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Analysis of the distribution of endemic and rare arthropods in high endemism areas of Algarve – South Portugal

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Summary

The study of several arthropod groups in high endemism areas (HEA) of Algarve, the Southernmost province of Portugal, has revealed endemic species and species not yet recorded for the Portuguese fauna. The list includes 3 species of Isopoda endemic to Algarve, to Portugal or to the Iberian Peninsula, 2 species new to Portugal and 2 species new to the Iberian Peninsula; 2 species of Pseudoscorpiones not yet cited to Portugal; 11 species of Pauropoda new to Portugal, including one new species probably endemic; 15 species of Collembola endemic to the Portuguese or to the Iberian Peninsula faunas (Gama et al. 1997) and 37 species and 5 subspecies of Staphylinidae endemic to Algarve.

With the exception of Collembola, which have been studied by us, the remaining groups have been submitted for study to several specialists.

These findings heighten the biological richness of these areas of high endemism in terms of conservation of biological diversity. The authors draw attention to the necessity to preserve or restore the biological value of these areas, encouraging the adoption of protective measures and the creation of research programmes that include the implementation of taxonomic studies and co-operation between taxonomists and ecologists in order to preserve the biodiversity of these areas.

Key words: Biodiversity conservation, soil arthropods, high endemism areas, endemic species, Algarve, South Portugal

Introduction

Conservation biology has recently developed as a response by the scientific community to the biodiversity crisis caused by the exponential growth of human population. The natural world has been affected at a rapid rate by human activity to the extent that massive alteration of habitats and associated biological changes threaten the existence of millions of species and basic ecosystem processes. It is a new synthetic concept that combines the principles of the traditional academic disciplines, such as ecology, biogeography, population genetics, economics, sociology, anthropology, philosophy, with the applied traditions of agriculture, forest management and allied fields to the maintenance of biological diversity throughout the world (Meffe & Carroll 1994).

The importance of biodiversity has been newly understood mainly after the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 and the creation of the Convention on Biodiversity (Wilson 1997). The Rio Convention stresses both pure conservation measures and sustainable use. Conservation measures must imply identification and preservation of sites, especially endemic sites. Measures for sustainable use must aim at keeping the soil biodiversity as high as possible in agricultural and forest soils, avoiding chemical treatments (Hagvar 1998). In fact the "new" conservation biology differs from traditional resource conservation in being motivated not only by economic, utilitarian philosophy (single-species issues), but by the need for conservation of entire ecosystems with all their biological components and processes (Meffe & Carroll 1994). In many cases this means developing compromises between conservation priorities and human needs (Primack 1993).

The most precious biological components of biodiversity (edaphic communities) from a conservation perspective are endemic biota which are particularly vulnerable to ecosystem disturbance. Endemic biota tend to occur in particular areas that represent high biodiversity spots, which must be considered of prime importance in nature conservation (Deharveng 1996).

Algarve, the Southernmost province of Portugal, is a special hot spot of biodiversity in the Iberian Peninsula where five well delimited ecological areas have been distinguished: Península de Sagres, Serra de Monchique, Barrocal, Parque Natural da Ria Formosa e Reserva Natural do Sapal de Castro Marim (Fig. 1). In these areas several endemic species of phanerogams (Rocha Afonso 1991) and Arthropods [Thysanura (Mendes 1985, 1992), Homoptera Cicadoidea Tibicinidae (Boulard 1982; Quartau 1995)] and Coleoptera Cicindelidae (Horn 1937; Serrano 1988, 1995)] have been pointed out (Table 1).

The study of the Collembolan populations from these areas of high endemism (HEA) is integrated in an EU project (1995-97) entitled "High Endemism Areas, Endemic Biota and the Conservation of Biodiversity in Western Europe". It has revealed 15 species endemic to Portugal or to the Iberian Peninsula and 23 species not yet referred to Portugal or to the Iberian Peninsula (Gama et al. 1997) (see also Table 2). Moreover, from our sampling in these areas, some interesting species of other arthropod groups have been found, which have been studied by specialists, some of them participating in this project (Table 3).

