarchalis* (Berlese, 1894)	EME	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Scolopendromorpha (8)																											
33. *Scolopendra cingulata* Latreille, 1829	MED	+	+	+	+	+	–	+	+	+	+	+	+	+	+	+	+	–	+	–	+	+	+	+	+	+	+
34. *S. oraniensis* H. Lucas, 1846	WME	+	–	–	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
35. *Cryptops anomalans* Newport, 1844	SEU	–	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	–	+	–
36. *C. croaticus* Verhoeff, 1931	SEU	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–
37. *C. hortensis* (Donovan, 1810)	CAE	–	+	–	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
38. *C. parisi* Brölemann, 1920	SEU	+	+	–	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+	+	+	+	+	–
39. *C. trisulcatus* Brölemann, 1902	MED	–	+	+	–	–	–	+	+	–	–	+	+	+	+	–	+	–	–	–	+	–	+	+	–	+	+
40. *C. umbricus* Verhoeff, 1931	SEU.ALAP	–	–	–	+	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Geophilomorpha (27)																											
41. *Himantarium gabrielis* (Linnaeus, 1767)	MED	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
42. *Stigmatogaster dimidiatus* (Meinert, 1870)	WME	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
43. *S. gracilis* (Meinert, 1870)	MED	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
44. *Dignathodon microcephalus* (Lucas, 1846)	MED	+	+	–	+	–	+	+	+	–	+	+	+	+	+	+	–	+	–	+	–	+	+	+	+	+	+
45. *Henia (Meinertia) bicarinata* (Meinert, 1870)	MED	+	+	+	–	–	–	+	–	–	+	+	–	+	–	+	–	–	–	+	+	–	–	–	–	–	+
46. *H. (Pseudochaetechelyne) brevis* (Silvestri, 1896)	WME	–	+	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
47. *H. (Chaetechelyne) montana* Meinert, 1870	SEU	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
48. *H. (Chaetechelyne) vesuviana* (Newport, 1845)	WME	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Tab. I - *(continue)*

Geographic sectors / species	chorotypes	MAM	CAM	PPO	TEV	AMI	VUL	CIM	TOL	SBA	ALB	LEP	AUS	SBI	PRE	ERN	CAI	REA	VEL	MAR	MAT	UMB	SIB	LAG	SAS	MAI	ADR
49. *Schendyla apenninorum* (Brölemann and Ribaut, 1911)	SEU.APPE	–	–	–	–	+	–	–	–	–	–	+	+	+	–	+	–	–	–	+	–	–	–	–	–	–	–
50. *S. armata* (Brölemann, 1901)	WME	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
51. *S. aternana* (Verhoeff, 1934)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
52. *S. carniolensis* Verhoeff, 1902	SEU	–	–	–	–	+	+	–	–	–	–	–	+	–	–	–	–	+	–	–	+	–	–	–	+	–	–
53. *S. montana* Attems, 1895	SEU	–	–	–	+	–	–	–	–	–	–	+	–	+	–	–	–	+	–	+	–	–	–	–	+	–	–
54. *S. nemorensis* (C.L. Koch, 1837)	EUR	+	+	+	+	+	+	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+
55. *S. viridis* Verhoeff, 1951	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
56. *Pachymerium ferrugineum* (CL. Koch, 1835)	WPA	+	+	+	+	–	–	+	+	+	+	–	+	+	+	+	+	+	–	+	+	+	–	+	–	+	+
57. *Clinopodes flavidus* C.L. Koch, 1847	TUE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
58. *Geophilus carpophagus* Leach, 1815	EUR	+	+	+	+	+	+	+	–	+	+	+	–	+	+	+	–	–	+	+	+	–	+	+	+	+	+
59. *G. flavus* (De Geer, 1778)	SIE	–	+	–	+	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
60. *G. insulptus* Attems, 1895	EUR	–	+	+	+	–	–	+	–	–	+	+	+	+	–	+	–	–	+	+	+	–	+	+	+	+	–
61. *G. osquidatum* Brölemann, 1909	SEU	–	+	+	+	–	–	+	+	–	–	+	–	–	–	–	–	–	+	–	+	–	–	–	+	+	–
62. *G. richardi* Brölemann, 1904	MED	–	–	–	+	–	+	+	+	–	+	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
63. *Stenotaenia romana* (Silvestri, 1894)	EUR.ALWA	–	+	+	+	–	–	–	–	–	+	+	–	+	–	+	–	+	–	–	–	–	–	–	–	–	–
64. *S. sorrentina* (Attems, 1903) (1)	EUR.ITAL	–	+	+	+	?	+	+	?	?	?	+	?	?	?	?	–	–	?	+	+	?	?	?	?	–	–
65. *Tuoba poseidonis* (Verhoeff, 1901)	MED	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
66. *Strigamia acuminata* (Leach, 1815)	CEU	–	–	–	+	+	+	+	–	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	–
67. *S. crassipes* (C.L. Koch, 1835)	EUR	+	+	+	+	–	+	+	+	+	+	+	–	+	–	+	+	–	+	+	+	+	+	+	+	+	+
Geographic sectors/species		MAM	CAM	PPO	TEV	AMI	VUL	CIM	TOL	SBA	ALB	LEP	AUS	SBI	PRE	ERN	CAI	REA	VEL	MAR	MAT	UMB	SIB	LAG	SAS	MAI	ADR
Total		26	42	25	41	24	31	39	28	22	32	39	32	35	28	37	22	21	30	31	36	32	25	34	36	32	34

(1) Most of Central Apennines records published by the Authors under *Geophilus linearis* C.L. Koch, 1837, an European species now in *Stenotaenia* C.L. Koch, 1847 whose presence is excluded from the area (Bonato and Minelli, 2008), must be probably assigned to *Stenotaenia sorrentina*; a critical evaluation of these uncertain data is necessary to reassess the local range of this species

still insufficiently explored and the numbers of species so far reported (21-25) are certainly less than what are actually there. Likewise the number of species actually present in areas like Maiella (32), Velino-Sirente (30), and Marsicano Mountains (31), whose species diversity values are similar to those of the Vulsini Mountains (31) and Albani Hills (32), of much lower altitude, are probably underestimated. The numbers of species present along the hills of the Adriatic side (34) and in the Umbrian-Marchigian Apennines (32) are also likely to be underestimated.

Zoogeographic analysis

According to the analysis of main chorotypes conducted on 62 species, the centipede fauna of the central Apennines is not only rich, but also relatively varied from zoogeographic point of view (Tab. II and III, Fig. 1). Indeed it is comprised by:

– a rather consistent endemic component, slightly less than 26% (16 species) of the total centipede fauna, two thirds of which are represented by Lithobiomorpha; these species are mainly Apenninic (11), with a few Alpino-Apenninic (2), and a single Italian, W-Alpino-Apenninic and

Tab. II - Percentages distribution of chorotypes and endemic species of central Apennines centipede fauna in the sectors of the studied area; for each area (see text for the abbreviations) the number of species considered is indicated (the introduced species and those with uncertain taxonomy were excluded); abbreviations used for the main chorotypes: OLO = chorotypes of species widely spread in the Holoarctic region, EUR = chorotypes of species more or less widely spread in Europe, MED = chorotypes of species more or less widely spread in the Mediterranean countries; Italian endemic species = END

