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Marine biogeography of the Mediterranean Sea: patterns and dynamics of biodiversity

Biogeography of benthic marine Amphipods in Mediterranean Sea

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SUMMARY

The fauna of Mediterranean amphipods includes 466 species, near 6% of the known world wide amphipod fauna. They constitute four major categories of geographical distribution: species common to Mediterranean and Atlantic (55%), indopacific probably lessepsian species (1.9%), cosmopolitan species (4.6%), mediterranean endemic species (38.5%). In consideration with these data, it is evident that it is a great affinity between Mediterranean fauna and the Atlantic one and that the level of endemicity is very high. 95% of the whole species are present in the western bassin, 70% in the eastern and 53% in the Adriatic. Inside the group of the species common with Atlantic and Mediterranean Sea, 11% are exclusively mauritanian, 18.5% mauritanian-lusitanian, 20.5% lusitanian, 32% lusitanian-boreal, 36.4% of the species have a large continued atlantic distribution and 12.2% a discontinuous distribution between the boreal and lusitanian regions. These boreo-mediterranean species are essentially bathyal. The analysis of species common to Atlantic and Mediterranean suggests different center of origin in the Atlantic and the Mediterranean. The supposedly lessepsian species (9) are essentially present in the eastern basin. Considering the historical population of the Mediterranean we consider the 10 endemic genera and the 12 genera common to Indopacific and Mediterranean and absent in the Atlantic to be particularly important. The general conclusions of the biogeographic data on the amphipod fauna confirm the complexity of the history of the origin, from premessinian to actual, of the Mediterranean fauna.

INTRODUCTION

The present list of Mediterranean benthic amphipods is composed by 466 species, 15 more than in 1998 (Bellan-Santini and Ruffo, 1998). The 15 new species for the Mediterranean are: *Autonoe catalaunica* Ruffo, Cartes and Sorbe, 1999, *Longigammarus planasiae* Messana and Ruffo, 2001, *Hyale michelini* Krapp-Schickel and Bousfield, 2002, *Eriopisella ruffoi* Martì and Villora-Moreno, 1996, *Gammarella garciai* Martì and Villora-Moreno, 1995, *Quadrimaera ariadne* Krapp, Martì and Ruffo, 1996, *Quadrimaera aurora* Krapp, Martì and Ruffo, 1996, *Quadrimaera revelata* Krapp, Martì and Ruffo, 1996, *Bathymedon longirostris* Jaume, Cartes and Sorbe, 1998, *Stenothoe pieropan* Krapp-Schickel, 1996, *Stenothoe mandragora* Krapp-Schickel, 1996, *Urothoe hesperiae* Conradi,

Lopez-Gonzalez and Bellan-Santini, 1995, *Caprella scaura* Templeton, 1836, *Caprella santosrosasi* Sanchez-Mojano, Jimenez-Martin and Garcia-Gomez, 1995, and *Pedoculina garciagomesi* Sanchez-Mojano, Carballo and Estacio, 1995. *Caprella scaura*, largely distributed in the Pacific Ocean and along the coast of South-America, and recently found in Venice Lagoon (Mizzan, 1999), is a possible new lessepsian species for the Mediterranean.

Research is less intensive now than ten years ago, and the new data essentially concern the eastern Mediterranean and the south coast of Spain. The number of species of benthic amphipods remains non-homogeneous through the different basins of the Mediterranean, with the highest number of species known in the western basin (95%); in the eastern one this number drops to 70% and to 53% in the Adriatic sea (Fig. 1). This phenomenon corresponds to a lower biodiversity in the eastern Mediterranean (Sorbe and Galil, 2001) and the Adriatic, but also to a difference in the intensity of research.

The 466 species of Mediterranean benthic amphipods constitute near 6% of the known world wide amphipod fauna (Vader, 2003) in an area approximately 2% of the world ocean. Two explications are plausible: research has been particularly intensive, and/or the biodiversity of the Mediterranean is particularly high.