Study areas and sampling sites

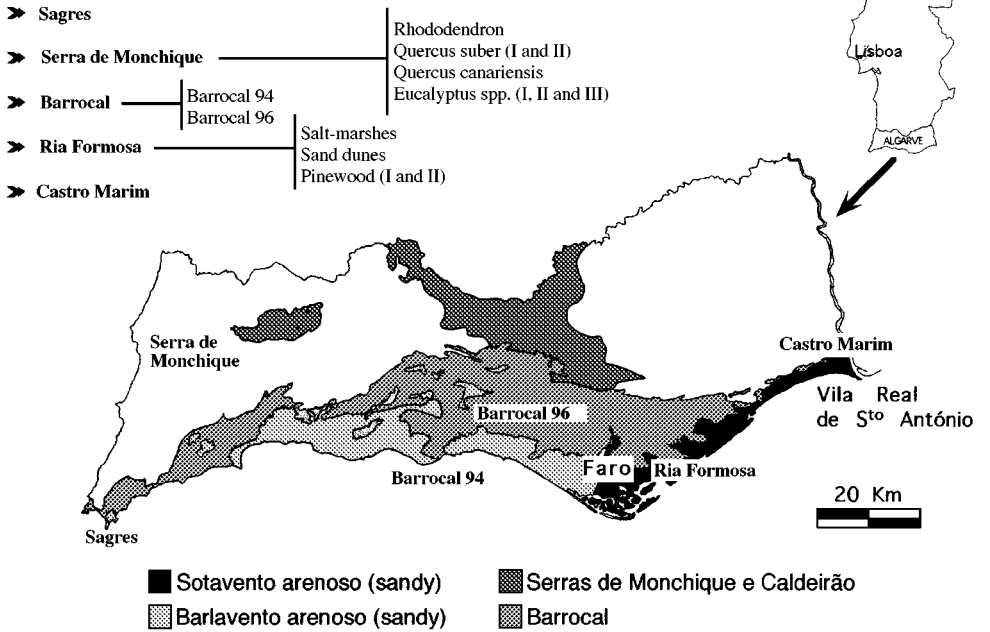


Fig. 1. High endemism areas (HEA) in Algarve and sampling sites.

Table 1. Endemic or rare plants and arthropods from high endemism areas in Algarve already previously known

	Sagres	Serra de Monchique	Barrocal Formosa	Ria Formosa	Castro Marim
Phanerogams					
<i>Iberis sampaiana</i> Franco & P. Silva, 1963	E				
<i>Biscutella vicentina</i> (Samp.) Guinea, 1964	E				
<i>Hycacinthoides vicentina</i> (Hoffmanns & Link) Rothm., 1944	E				
<i>Thymus camphoratus</i> Hoffmanns & Link, 1809	E				
<i>Diplotaxis vicentina</i> (Coutinho) Rothm., 1940	E				
<i>Cistus palhinhae</i> Ingram, 1943	E				
<i>Astragalus massiliensis</i> (Miller) Lam., 1783					
<i>Quercus canariensis</i> Willd., 1809		R			
<i>Euphorbia monchiquensis</i> Franco & P. Silva, 1968		E			
<i>Rhododendron ponticum</i> L. ssp. <i>baeticum</i> (Boiss. & Reuter) Hand.-Mazz., 1762		IE			
<i>Ilex aquifolium</i> L., 1753		R			
<i>Ophrys speculum</i> Link ssp. <i>lusitanica</i> O. & A. Danesch			IE		
<i>Dittrichia viscosa</i> (L.) W. Greuter ssp. <i>revoluta</i> (Hoffmanns & Link)				E	
P. Silva & Tutin, 1973				E	
<i>Tuberaria major</i> (Willk.) P. Silva & Rozeira, 1964					
<i>Thymus lotocephalus</i> G. López & R. Morales, 1984			E		
Thysanura (Microcoryphia)					
<i>Machilis sacra</i> Mendes, 1976	E				
<i>Machilis</i> cf. <i>lusitana</i> Wygodzinsky, 1945		IE			
<i>Machilinus rosaliae</i> Mendes, 1977				E	
<i>Bachilis multisetosa</i> Mendes, 1977				E	
<i>Dilta bitschi</i> Mendes, 1976				E	