Geographic areas	number of species	Main chorotypes			
		OLO	EUR	MED	END
Tyrrhenian flat lands and mid-valley of Tevere River					
1. Mam	24	8.3	29.2	41.6	20.8
2. Cam	41	9.7	41.5	26.8	22.0
3. Ppo	25	8.0	44.0	28.0	20.0
4. Tev	40	10.0	40.0	25.0	25.0
Volcanic sectors of the Tyrrhenian coast					
5. Ami	24	4.2	54.2	20.8	20.8
6. Vul	31	6.4	51.6	22.6	19.3
7. Cim	38	10.5	44.7	26.3	18.4
8. Tol	28	10.7	42.8	32.1	14.3
9. Sba	21	14.3	57.6	23.8	14.3
10. Alb	30	10.0	50.0	26.7	13.3
Anti-Apennines					
11. Lep	39	5.1	43.6	23.1	28.2
12. Aus	32	9.4	37.5	31.2	21.9
Western Apennines chains					
13. Sbi	34	8.8	47.1	23.5	20.6
14. Pre	28	10.7	42.8	28.6	17.8
15. Ern	37	8.1	40.5	24.3	27.1
16. Cai	22	13.6	45.4	31.8	9.1
Central Apennines chains					
17. Rea	21	14.3	42.8	14.3	28.6
18. Vel	29	6.9	58.6	20.7	13.8
19. Mar	30	10.0	60.0	13.3	16.6
20. Mat	36	8.3	55.5	22.2	13.9
Oriental Apennines chains					
21. Umb	32	9.4	50.0	21.9	18.7
22. Sib	25	8.0	56.0	24.0	12.0
23. Lag	34	8.8	47.1	23.5	20.6
24. Sas	34	5.9	52.9	20.6	20.6
25. Mai	31	9.7	45.2	25.8	19.3
Hilly Adriatic sector					
26. Adr	31	9.7	29.0	32.2	29.0

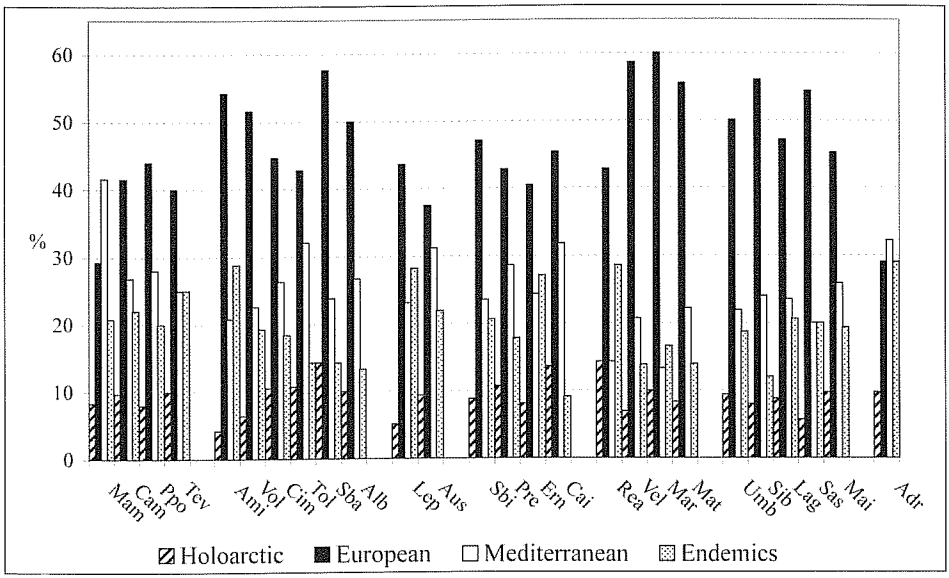

Fig. 1 - Percentages of main chorotypes (Holoarctic, European, Mediterranean) and Italian endemic species in the centipede fauna of the central Apennines; see text for the abbreviations

Tyrrhenian endemic species respectively; moreover, it should be noted that the central Apennine region has approximately a third of the centipede species exclusive to the Italian fauna, 48 according to Foddai et al. (1995), even if this estimate is probably in excess given the uncertain validity of some taxa (Zapparoli and Minelli, 2006);

– a percent lightly greater than 50% of northern elements, Holarctic (4 species) and especially European *sensu lato* species, sixty percent of the former represented by lithobiomorph species; among the European species, the S-European (10 species) and the Centraleuropean (7 species) species are prevalent; moreover, the European component is more consistent in the more internal Apennine areas, which are part of the central mountain chain (Reatini, Velino-Sirente, Marsicano, Matese Mountains), and, secondarily, in areas of the more oriental Apennine chains (Catria, Nerone, Sibillini, Laga, Gran Sasso, Maiella Mountains); lower values were observed in the reliefs of the western mountain chains (Sabini, Prenestini, Simbruini-Ernici, Cairo Mountains) and of the Anti-Apennines mountains (Lepini and Ausoni-Aurunci Mountains); intermediate values were observed in the hilly areas of volcanic origin of the Tyrrhenian side (Amiata, Tolfa, Cimini-Vicani, Sabatini Mountains, and Albani Hills); in the flatlands and hilly areas, in particular those along the Adriatic side, the consistency of this component is, on the contrary, relatively modest;

Tab. III - Zoogeographic summary of the Chilopoda of the central Apennines (n = 62); for each chorotype and recurrent patterns of endemic species the numerical code based on Vigna Taglianti et al. (1992, 1999) is given

A. MAIN CHOROTYPES

1. CHOROTYPES OF SPECIES WIDELY SPREAD IN THE HOLOARCTIC REGION (4 species; 6.5%)

1.03. W-Palearctic (1)
Pachymerium ferrugineum

1.05. Sibero-European (1)
Geophilus flavus

1.07. Centralasiatic-European (1)
Cryptops hortensis

1.10. Turano-European (1)
Clinopodes flavidus

2. CHOROTYPES OF SPECIES MORE OR LESS WIDELY SPREAD IN EUROPE (26 species; 41.9%)

2.01. European (8)
Lithobius erythrocephalus
Lithobius forficatus
Lithobius melanops
Lithobius microps
Schendyla nemorensis
Geophilus carpophagus
Geophilus insculptus
Strigamia crassipes

2.03. Centraleuropean (7)
Eupolybothrus grossipes
Lithobius tricuspis
Lithobius lapidicola
Lithobius macilentus
Lithobius mutabilis
Lithobius piceus
Strigamia acuminata

2.04. S-European (10)
Lithobius castaneus
Lithobius micropodus
Lithobius punctulatus
Cryptops anomalans
Cryptops croaticus
Cryptops parisi
Henia montana
Schendyla carniolensis
Schendyla montana
Geophilus abbreviatus
Geophilus linearis
Geophilus osquidatum

2.05. W-European (1)
Lithobius calcaratus

3. CHOROTYPES OF SPECIES MORE OR LESS WIDELY SPREAD IN THE MEDITERRANEAN COUNTRIES (16 species; 25.8%)

3.01. Mediterranean (9)
Scutigera coleoptrata
Scolopendra cingulata
Cryptops trisulcatus
Himantarium gabrielis
Stigmatogaster gracilis
Dignathodon microcephalus
Henia bicarinata
Geophilus richardi
Tuoba poseidonis

Tab. III - (*continue*)

3.02. W-Mediterranean (6)	
Eupolybothrus nudicornis	
Scolopendra oraniensis	
Stigmatogaster dimidiatus	
Henia brevis	
Henia vesuviana	
Schendyla armata	
3.03. E- Mediterranean (1)	
Pleurolithobius patriarchalis	
B. ITALIAN ENDEMIC ELEMENTS (16 species; 25.8%)	
01. Italian (1)	
Stenotaenia sorrentina	European affinity
10. Alpino-Apenninc (2)	
Lithobius sphinx	S-European affinity
Cryptops umbricus	S-European affinity
11. W-Alpino-Apenninic (1)	
Stenotaenia romana	European affinity
13. Apenninic (11)	
Eupolybothrus fasciatus	S-European affinity
Eupolybothrus imperialis	S-European affinity
Lithobius aleator	S-European affinity
Lithobius cassinensis	S-European affinity
Lithobius sp. cfr. *lucifugus*	Centraleuropean affinity
Lithobius minellii	S-European affinity
Lithobius nocellensis	S-European affinity
Lithobius pasquinii	S-European affinity
Lithobius romanus	S-European affinity
Lithobius tylopus	S-European affinity
Schendyla apenninorum	S-European affinity
18. Tyrrhenian (1)	
Lithobius infossus	?