Among the Mediterranean benthic amphipods, four major categories of species can be identified by their type of distribution:

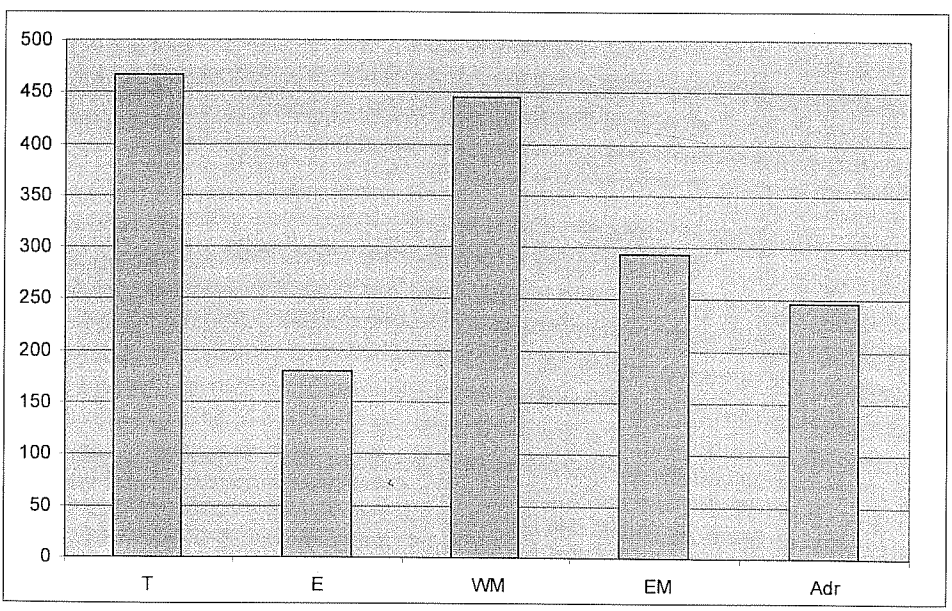

Fig. 1 - Number of amphipod species in the Mediterranean: T = total number; E = endemics; WM = Western Mediterranean; EM = Eastern Mediterranean; A = Adriatic Sea.

1. 256 species common to Mediterranean and Atlantic (55%);
2. 180 species endemic in the Mediterranean (38.5%);
3. 21 species widely distributed throughout the world (cosmopolitan, 4.6%);
4. 9 indo-pacific species present due to active or passive migration through the Suez Canal (Lessepsian species, 1.9%).

The Mediterranean fauna of marine benthic amphipods is characterised by two essential facts:

1. great affinity with the Atlantic fauna;
2. high number of endemic species.

Nevertheless, it is necessary to analyse these different data in detail in order to explain all the aspects of the biogeographic distribution of this Crustacean order.

Within the group of atlanto-mediterranean species, contingents with different distribution are observed: 11% are exclusively mauritanian, 18.5% mauritanian-lusitanian, 20.5% lusitanian, 3.2% lusitanian-boreal, 34.6% of the species have a large continuous Atlantic distribution and 12.2% a discontinuous known distribution (boreo-mediterranean species). 40.9% of the atlanto-mediterranean species have a subtropical-warm-temperate origin, confirming the strong subtropical character of the Mediterranean fauna.

The centre of evolution and/or dispersion of the species has been in the Atlantic, the Mediterranean or even the Indo-Pacific.

The species common to the Atlantic and Mediterranean may have this type of distribution as a result of penetration from the Atlantic towards the Mediterranean, or vice-versa, during the different geological cold or warm periods and probably since a long time (Mesogeic period). It is not always possible to attribute a species to one or other centre of evolution; it is sometimes necessary to have a total revision of the genus coupled with ecological, biogeographic and evolutionary studies.

A typical case is that of the two species of *Ichnopus* (Lysianassoidea), as has been demonstrated by Lowry and Stoddart (1992). The monophyletic genus "*Ichnopus* with 16 species is basically a shallow water tropical to warm temperate genus in the Pacific and Indian Ocean" except for *I. spinicornis* and *I. taurus* which occur in the Mediterranean sea and eastern North Atlantic waters (Fig. 2). The more primitive species occur in the eastern Atlantic, Mediterranean, Red sea and the western Indian Ocean, the more advanced species occur in Australian waters. "No species have been found along the well studied east coast of North America" and in the south Atlantic. It is probable that the centre of evolution of the genus is Mesogeic.

It is also probable that many of the species constituting the Mediterranean subtropical component have a similar origin (in particular species of the families Ampithoidae, Hyalidae, Leucothoidae, Melitidae, Podoceridae and Talitridae).