	Sagres	Serra de Mon- chique	Barrocal	Ria Oformosa	Castro Marim
Thysanura (Zygentoma)					
<i>Ctenolepisma algharbica</i> Mendes, 1978	E			IE	
<i>Ctenolepisma guadianica</i> Mendes, 1992				IE	
<i>Coleitima mendesi</i> Wygodzinsky, 1980					
Homoptera (Cicadoidea)			E		
<i>Tettigeta josei</i> Boulard, 1982					
Homoptera (Coccoidea)			R		
<i>Kermes vermilio</i> Planchon					
Coleoptera (Cicindelidae)					
<i>Cicindela hybrida silvaticoides</i> Horn, 1937	E				IE
<i>Cephalota hispanica</i> (Gory, 1833)					(Tertiary relict)

NOTES: (R) – Rare species (E) – Endemic species (IE) – Iberian endemic species
 Phanerogams (Rocha Afonso, 1991) Thysanura (Mendes, 1985, 1992 and in litteris)
 Homoptera Cicadoidea (Boulard, 1982; Quartau, 1995)
 Homoptera Coccoidea (Passos de Carvalho, in litteris)
 Coleoptera Cicindelidae (Horn, 1937; Serrano 1988, 1995)

Table 2. Endemic or rare Collembola species from high endemism areas in Algarve

	Sagres	Serra de Monchique	Barrocal Formosa	Ria Formosa	Castro Marim
<i>Microgasterura sensilitata</i> Jordana, 1981		IE		IE	
<i>Odontellina nivalis</i> (Cassagnau, 1959)			M		
<i>Deutonura atlantica</i> Deharveng, 1982		E			
<i>Deutonura coiffaiti</i> (Deharveng, 1979) (*)		E			
<i>Endonura baculifer</i> (Deharveng, 1979) (*)		E			
<i>Friesea acuminata</i> Denis, 1925		M		A-M	
<i>Friesea pseudodecipiens</i> Arbea & Jordana, 1997					
<i>Friesea ladeiroi</i> Gama, 1959			A-M	A-M	A-M
<i>Friesea stachi</i> Kseneman, 1936			M		
<i>Gamachorutes verrucosus</i> Cassagnau, 1978		IE	IE	IE	
<i>Fissuraphorura gisini</i> (Selga, 1963)		A-M			
<i>Mesaphorura arbei</i> Simón & Lucíañez, 1994		IE		IE	IE
<i>Mesaphorura florum</i> Simón & Lucíañez, 1994	IE				
<i>Mesaphorura</i> sp. 1	IE	IE			
<i>Mesaphorura</i> sp. 2	E	E			
<i>Mesaphorura</i> sp. 3	E	E			
<i>Metaphorura denisi</i> Simón, 1985			M		
<i>Onychiurus penetrans</i> Gisin, 1952		M			
<i>Cryptopygus debilis</i> (Cassagnau, 1959)	M	M	M	M	M
<i>Folsomides pocosensillatus</i> Fjellberg, 1993	A-M				
<i>Folsomides xerophilus</i> Fjellberg, 1993	A-M				
<i>Proisotoma coeca</i> Gama, 1961		E			
<i>Proisotoma gisini</i> Gama, 1964				E	

	Sagres	Serra de Monchique	Barrocal Formosa	Ria Formosa	Castro Marim
<i>Lepidocyrtus lusitanicus</i> Gama, 1964		IE		IE	
<i>Lepidocyrtus tellecheae</i> Arbea & Jordana, 1990		IE			E
<i>Pseudosinella</i> sp.					
<i>Troglopedetes cavernicola</i> Delamare, 1944		E	E		
<i>Willowsia</i> sp.			E		
<i>Arrhopalites microphthalmus</i> Cassagnau & Delamare, 1953	M				
<i>Stenacidia hystrix</i> (Börner, 1903)					M