– a smaller percentage, slightly greater than 25%, of elements with a wide distribution in the Mediterranean basin, mostly belonging to the Mediterranean *sensu stricto* chorotype (9 species), a few W-Mediterranean (6 species), and only one E-Mediterranean; this component, of which the geophilomorphs are the major portion (60%), is mainly represented in the flatlands and hilly areas along the Adriatic and Tyrrhenian side, in particular the Tuscan Maremma and Tolfa Mountains.

Thus it should be possible to recognize in the centipede fauna as well those four components (eastern, western, southern and northern), not only in quality but also, as we will see, in quantity, already recognized by Ruffo (1971) for the fauna of central Apennines in general. Each of these four components is discussed below.

Eastern component

Among the species with an eastern geographic distribution, which is the lesser component of the centipede fauna of the area, only *Pleurolithobius patriarchalis*,

distributed in western Anatolia, continental and insular Greece, southern Bulgaria, Macedonia (FYROM), Albania, and Montenegro, can be mentioned. This species has also been reported in North Africa (Cirenaica) where perhaps it has been introduced. In Italy (Fig. 2), it is present in Puglia and Molise, and there have been

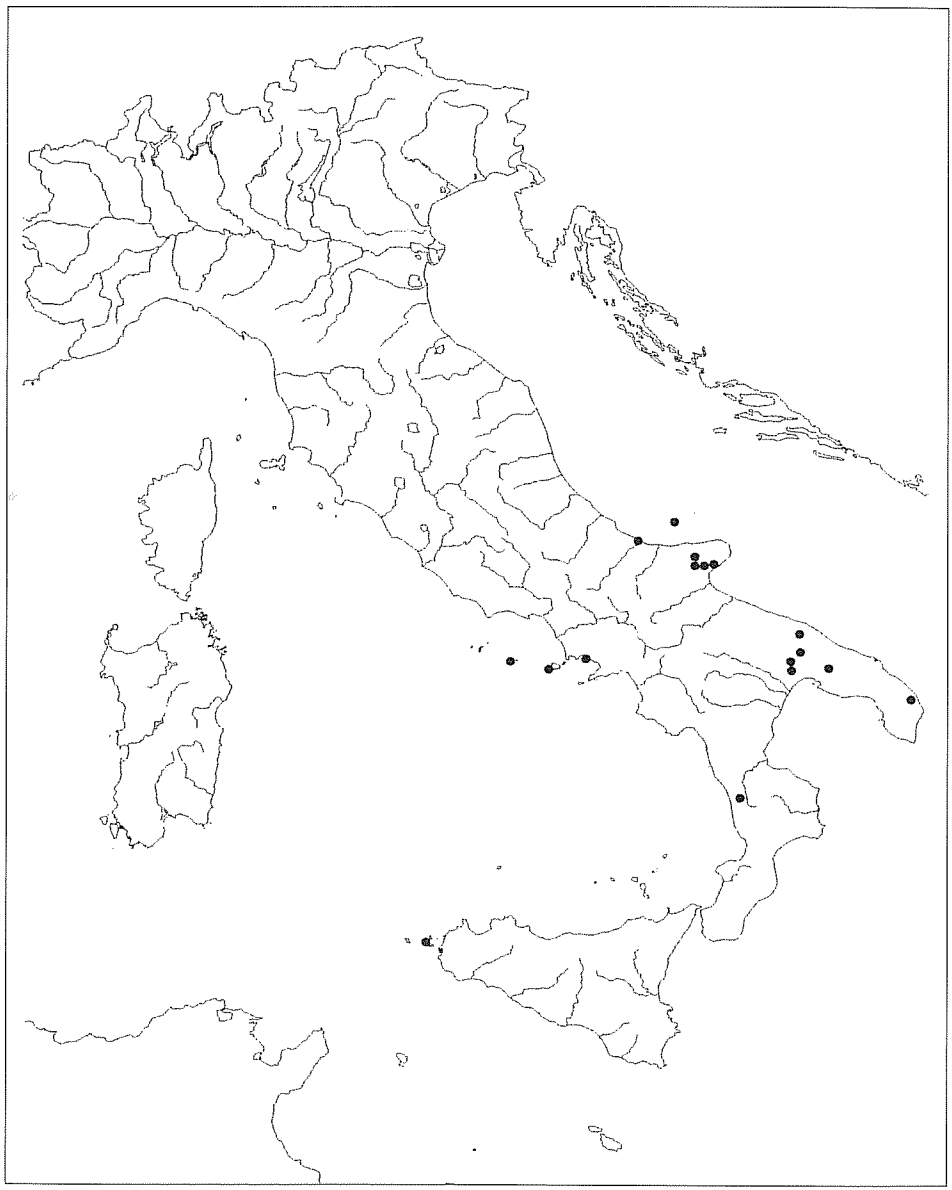

Fig. 2 - Italian distribution of *Pleurolithobius patriarchalis* (Berlese, 1894) (from Zapparoli and Minelli, 2006)

records, probably also related to introduced populations, from Lazio (Ponziane Isl.: Santo Stefano Is.), Campania, Calabria and Sicily (Egadi Isl.: Favignana Is.) (Zapparoli and Minelli, 1993). *P. patriarchalis* it is representative of a genus distributed in the southern Balkans and the Aegean-Anatolian area, which includes