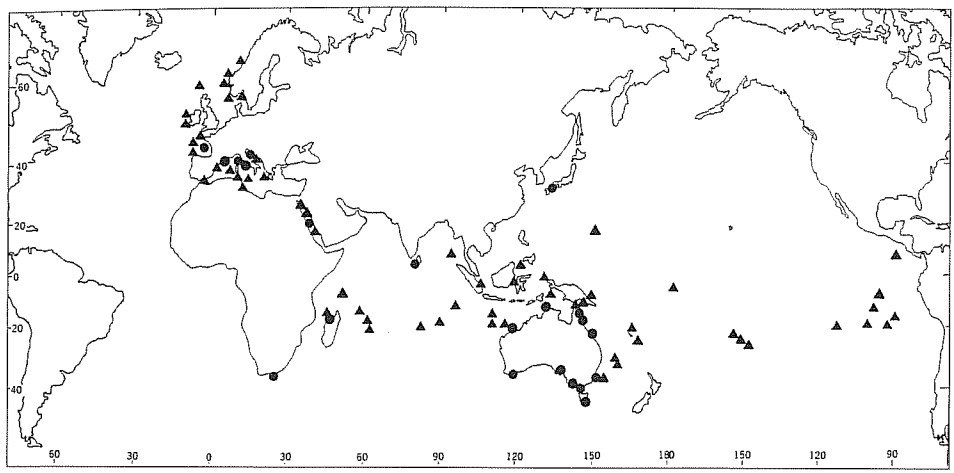

Fig. 2 - World distribution of the genus *Ichnopus*. Triangles *I. spinicornis* species group. Circles *I. taurus* species group (after Lowry and Stoddart, 1992).

On the other side, some genera present in the Mediterranean and unknown in the Indo-Pacific, have probably their centre of evolution in the Atlantic where they are well represented: *Amphilochoides*, *Tritaeta*, *Tmetonyx*, *Tryphosites*, *Melphidippella*, *Arrhis*, *Oediceropsis*, *Pontocrates*. They represent the cold component of the Mediterranean fauna.

The so-considered lessepsian component consists of 9 species (1.9%): *Cymadusa filosa*, *Bemlos leptocheirus*, *Unciolella lunata*, *Gammaropsis togoensis*, *Photis lamellifera*, *Elasmopus pectenicrus*, *Linguimaera caesaris*, *Stenothoe gallensis* and *Caprella scaura*. Their distribution is essentially eastern Mediterranean. This component is less important than in other groups of Crustacea. Two reasons might be evoked: the amphipods are poorly studied in the eastern Mediterranean and, as they having no planktonic larval stages, as the decapods have, their dispersal is essentially passive. We have no confirmation on the true origin of these species, nevertheless they are probably lessepsian.

The cosmopolitan species comprise 4.6% of the fauna. The major part of these species are more or less euryhaline and eurytherm and have an aptitude for passive dispersal, typical of fouling, or are transported with aquaculture live material. Some of these species which have a large and ancient distribution, consist in reality probably of complexes of different species with for each of them a more limited geographical distribution.

The number of endemic species is very high, 180 species. This percentage, 38.5% is clearly higher than the mean for all Mediterranean fauna except Porifera and Chordata. The relative low vagility of the benthic amphipods and the absence of larval stages explain in part the high percentage of endemic species in this order. It is significant, in this regard, that among the 70 mediterranean species of the Amphipoda

Hyperiidea, all planktonic, no species is a Mediterranean endemic. The level of endemism reaches the generic level in 10 endemic genera: *Aurobogidiella*, *Marinobogidiella*, *Longigammarus*, *Lunulogammarus*, *Neogammarus*, *Degocheirocratus*, *Parunciola*, *Sardorchestia*, *Pedoculina*, and *Pseudolirius*.

Twelve endemic species belong to Indo-Pacific genera, never found in the Atlantic: *Peramphithoe*, *Cheiriphotis*, *Coboldus*, *Aroui*, *Onesimoides*, *Prachynella*, *Rhinolabia*, *Arculfia*, *Pardaliscoides*, *Ileraustroe*, *Pseudotiron*, *Deutella*.

The percentage of endemic species varies considerably with depth (Fig. 3). The very high percentage of endemic species (61.9%) in the upper zone can be explained by the greater possibility of isolation among superficial populations in connection with the high diversity of habitat. On the other side, the high percentage of endemic species in the bathyal zone (49.2%) reveals the originality of the Mediterranean bathyal component, in particular in the eastern basin.