NOTES: A-M – Atlantic-Mediterranean species E – Endemic species IE – Iberian endemic species
M – Mediterranean species (*) Not found in this project sampling

Table 3. Endemic or rare arthropods from high endemism areas in Algarve

	Sagres	Serra de Monchique	Barrocal Formosa	Ria Formosa	Castro Marim
Isopoda					
<i>Trichoniscoides machadoi</i> Vandel, 1946 (•)			E		
<i>Haplophthalmus siculus</i> Dollfus, 1896 (•)			M		
<i>Buchnerillo littoralis</i> Verhoeff, 1942 (**)				A-M	
<i>Armadilloniscus littoralis</i> Budde-Lund, 1885 (*)			IE	A-M	
<i>Trichorhina anophthalma</i> Arcangeli, 1935				A-M	
<i>Stenoniscus pleonalis</i> Aubert & Dollfus, 1890 (*)				E	
<i>Trogarmadillidium machadoi</i> Vandel, 1946 (•)			R (M)		
<i>Paraschizidium olearum</i> Verhoeff, 1917 (**)					
Pseudoscorpiones					
<i>Chthonius</i> (E.) gibbus Beier, 1952	M	M			
<i>Chthonius</i> (C.) jonicus Beier, 1931 (*)	A-M				
<i>Chthonius</i> (C.) halberti Kew, 1916 (*)				Lusitanian	
<i>Microcreagrina hispanica</i> (Ellingsen, 1910)			M		
<i>Geogarypus minor</i> (L. Koch, 1873)	M	M			
<i>Olpium pallipes</i> (H. Lucas, 1846)	M			M	
<i>Hysterochelifer tuberculatus</i> (H. Lucas, 1846)			M		
<i>Roncocreagris</i> cf. <i>galeonuda</i> (Beier, 1955)		M			
Araneae					
<i>Theridion simile</i> C. L. Koch, 1836		IP			
<i>Nigma puella</i> (E. Simon, 1870)		IP			
Pauropoda					
<i>Pauropus</i> sp. (*)					"
<i>Allopauropus</i> sp. (10 species) (*)					"

	Sagres	Serra de Mon-chique	Barrocal	Ria Formosa	Castro Marim
Symphyla	"	"	"	"	"
Chilopoda	"	"	"	"	"
Diplopoda	"	"	"	"	"
Protura	"	"	"	"	"
Diplura		M	M		
<i>Podocampa ceballosi</i> (Silvestri, 1932)			C		
<i>Parajapyx (P.) isabellae</i> (Grassi)					
Dermaptera		<i>Rhododendron</i> flowers			
Embioptera	"	"	"	"	"
Psocoptera	"	"	"	"	"
Hemiptera	"	"	"	"	"
Thysanoptera	"	<i>Rhododendron</i> flowers and in other sites	"	"	"
Curculionidae	"	"	"	"	"
Staphylinidae	"	"	"	"	"
Cantharidae: <i>Rhagonycha</i> sp.		<i>Rhododendron</i> flowers			
Melyridae: <i>Atallus</i> sp.		<i>Rhododendron</i> flowers			
Nitidulidae: <i>Meligethes</i> sp.		<i>Rhododendron</i> flowers			
Alleculidae		<i>Rhododendron</i> flowers			

	<i>Sagres</i>	<i>Serra de Monchique</i>	<i>Barrocal Formosa</i>	<i>Ria Marim</i>	<i>Castro</i>
Chrysomelidae					
Diptera					
Hymenoptera Chalcidoidea					
		<i>Rhododendron</i> flowers			
		<i>Rhododendron</i> flowers			
		<i>Rhododendron</i> flowers			

NOTES: (R) – Rare species (A-M) – Atlantic-Mediterranean species IP – Iberian Peninsula (E) – Endemic species
 (IE) – Iberian endemic species (M) – Mediterranean species (C) – Cosmopolitan species
 (*) Recorded in Portugal for the first time (***) Recorded in the Iberian Peninsula for the first time
 (•) Not found in this project sampling

Materials and Methods

The methods used in this study can be divided into two groups. The first one was the performance of an extensive bibliography search on published material from the Algarve region; the second method consisted in real fieldwork integrated in a broader research project (see above). In this project five well delimited areas were chosen as representative of landscape units from the Algarve province (Fig. 1).