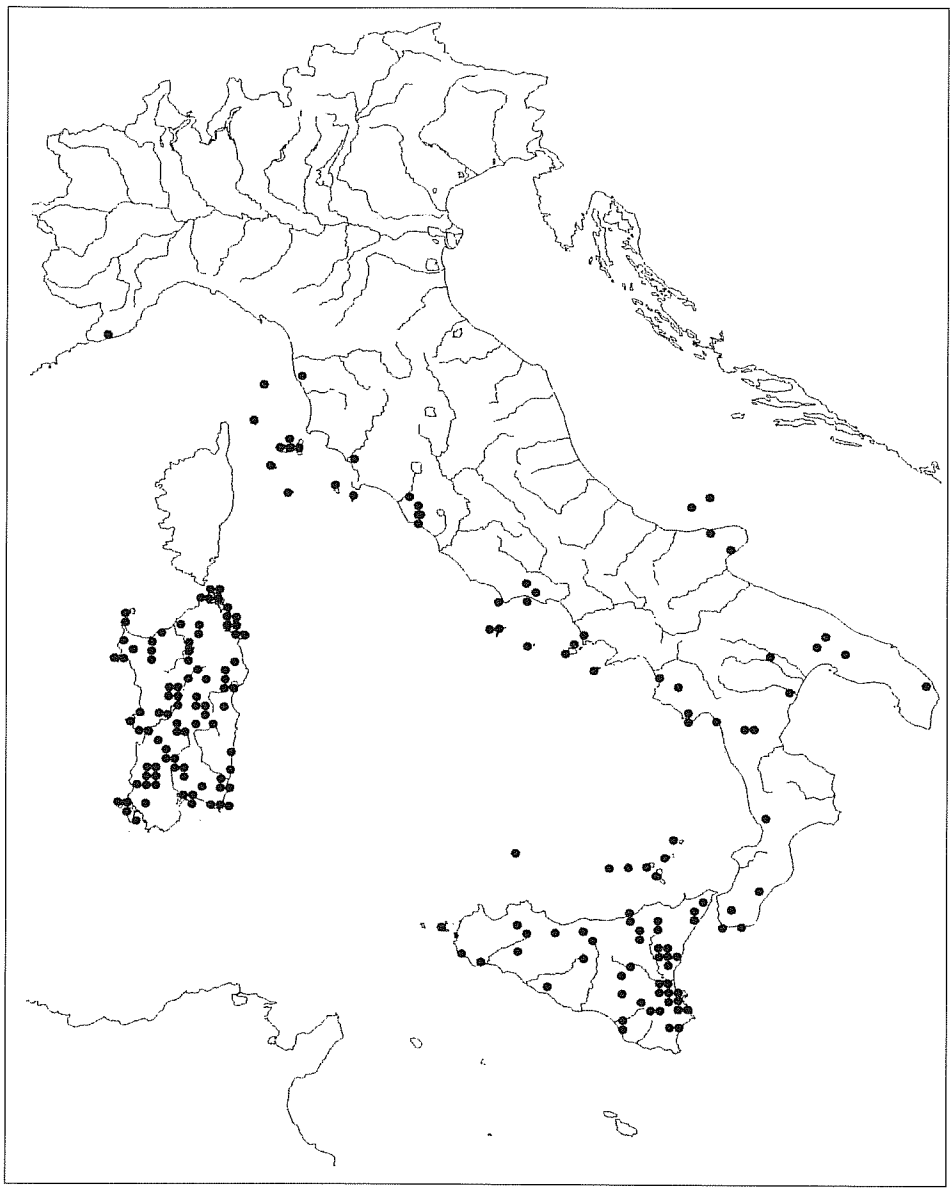

Fig. 3 - Italian distribution of *Scolopendra oraniensis* H. Lucas, 1846 (from Zapparoli and Minelli, 2006)

only one other species, *P. orientis* (Chamberlin, 1952), found in Greece and western Turkey (Zapparoli and Minelli, 1993). *P. patriarchalis* is a thermophilous species, quoted in Italy from sites between sea level and 250 m elevation, in open habitat or in sclerophyllous Mediterranean forests (Minelli and Iovane, 1987; Zapparoli and Minelli, 1993). In other regions of its geographic range this species is found at 1,000-1,400 m elevation (e.g., Bulgaria, 1,000 m: Stoev, 2002; continental Greece, 1,400 m: Zapparoli, 2002), where it also colonizes mixed and pure broad-leaf and montane and sub-montane conifer forests. The presence of *P. patriarchalis* in the central Apennines is rather marginal, as it has been recorded only in a single locality at the southern border of the studied area.

Western component

The group of species with a western distribution is larger. It includes both rather localized elements, only known in the studied area in few localities at low elevation, and species with a wider distribution. Among the more localized species is *Scolopendra oraniensis* (Fig. 3), belonging to the *S. canidens* Newport, 1844 group, including five species ranging in the Mediterranean basin. *S. oraniensis* is present in North Africa, the Iberian Peninsula (including the Balearic Islands), Corsica, Malta, Sicily, Sardinia and peninsular Italy, where it has a discontinuous distribution in the Tyrrhenian regions from Liguria to Calabria, in Basilicata and Puglia (Würmli, 1980). It is a thermophilous species, inhabiting open or sclerophyllous forests habitats, mostly from sea level to 600-700 m, reaching in Sicily near 1,500 m above sea level (Minelli and Iovane, 1987). The only known populations in central Italy are found along the Tyrrhenian side, in Tuscany (Uccellina Mountains) and in Lazio (Tolfa, Circeo, Mounts Ausoni-Aurunci).

Stigmatogaster dimidiatus is also a rather localized species in the studied area, widespread in Macaronesia, North Africa, the Iberian peninsula (including the Balearic Islands), south-western France and Italy, where it has been reported in a few localities in Piedmont, Liguria, Lazio, Abruzzo, Campania, and Sicily (including the Egadi, Pantelleria and Lampedusa islands). Its habitat preferences are not well known, but it is likely a thermophilous species. In central Italy it is only found in two sites, in Lazio (Mount Soratte, in the province of Rome) and in Abruzzo (Civitella Alfedena, in the province of L'Aquila).

Only a few findings have been reported for *Henia brevis*, which is distributed in southern France (Maritimes Alps), south-western Germany and Italy. In Italy, this species is widely distributed in the north-western regions, and sporadically distributed in the peninsular and insular regions. In central Italy, there are only four records in mid and low altitude areas of Tuscany, Umbria and Lazio.

The presence of *Schendyla armata* is of some interest. This species is tied to Mediterranean forest (*Quercus ilex*, *Q. suber*), and it is present in southern France, Sardinia, Tuscany and Lazio. In these latter two Italian regions, it has been reported only on single records at low altitude localities, Prato and Tuscania respectively.

Among the relatively common species is *Eupolybothrus nudicornis*. It is also a thermophilous species, found in Malta, North Africa, Spain (but the data needs to be confirmed), southern France, Corsica and in Italy, where it is distributed in the western Alps, Ligurian Apennines, along the whole peninsula (excluding the south-eastern regions), in Sicily and in Sardinia. In the central Apennines, *E. nudicornis* is especially frequent in open habitats, mostly at 500-1,800 m above sea level and often characterize the high elevation grassland centipede communities (1,800-2,000 m) as, for example, on the Laga and Simbruini-Ernici Mountains and on the Gran Sasso massif.

Henia vesuviana also belongs to the group of species of western distribution. It is present throughout western Europe, as far east as Romania; it is synanthropous in central Europe, uncertain records are from North Africa and it has been introduced in North America. It is very common throughout continental and insular Italy where it is a forest element, regularly present in broad-leaf forests, particularly in the oakwoods. In the studied area, it is present in the forest formations up to 1,400 m elevation, but rarely encountered at higher elevations.

Lithobius infossus is also part of this group. It is the only Tyrrhenian endemic species reported in the studied area. This species is essentially inhabiting thermophilous and thermomesophilous forest formations. It is present in Liguria, along the Italian peninsula excluding the south-eastern areas, in Sardinia and Sicily. It is also known from Lombardy and Veneto, where perhaps it has been introduced.

Southern component

Nine species with Mediterranean *sensu stricto* chorotype are included in this group. Two species are more or less widely distributed throughout Italy with the exclusion of the Alps and the south-eastern regions, *Himantarium gabrielis* and *Stigmatogaster gracilis*. *H. gabrielis*, tendentially thermophilous, is found in a wide variety of habitats in Italy, from open to arbustive and forest habitats. In the central Apennines it colonizes mostly oakwoods but sometimes other typologies of forests, such as beechwoods, both those at ordinary elevations in the Anti-Apennines (Lepini and Ausoni-Aurunci) and in the western Apennines mountains chains (Sabini and Simbruini-Ernici), and those at lower elevations of the Lazio reliefs of volcanic origin. *S. gracilis* is frequent in the broad-leaf forest formations.

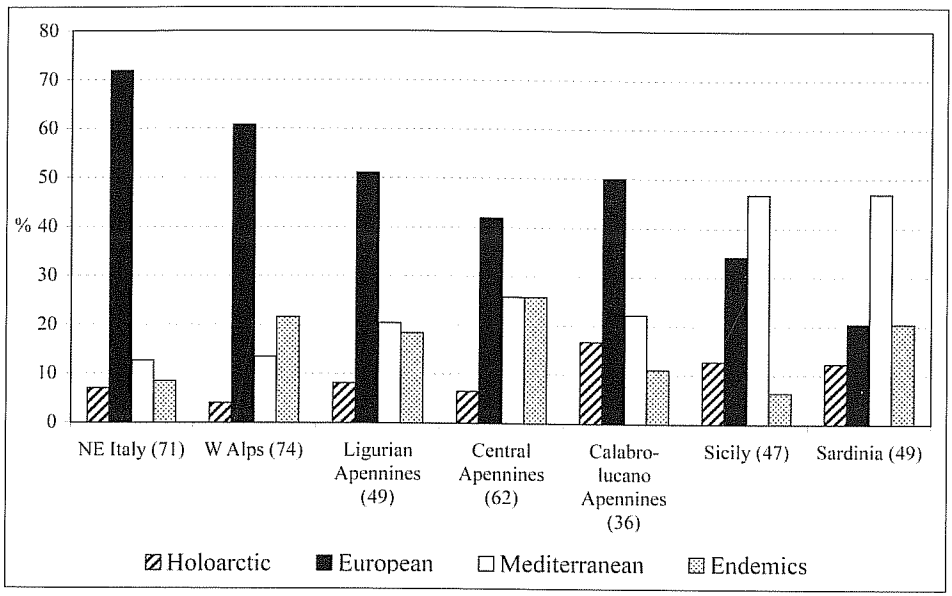

Fig. 4 - Percentages of main chorotypes (Holoarctic, European, Mediterranean) and Italian endemic species in the centipede fauna of selected Italian geographic areas. The number of species in each area is indicated in parenthesis; the introduced species and those of uncertain identity have been excluded; with the exception of the Central Apennines the used sources are: Foddai et al. (1994), Minelli (1991), Minelli and Zapparoli (1983, 1992), Zapparoli (1986, 1989), revised and updated; for Sicily, the islands of Lampedusa and Pantelleria have not been taken under consideration