The endemic components are interesting not only for their important percentage ratio but also by the biogeographic significance resulting from the different origin of the species. A certain number of endemic species belongs to genera present in the Indo-Pacific and unknown in the Atlantic ocean, but there are also genera found in the Atlantic that have their origin in the Indo-Pacific; this is the case for most of the endemic species of the subtropical Mediterranean component belonging to the families Hyalidae, Leucothoidae, Melitidae,

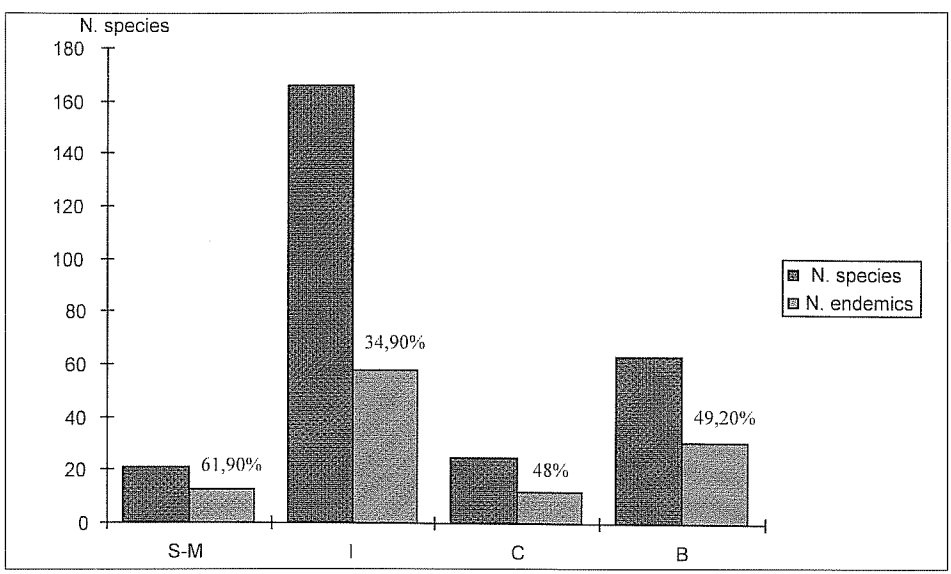

Fig. 3 - Number of the amphipod species and endemics in each bathymetric zone of the Mediterranean Sea: SM = Supra and Mediolittoral; I = Infralittoral; C = Circalittoral; B = Bathyal-Abyssal. The number is the percentage of endemics species in each bathymetric zone.

Podoceridae and Talitridae. The Bogidiellidae and Ingolfiellidae are of Mesogeic origin and linked to the evolution of the Tethys.

The case of the Gammaridae with 13 endemic species in Mediterranean out of the known 18 is entirely different. The family is not present in the Indo-Pacific and is poorly represented in the Atlantic fauna. We believe that the centre of origin of the Mediterranean Gammaridae (probably derived from secondary marine colonisation by freshwater elements) lies in the Mediterranean area itself.

Endemic species of Atlantic origin are quite numerous and belong to genera known only in the Atlantic and not in the Indo-Pacific: *Peltocoxa*, *Apherusa*, *Haustorius*, *Idunella*, *Nannonyx*, *Normanion*, *Harpinia*, *Phoxocephalus* and *Bathyporeia*.

In conclusion, the multiplicity of the areas of origin of the endemic Mediterranean species reflects the complexity of the origin of the Mediterranean fauna and probably explains the high level of its biodiversity.

To compare the affinity between the three basins of Mediterranean (western, eastern and Adriatic) with a certain number of Atlantic faunas that were well described in recent studies, different methods of similarity and parsimony were used (Bellan-Santini and Ruffo, 1998; Dauvin and Bellan-Santini 2002, Dauvin and Bellan-Santini, 2004). The general results agree on several points:

1. High affinity between eastern, western Mediterranean and Adriatic sea when this sea is distinguished from eastern basin.
2. High affinity between North Atlantic and Norwegian waters, and a high level of discrimination for this group.
3. The Atlantic African and Lusitanian coasts are most closely related to the Mediterranean.

For the bathyal faunas the conclusions are less clear

It will be necessary to intensify the studies of local collections and the collection and review of ancient data, in particular because the level of affinity calculated is variable between different zones in function of the designation of the limits and the level of knowledge of the local amphipod fauna.

The general conclusions on the biogeographic approach on the Mediterranean Amphipods data confirm the analysis of 1998.