At each unit soil samples were taken in several periods between 1994 and 1996. The extracted biological material was then identified by specialists (Collembola were identified in our laboratory and other groups in different laboratories across Europe).

For more details concerning biotope characterization, sampling and soil analysis please refer to Gama et al. (1987).

Results and Conclusions

Most of the endemic or rare species and the species with a Mediterranean or Atlantic-Mediterranean distribution belonging to the arthropod groups figured in Table 2 and Table 3 have been sampled by us in high endemism areas of Algarve (see Introduction):

Collembola (Table 2): Only two endemic species, *Deutonura coiffaiti* and *Endonura baculifer*, known from Porto de Lagos (Monchique), have not been found in our sampling. Among the other endemic species we emphasise *Deutonura atlantica* known from several localities of Portugal and the two paleoendemics, *Troglopedetes cavernicola*, previously found exclusively from caves in the South of Portugal and recorded here in soil, and *Gamachorutes verrucosus*, a very interesting Iberian endemic which is recorded for the first time since its original description in 1978. *Pseudosinella* sp. and *Willowsia* sp. as well as *Mesaphorura* sp. 2 and *Mesaphorura* sp. 3 may be new to science and probably represent neoendemics.

Other collembolan species present a restricted distribution: *Odontellina nivalis* (= *Odontellina bisetosa* Selga, 1963) is a rare Pyreneo-iberic species. *Friesea acuminata* is characteristic of littoral habitats and has been recorded from England, North Adriatic Sea (Island of Krk, Venice and Trieste) and recently from Algarve. *Friesea pseudododecipiens* has been recorded in Italy, Hungary, Crete, Spain, Morocco and lately in Algarve. *Friesea ladeiroi* is known only from Portugal and Madeira Island and *Friesea stachi* from the Oriental Carpathians (Rumania) and Morocco and it was recently collected in Algarve. *Fissuraphorura gisini* has been recorded from Spain and the Canary Islands and recently from Algarve and *Metaphorura denisi*, although previously recorded only from the septentrional part of the Iberian Peninsula, may also exist in Crete and France (Arbea, 1987) because it has been confused with *M. affinis*. This species was found recently by us in Algarve. *Cryptopygus debilis* was considered an endemic to beech forest from the French Pyrenees but it also exists in the Iberian Peninsula and in Crete. *Folsomides pocosensillatus* and *F. xerophilus* have been recorded only from the Canary Islands and Algarve. *Arrhopalites microphthalmus*, recorded until now only in France (surroundings of Toulouse) and the North of Spain, was found recently in Algarve and *Stenacidia hystrix* is a rare species which has been cited from the Iberian Peninsula and Eolic Islands.

Isopoda (Table 3): *Trichorhina anophthalma* is an Iberian endemic cited from Serpa and Setúbal (Portugal), Malaga and Algésiras (Spain) and *Paraschizidium olearum* was known until now only from Minorca. Three species represented in Ta-