Other thermophilous species belonging to this group, mostly found in open Mediterranean habitats, are *Scutigera coleoptrata*, which is often synanthropous and therefore widely spread throughout Italy, and *Scolopendra cingulata*, which geographic range includes also Tadjikistan (Zalesskaja and Shileyko, 1992), present throughout Italy, excluding the north-western regions and Sardinia. In addition to the flatlands and hilly sectors of the studied area, both species are also found in sites at the periphery of inner mountain areas, but not at elevations higher than 700-800 m for the former and 1,600 m for the latter.

The other species, *Cryptops trisulcatus*, *Dignathodon microcephalus*, *Henia bicarinata* and *Geophilus richardi*, are less frequent than the previous ones, and inhabits both forest and open habitats, *H. bicarinata* also in littoral habitats. These species rarely colonize the central mountain sectors of the studied area and are especially distributed in the inferior horizons of the basal plane, usually between 0-900 m above sea level. Exceptionally, *C. trisulcatus* and *D. microcephalus* are found in some inner sectors (Laga Mountains, Gran Sasso and Matese massifs), but not above 1,300-1,600 m in elevation.

Also belongs to this group *Tuoba poseidonis*, a littoral halophilous species found in the studied area in very few localities of the Tyrrhenian coast.

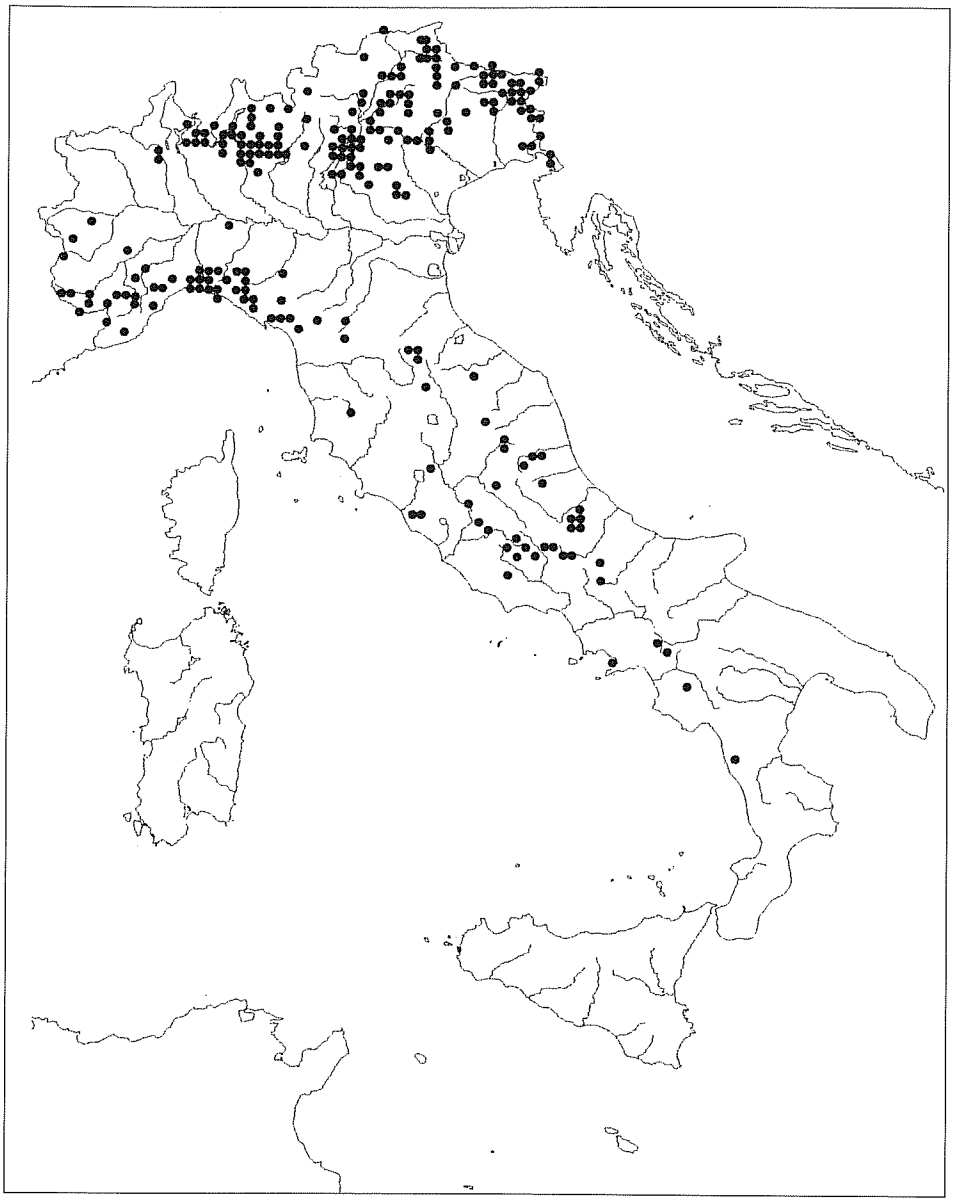

Fig. 5 - Distribution in Italy of *Eupolybothrus grossipes* (C.L. Koch, 1847) (from Zapparoli and Minelli, 2006)

Northern component

The most consistent component of the centipede fauna of the studied area is represented by species with a northern distribution, especially European.