1. High complexity in the composition and the origin of the Mediterranean fauna.
2. Close affinity between the Mediterranean and Atlantic fauna.
3. High level of endemicity of different origin, Atlantic but also Indo-Pacific.
4. Low level of lessepsian migrants but a possible increase in the future.
5. Presence of a group of "relicts" of cold elements penetrated from the Atlantic into the Mediterranean during the Quaternary glacial periods, such as *Gitana abyssicola*, *Ichnopus taurus*, *Trischizostoma raschi*, *Tryphosella nanoides*, *Monoculodes*

latissimanus, *Pardaliscoides boecki*, *Harpinia truncata*, and *Dulichia nordlandica*, all known in the Northern Atlantic up to the South of Norway and in Mediterranean.

6. Presence of a "warm" component known as subtropical Atlantic along the African coast and lacking along European coasts, which penetrated into the Mediterranean during the interglacial periods, such as *Pardia punctata* (coast of Senegal and Mediterranean, not known for the Indopacific Ocean).

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Tab. I - Biogeographic distribution of Mediterranean Amphipods. WM = West Mediterranean; EM = East Mediterranean; Adr = Adriatic Sea; ME = Mediterranean endemic; Afr.= African coast from Ceuta to Cap Vert; I = Iberian coast; Fr = French coast: Br = British coast; Norw = Norway coast; Arct = Arctis Sea; Ind-P = Indo-Pacifc Ocean; Cosm = Cosmopolit; OX = British coast, only Channel.

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
Ampeliscidae													
1	*Ampelisca anophthalma*	X					X						
2	*Ampelisca antennata*	X			X								
3	*Ampelisca brevicornis*	X	X	X		X	X	X	X	X		X	X
4	*Ampelisca calypsonis*	X	X				X						
5	*Ampelisca dalmatina*	X	X	X			X						
6	*Ampelisca diadema*	X	X	X		X	X	X	X	X			
7	*Ampelisca gibba*	X	X	X		X	X	X	X	X	X		
8	*Ampelisca intermedia*	X			X								
9	*Ampelisca jaffaensis*	X	X	X	X								
10	*Ampelisca ledoyeri*	X	X		X								
11	*Ampelisca massiliensis*	X	X				X						
12	*Ampelisca melitae*	X			X								
13	*Ampelisca multispinosa*	X	X				X						
14	*Ampelisca planierensis*	X			X								
15	*Ampelisca provincialis*	X	X				X						
16	*Ampelisca pseudosarsi*	X	X				X						
17	*Ampelisca pseudospinimana*	X	X	X			X						
18	*Ampelisca rubella*	X	X	X		X	X	X					
19	*Ampelisca ruffoi*	X	X	X			X						
20	*Ampelisca sarsi*	X	X	X		X	X	X					
21	*Ampelisca serraticaudata*	X	X			X	X						
22	*Ampelisca spinifer*	X	X			X	X	X	X				
23	*Ampelisca spinipes*	X	X			X	X	X	X	X			
24	*Ampelisca tenuicornis*	X	X	X		X	X	X	X	X		X	
25	*Ampelisca truncata*	X	X		X								
26	*Ampelisca typica*	X	X	X		X	X	X	X	X			
27	*Ampelisca unidentata*	X	X			X							
28	*Ampelisca vervecei*	X			X								
29	*Byblis guernei*	X	X	X		X	X	X					
30	*Haploops dellavallei*	X	X		X								
31	*Haploops nirae*	X	X			X	X	X					
32	*Haploops proxima*	X	X			X	X	X					
Amphilochidae													
33	*Amphilochoides boecki*	X						X		X			
34	*Amphilochoides serratipes*	X						X	X				
35	*Amphilochus brunneus*	X	X				X	X				X	
36	*Amphilochus manudens*	X					X	X	X	X	X		
37	*Amphilochus neapolitanus*	X	X	X		X	X	X	X			X	
38	*Amphilochus picadurus*	X	X			X							
39	*Amphilochus planierensis*	X			X								
40	*Amphilochus spencebatei*	X	X			X		X	X				
41	*Gitana abyssicola*	X							?		X		