Table 4. Endemic Staphylinidae species from high endemism areas in Algarve

	<i>Costa Vicentina</i>	<i>Monchique</i>	<i>Barrocal</i>	<i>Ria Formosa</i>
<i>Astenus (A.) algarvensis</i> Coiffait, 1968			Loulé	
<i>Astenus (A.) algarvensis virgo</i> Coiffait, 1968			Alportel	
<i>Astenus (s. str.) fageli luteomarginatus</i> Coiffait, 1968		Serra de Monchique	Alportel	
<i>Bythinus anguliceps</i> Reitter, 1885	Albufeira, Bordigueira	Alferce	Algoz, Alportel, Loulé, St. ^a Catarina	Tavira
<i>Cylindropsis (s. str.) littoralis</i> Coiffait, 1969		Loulé (St. ^a Bárbara de Nexe)		
<i>Entomoculia (S.) vicinus</i> Coiffait, 1964	Portimão			Faro
<i>Geomitopsis lusitanicus</i> Coiffait, 1965		Porto de Lagos		
<i>Geostiba (L.) plicatella subopacula</i> Bernhauer, 1909		Barranco-do-Velho		
<i>Hesperotyphlus algarvensis</i> Coiffait, 1964	Algarve			
<i>Hesperotyphlus lusitanicus</i> Coiffait, 1978				
<i>Holotrochus lusitanicus</i> Coiffait, 1978	Portimão			
<i>Leptobium doderoi</i> Gridelli, 1926	Albufeira	Alferce	Alportel, Loulé	Tavira
<i>Lusitanopsis (s. str.) littoralis</i> Coiffait, 1969		Porto de Lagos		
<i>Lusitanopsis (s. str.) monchicus</i> Coiffait, 1969				
<i>Lusitanopsis algarvensis</i> Coiffait, 1965			Loulé	
<i>Mayetia (s. str.) algarvensis</i> Coiffait, 1961			Silves	
<i>Medon lusitanicum</i> Coiffait, 1969			Algoz	
<i>Mesotyphlus (A.) affinis</i> Coiffait, 1964			Loulé	
<i>Mesotyphlus (A.) albuferiensis</i> Coiffait, 1970	Albufeira			
<i>Mesotyphlus (A.) bordigueirensis</i> Coiffait, 1970	Bordigueira			
<i>Mesotyphlus (A.) campus</i> Coiffait, 1964	Boliqueime			
<i>Mesotyphlus (A.) furcatus</i> Coiffait, 1964		Porto de Lagos		
<i>Mesotyphlus (A.) inversus</i> Coiffait, 197				
<i>Mesotyphlus (A.) montanus</i> Coiffait, 1964			St. ^a Catarina	
<i>Mesotyphlus (A.) paeonius</i> Coiffait, 1964			Loulé (Querença)	
			Loulé (Amendoeira)	

	Costa Vicentina	Monchique	Barrocal	Ria Formosa
<i>Mesotyphlus (A.) rupestris</i> Coiffait, 1964			S. Brás de Alportel (Vilharinhos)	
<i>Mesotyphlus (A.) siliquus</i> Coiffait, 1964			S. Brás de Alportel (S. Romão) Silves	
<i>Mesotyphlus (A.) silvensis</i> Coiffait, 1964			S. Brás de Alportel (S. Romão)	
<i>Mesotyphlus (A.) simplex</i> Coiffait, 1964				
<i>Mesotyphlus (D.) brevis</i> Coiffait, 1970	Bordigueira			
<i>Mesotyphlus (D.) pervincus</i> Coiffait, 1964			Estoi	
<i>Mesotyphlus (D.) vicinus</i> Coiffait, 1964		Amoreira	St. ^a Bárbara de Nexe	
<i>Mesotyphlus (s. str.) maritimus</i> Coiffait, 1964		Porto de Lagos		
<i>Mesotyphlus (T.) rivularis</i> Coiffait, 1964		Serra de Monchique	St. ^a Bárbara de Nexe	
<i>Mimogonia europaea</i> Coiffait, 1978				
<i>Nazeris algarvensis</i> Coiffait, 1971				
<i>Paratyphlus (s. str.) algarvensis</i> Coiffait, 1964			Almancil, St. ^a Bárbara de Nexe	
<i>Paratyphlus (s. str.) brazensis</i> Coiffait, 1964			S. Brás de Alportel Carvoeiro	
<i>Paratyphlus (s. str.) carvoeirensis</i> Coiffait, 1970				
<i>Paratyphlus (s. str.) delicatulus</i> Coiffait, 1964		S. Brás de Alportel, S. Romão		
<i>Pselaphostomus franzi</i> Besuchet, 1961		Monchique		
<i>Pseudobium gridellii ibericum</i> Coiffait, 1982		Monchique	Alportel, Silves	Tavira
<i>Quedius (M.) crassus var. nigricans</i> Gridelli, 1924		Caldas de Monchique, Porto de Lagos		
<i>Xantholinus algarvensis</i> Coiffait, 1972				

ble 3 have not appeared in our sampling: *Troglarmadillidium machadoi*, an endemic cited exclusively from Faro, *Trichoniscoides machadoi*, endemic to Portugal and *Haplophthalmus siculus* recorded from the Iberian Peninsula, Sicily and Algeria. The remaining species show an Atlantic-Mediterranean distribution.