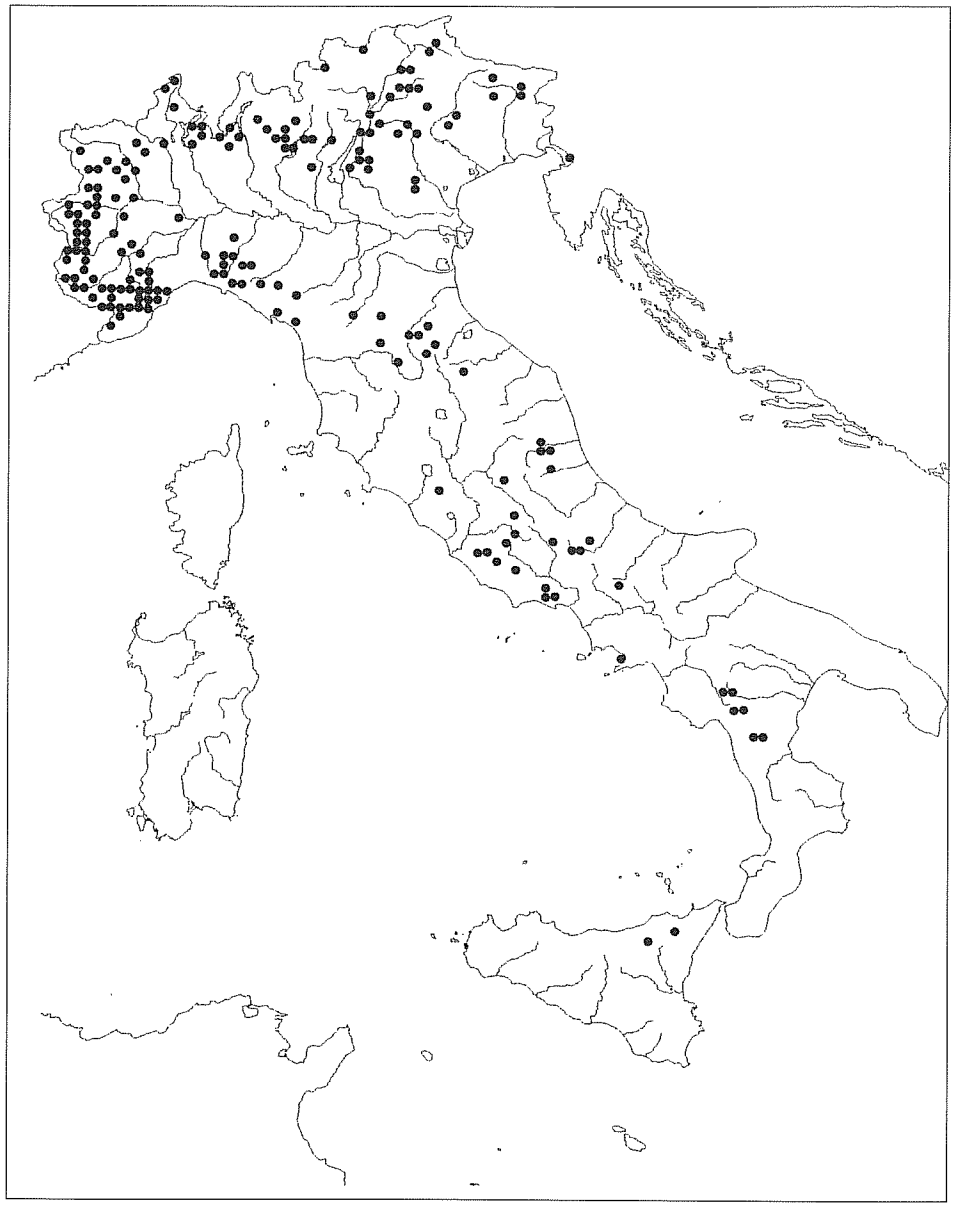

Fig. 6 - Distribution in Italy of *Strigamia acuminata* (Leach, 1815) (from Zapparoli and Minelli, 2006)

In comparison with other Italian geographic sectors, this group is predominant not only in the central Apennines but also in other areas from the north to the south along the peninsula, as well as in the Alps and generally in the northern regions. Like in many other taxonomic groups (AA.VV., 1971), the

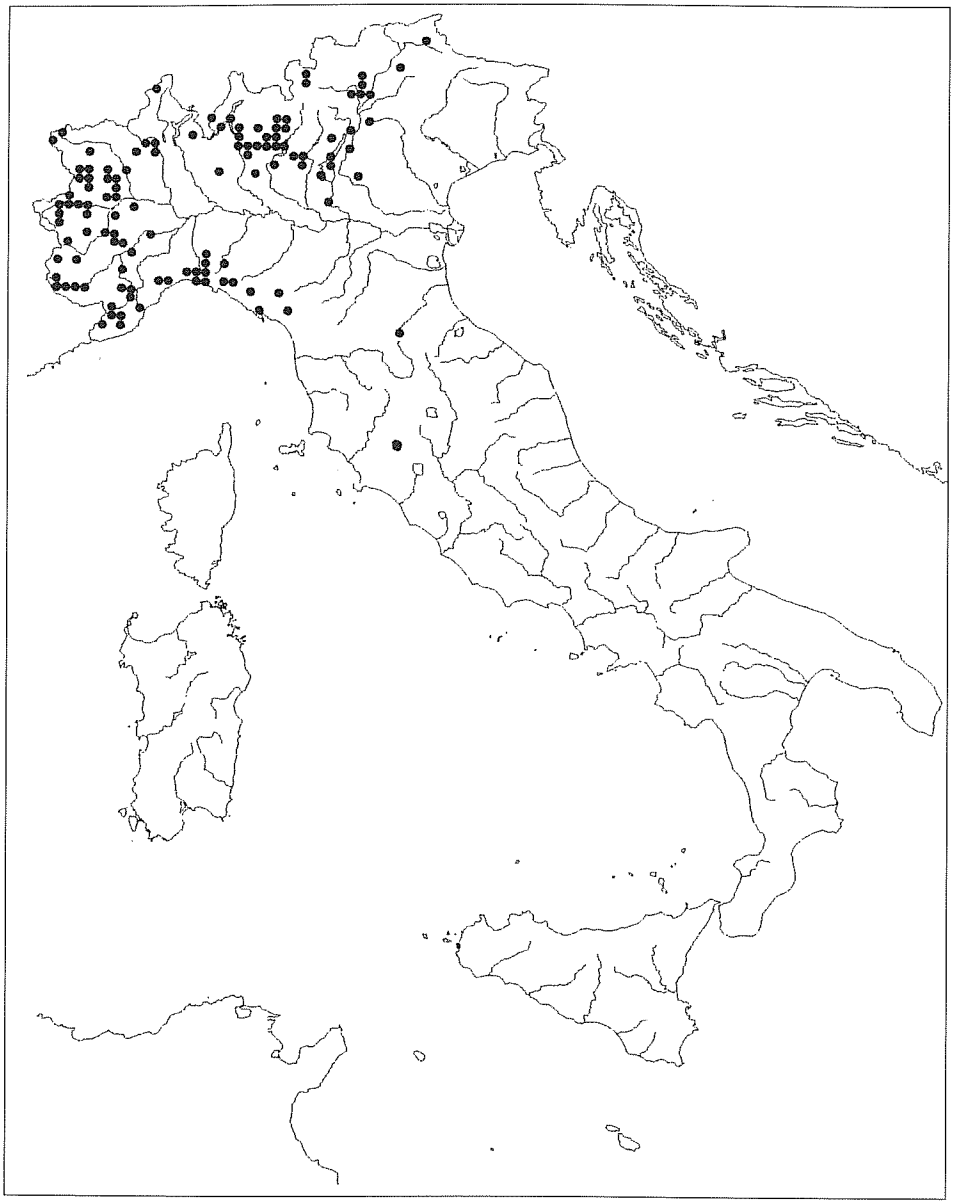

Fig. 7 - Distribution in Italy of *Lithobius piceus* L. Koch, 1862 (from Zapparoli and Minelli, 2006, updated)

consistency of this component decreases to the south in favor of the Mediterranean component, which become prevailing in Sicily and Sardinia (Minelli, 1983; Minelli and Zapparoli, 1985, 1992; Zapparoli, 1986 and unpublished data) (Fig. 4).

Omitting the species with a wide Holarctic (*Cryptops hortensis*, *Pachymerium ferrugineum*, *Clinopodes flavidus* and *Geophilus flavus*) and European *sensu stricto* distribution (*Lithobius erythrocephalus, L. forficatus, L. melanops, L. microps, Schendyla nemorensis, Geophilus carpophagus, G. insculptus* and *Strigamia crassipes*), that are all rather common in Italy, some mostly inhabiting forest habitats (*Cryptops hortensis, Schendyla nemorensis, Geophilus carpophagus, G. insculptus, Strigamia crassipes*), some mostly frequent in open habitats (*Lithobius erythrocephalus, Pachymerium ferrugineum*), and some more or less euriecious (*Lithobius forficatus, L. melanops, L. microps, Clinopodes flavidus, Geophilus flavus*), can be assigned to this group also a number of Centraleuropean species that are found especially in mesophilous forest habitats, such as *Eupolybothrus grossipes* (Fig. 5) and *Strigamia acuminata* (Fig. 6), which in the Apennines are present only in inner areas and that are present more or less in the south along the peninsula and in Sicily, but not beyond the Nebrodi Mountains (Zapparoli and Minelli, 2006). Although these species also inhabit other montane broad-leaf and conifer forest, in the studied area they are constantly present in the *Fagus sylvatica* woods of the Anti-Apennines and the Apennines, especially between 800-1,500 m above sea level. *Lithobius mutabilis* and *L. tricuspis* are also part of this group but are found in a wider altitude and forest formation ranges.

Of some interest is also *Lithobius piceus*, a Centraleuropean species represented in Italy by the subspecies *L. p. verhoeffi* Demange, 1958 which distribution includes the Alpine arc, the Ligurian and the Tuscan-Emilian Apennines, whose most southern locality is in the Amiata Mountain area (Siena province, Piancastagnaio, "Il Pigelleto" Natural Reserve), at the northern margins of the studied area (Fig. 7).

Among the S-European species, besides some common species that are found in all the forest formations of the area, such as *Lithobius castaneus, L. micropodus, Cryptops parisi* and *C. anomalans*, and other more or less localized species, such as *Schendyla carniolensis* and *Geophilus osquidatum*, all related to forest habitats as well, one can mention other four species more or less related to forest habitats and known in a few localities of the studied area: *Lithobius punctulatus*, a species in Italy widespread in northern regions (Alps, Po Plain) except in Liguria, probably a transpadanian element expanding its range although discontinuously also in the Apennines up to Aspromonte (Fig. 8); *Cryptops croaticus*, recorded in the Sibillini Mountains and Matese; *Henia montana*, found in the Sibillini and Soratte Mountains, which in Abruzzo reach the southern limit of its distribution; and *Schendyla montana*, known in some localities of Lazio and Abruzzo.

Lithobius calcaratus, a W-European element which in the studied area reach the south-eastern limit of its range, is also quite frequently found in the central Apennines, mostly in open xeric habitas but also in broad-leaf forests.

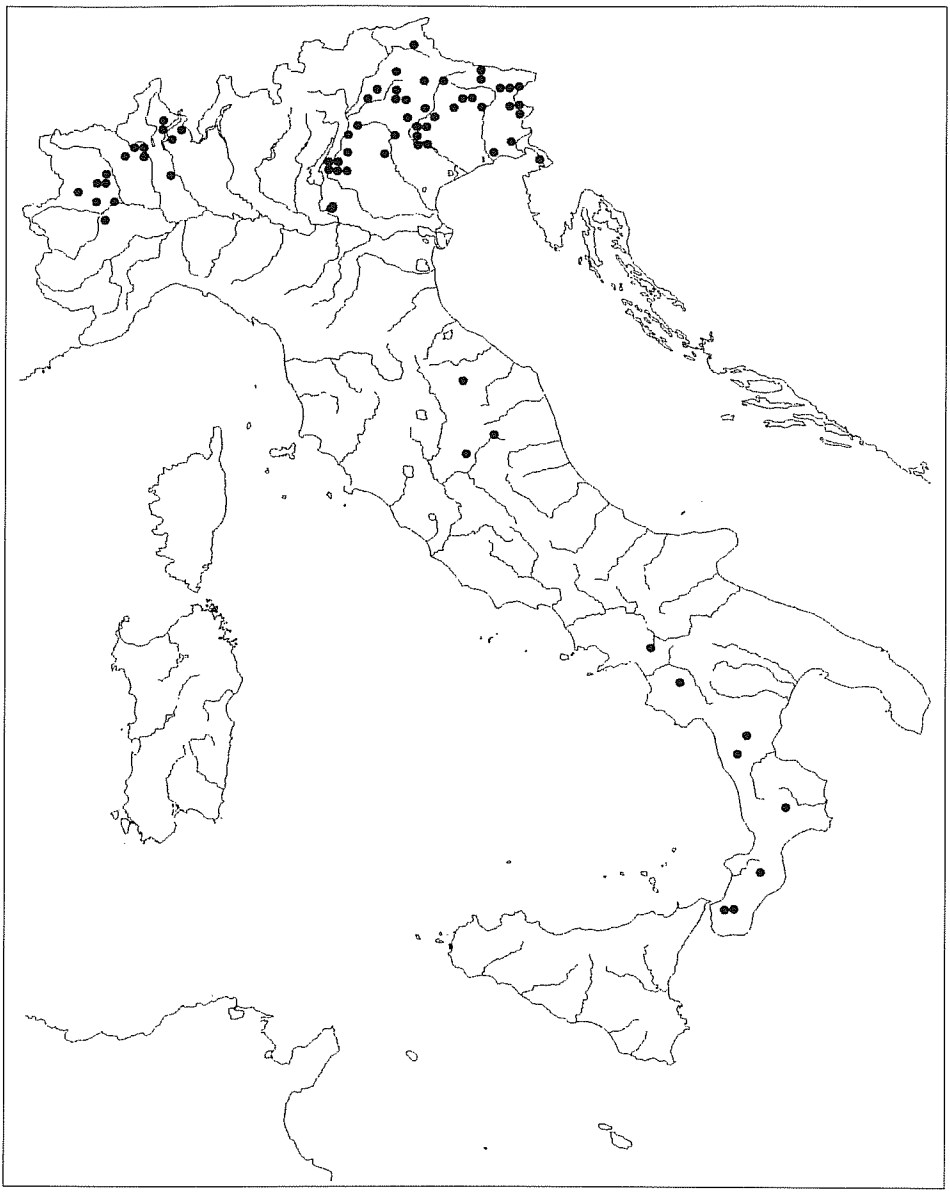

Fig. 8 - Distribution in Italy of *Lithobius punctulatus* C.L. Koch, 1847 (from Zapparoli and Minelli, 2006, updated)

Most of Italian endemic species found in the studied area are obviously part of this group; they are mostly Apenninic endemic with a S-European affinity. Some have a rather wide distribution, such as *Eupolybothrus fasciatus*, which is common throughout the Italian peninsula, from the Ligurian Apennines to the