Pseudoscorpiones (Table 3): Among the 9 species appearing in our samples, *Chthonius* (C.) *halberti* and *Chthonius* (C.) *jonicus* are cited for the first time in the Portuguese fauna: The first species has a Lusitanian distribution and the second was known from the Oriental Mediterranean, having been recently discovered in the Canary Islands (Manhert – personal communication). The remaining species in Table 3 present a Mediterranean distribution.

Araneae (Table 3): Most of the species collected in the flowers of *Rhododendron ponticum* L. ssp. *baeticum* (Boiss. and Reuter) Hand. – Mazz. (Serra de Monchique) have a wide distribution, only *Theridion simile* and *Nigma puella*, figured in Table 3, are restricted to the Iberian Peninsula.

Pauropoda (Table 3): Our sampling has revealed one species of the genus *Pauropus* and 10 species of *Allopauropus*, among them one new species probably endemic. All these taxa are new to Portugal.

Diplura (Table 3): *Podocampa ceballosi* is known from several localities in the meridional half of the Iberian Peninsula and from the North of Africa. One cosmopolitan species *Parajapyx* (P.) *isabellae* was found in the Barrocal, and in Serra de Monchique, and another species, belonging probably to the genus *Japyx*, was also collected.

Staphylinidae: It is the richest family of all animal groups with a huge number of endemics already recorded for Western Europe. Table 4 shows the endemic species and subspecies from Algarve which were obtained from the database of D. Drugmand (*in litteris*). Among these 39 species and 5 subspecies, 1 species exists in Costa Vicentina, 11 species and 1 subspecies in Monchique, 22 species and 3 subspecies in Barrocal, and 2 species and 2 subspecies in Ria Formosa.

The remaining groups of Myriapoda and the other families of insects cited in Table 3 have not yet been identified.

Although the number of the remaining arthropod endemics recorded in this paper will most probably increase in the future, the actual knowledge of them reveals that Staphylinidae must be the most diversified group in Algarve.

The results obtained in this work suggest that areas of high endemism in Algarve, supporting a great variety of endemic and rare species of arthropods, should be considered a priority for conservation (Deharveng 1996).

These areas are constantly being threatened by several stress factors such as reafforestation with eucalyptus (a critical problem in Serra de Monchique), forest fires and by uncontrolled touristic development (a serious threat in coastal areas). In the face of this situation, well established plans of conservation are needed to avoid habitat degradation and local loss of biodiversity (Gama et al. 1997). The major threat to biological diversity is the loss of habitat and the most important means of protecting biological diversity is preserving habitat (Primack 1993). Natural ecosystems can easily be destroyed, but they cannot be created and at best only partially restored (Meffe & Carroll 1994). Nevertheless, as species are a very important and integral part of the ecosystems, there is a vital need for more taxonomic scientists to study, classify and protect the world's biological diversity.

In fact, only a small percentage of the living species are known to science. About 1.5 million species have been described and at least twice that number of species re-

main to be described, leading to a conservative estimate that there are about 5 million species worldwide (Primack 1993). With respect to arthropods, which are by far the most diversified of living organisms, their species richness cannot be measured even at local scale in temperate forest soils because of a lack of taxonomists (Deharveng 1996). However, taxonomists must collaborate with ecologists in order to apply their work to the issues of conservation and of sustainable use of species and habitats. Much greater cohesion between taxonomy and ecology is required if we are to present convincing arguments to save the diversity on our planet (Prance 1998).

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