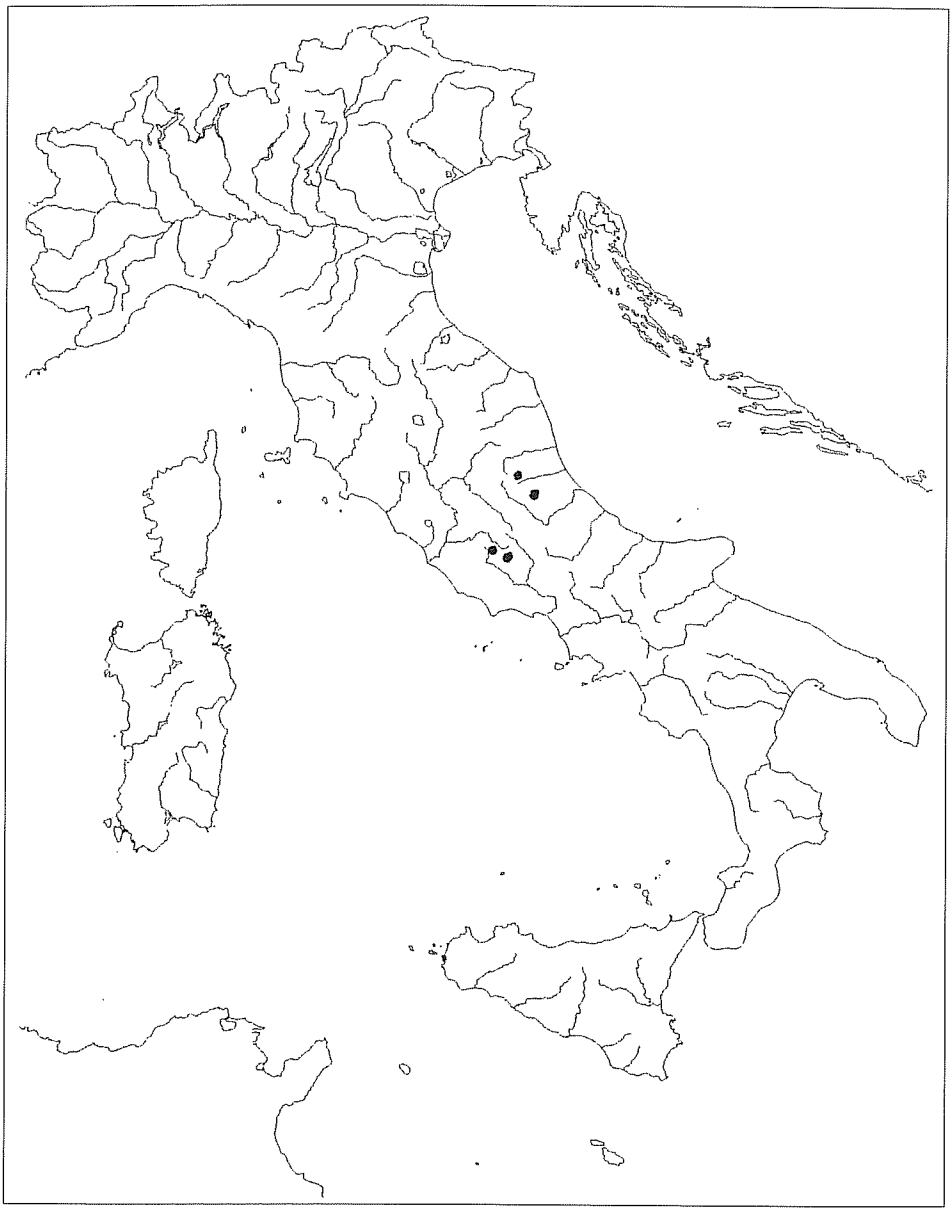

Fig. 9 - Distribution of *Lithobius pasquinii* Matic, 1967 (from Zapparoli and Minelli, 2006, updated)

Aspromonte, and has also been reported in Sardinia (outskirts of Olbia) where it was probably introduced. Another example is *Lithobius tylopus*, whose distribution is substantially identical to that of the previous species, although it has not been reported south of the Orsomarso Mountains (Calabria) and it has been

recorded in some localities of northern Italy. The taxonomic relationships of *L. tylopus* with the other species of the group (*L. nicaeensis* Brölemann, 1904; *L. ruffoi* Matic, 1966; *L. salernitanus* Manfredi, 1956) remain however to be defined. *Schendyla apenninorum* is found in a few localities in northern Italy, from Pavia province to the National Park of Abruzzo and the Ausoni-Aurunci Mountains.

Other endemic species have a more or less limited distribution, such as: *Eupolybothrus imperialis,* which is also present in southern and south-eastern Italy; *Lithobius aleator*, which is distributed from the Maritimes Alps (France) to southern Italy (Campania), through Umbria, Lazio and Abruzzo; *L. cassinensis*, which is widely distributed in central Apennines and some populations are also known in Tuscany (Siena province) and Campania (Naples province); and *L. romanus*, which has been reported along the Tyrrhenian side of Lazio but is also present on some Tyrrhenian small islands (Ponza, Capri and Salina islands), where it may have been introduced. In all the cases these are species mostly inhabiting forest habitats, in particular oakwoods and other broad-leaf forests. *E. fasciatus*, *L. aleator*, *L. tylopus* and *L. cassinensis* live in the studied area within a rather wide elevation range, from sea level up to 1,500-1,600 m, and rarely higher. In a few cases, *E. imperialis* has been recorded above 100 m elevation and only *S. apenninorum* has thus far been found at higher elevations, between 900 and 1,500 m.

Other three endemic species have a more limited distribution: *Lithobius minellii*, reported in the oriental (Laga Mountains, Gran Sasso, Maiella) and central chains (Reatini and Matese Mountains) of the central Apennine, as well as in low elevation localities of the Abruzzo (Teramo province); *L. nocellensis*, found in very few localities at mid and low elevations in Abruzzo (Teramo province), Umbria (Perugia province) and Campania (Islands Ischia and Capri); and *L. pasquinii,* recorded in the Gran Sasso and the Ernici Mountains (Fig. 9). These are Apenninic elements, likely related to forest habitas, which the knowledge about their distribution and habitat preferences is still insufficient. The identity of a *Lithobius* sp. morphologically close to *L. lucifugus*, found in several localities of the studied area, is still being defined.

The few Alpino-Apenninic endemic species are represented by *Lithobius sphinx*, found in a few localities of north-western (Piedmont, Liguria), central (Marches, Umbria, Abruzzo) and southern (Campania, Ischia island) Italy, *Cryptops umbricus*, present in France (Maritimes Alps), throughout northern Italy and along the Apennines up to Basilicata (Pollino Mount) (Minelli and Zapparoli, 1985; Iorio and Minelli, 2005), and *Stenotaenia romana* (W-Alpino-Apenninic), distributed from the Ligurian Apennines to Lazio but also recorded in north-western (Piedmont), north-east (Veneto: Euganei Hills) and southern (Campania) Italy (Bonato and Minelli, 2008).

CONCLUSIONS

In summary, the centipede fauna of the central Apennines seem to be rather homogenous from a faunistic perspective, in spite of the cognitive and taxonomic gaps that still exist. There are however clear differences between the coastal/sub-coastal/hilly region (especially on the Tyrrhenian side) and the inner mountain areas, probably due to present ecological factors.

Notably, some northern and oriental elements, such as *Lithobius piceus* (Centraleuropean) and *Pleurolithobius patriarchalis* (E-Mediterranean) respectively, are only in a marginal part of the studied area. Moreover, it is interesting to note the absence of records of *Harpolithobius anodus* (Latzel, 1880), a lithobiomorph centipede which range includes Anatolia and south-eastern Europe, from Bulgaria to Austria and from Poland to the Peloponneso, present in Italy in the Alps, in the Ligurian Apennines and along the northern border of the Tuscan-Emilian Apennines. *H. anodus* is the only Italian species of a genus discontinuously distributed in the Caucasus, Middle East, Pontus, Taurus, and south-eastern Europe (Zapparoli, 2003; Zapparoli and Minelli, 2006).

Apart from *Hydroschendyla* Brolemann and Ribaut, 1911, which comprises a single halophilous species, among the geophilomorph genera represented in peninsular Italy (from Emilia-Romagna to Calabria), *Nannophilus* Cook, 1895, distributed in Macaronesia and in the Mediterranean basin, represented in Italy by *N. eximius* (Meinert, 1870), whose range extends from Macaronesia to continental Greece, through North Africa, southern Italy and Sicily, and *Acanthogeophilus* Minelli, 1982, a monospecific taxon whose the only representative, *A. dentifer* Minelli, 1982, has been recorded in Liguria (La Spezia province) and Puglia (Gargano) (Minelli, 1982b; Minelli and Zapparoli, 1985), have not been recorded in the central Apennine.

As far as the strictly mountain sectors of the studied area concerns, it is difficult to identify the two distinct subregions recognized for other terrestrial arthropods, e.g. carabids beetles (Coleoptera Carabidae) (Vigna Taglianti, 1992), that is the northern (Sibillini, Laga, Reatini Mountains and the Gran Sasso) and the southern (Simbruini-Ernici, Velino Sirente, Maiella, Marsicano, Matese Mountains) areas. Neither among the endemics, nor among the more widely distributed species it has been possible to discern a characterizing element. Although a detailed understanding of its distribution and affinity has not been achieved, *Lithobius pasquinii*, an Apenninic endemic species found in the Gran Sasso but also in the Ernici Mountains, may be the only exception.

Several factors, in addition to insufficient faunistic knowledge, may contribute to these results. Firstly to a lack in the studied area of alticolous species, as opposed to the Alps where this component, although not numerous, is however represented. Secondly, to a lack (or scarcity) of strictly central Apenninic endemic species. And finally, to the greater significance that the ecological than

the historical factors evidently have in the distribution of these arthropods in the studied area, whose colonization into the inner sector of central Italy is likely of relatively recent origin.

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