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
42	*Gitana longicarpus*	X			X								
43	*Gitana sarsi*	X	X				X	X	X	X	X		
44	*Peltocoxa gibbosa*	X			X								
45	*Peltocoxa marioni*	X	X	X	X								
46	*Peltocoxa mediterranea*	X	X		X								
	Ampithoidae												
47	*Ampithoe ferox*	X	X			X	X						
48	*Ampithoe helleri*	X	X	X		X	X	X	X				
49	*Ampithoe ramondi*	X	X	X		X	X	X	X			X	X
50	*Ampithoe riedli*	X	X	X	X								
51	*Cymadusa crassicornis*	X	X	X		X						X	
52	*Cymadusa filosa*	X	X			X						X	
53	*Peramphithoe spuria*			X	X								
54	*Sunamphitoe pelagica*	X	X	X		X	X	X	X	X		X	X
	Aoridae												
55	*Aora gracilis*	X	X	X		X	X	X	X	X			
56	*Aora spinicornis*	X	X	X		X	X	X					
57	*Autonoe angularis*	X	X		X								
58	*Autonoe catalaunica*	X			X								
59	*Autonoe karamani*	X	X	X	X								
60	*Autonoe rubromaculatus*	X	X		X								
61	*Autonoe spiniventris*	X			X								
62	*Autonoe viduarum*	X	X		X								
63	*Bemlos leptocheirus*		X									X	
64	*Lembos websteri*	X	X	X		X	X	X	X	X			
65	*Leptocheirus bispinosus*	X	X	X				X					
66	*Leptocheirus guttatus*	X	X	X		X							
67	*Leptocheirus hirsutimanus*	X	X	X			X	X	X	X			
68	*Leptocheirus longimanus*	X			X								
69	*Leptocheirus mariae*	X	X	X	X								
70	*Leptocheirus pectinatus*	X	X	X		X	X	X	X				
71	*Leptocheirus pilosus*	X	X	X		X	X	X	X				
72	*Microdeutopus algicola*	X	X	X		X							
73	*Microdeutopus anomalus*	X	X	X		X		X	X	X			
74	*Microdeutopus armatus*	X					X	X					
75	*Microdeutopus bifidus*	X	X		X								
76	*Microdeutopus chelifer*	X	X	X		X	X	X	OX				
77	*Microdeutopus gryllotalpa*	X	X	X			X	X	X	X			
78	*Microdeutopus obtusatus*	X	X			X	X						
79	*Microdeutopus similis*	X	X		X								
80	*Microdeutopus sporadhi*	X	X		X								
81	*Microdeutopus stationis*	X	X	X		X	X	X	OX				
82	*Microdeutopus versiculatus*	X	X	X		X	X	X	X				
83	*Tethylembos viguieri*	X	X	X			X						
84	*Unciolella lunata*	X										X	

	WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw Arct		Ind-P	Cosm
Argissidae												
85 *Argissa stebbingi*	X	X			X	X	X				X	X
Biancolinidae												
86 *Biancolina algicola*	X	X	X								X	
Bogidiellidae												
87 *Aurobogidiella italica*	X			X								
88 *Bogidiella chappuisi*	X	X	X	X								
89 *Bogidiella dalmatina*			X	X								
90 *Marinobogidiella tyrrhenica*	X			X								
Carangoliopsidae												
91 *Carangoliopsis spinulosa*	X	X	X				X					
Cheluridae												
92 *Chelura terebrans*	X	X	X				X	X	X			X
Colomastigidae												
93 *Colomastix pusilla*	X	X	X		X	X	X	X			X	X
Corophiida												
94 *Corophium acherusicum*	X	X	X		X	X	X	OX			X	X
95 *Corophium aculeatum*	X			X								
96 *Corophium acutum*	X	X	X		X	X	X	X			X	X
97 *Corophium annulatum*	X					X						
98 *Corophium insidiosum*	X	X	X		X	X	X	OX				X
99 *Corophium minimum*	X	X		X								
100 *Corophium orientale*	X	X			X	X						
101 *Corophium rotundirostre*	X			X								
102 *Corophium runcicorne*	X	X	X		X	X						
103 *Corophium sextonae*	X	X	X			X	X	X				
104 *Siphonoecetes dellavallei*	X	X	X			X						
105 *Siphonoecetes neapolitanus*	X					X						
106 *Siphonoecetes sabatieri*	X				X	X						
Cressidae												
107 *Cressa cristata*	X	X	X	X								
108 *Cressa mediterranea*	X	X			X							
Dexaminidae												
109 *Atylus guttatus*	X	X	X		X	X	X	X				
110 *Atylus massiliensis*	X	X		X								
111 *Atylus swammerdami*	X	X			X	X	X	X	X	X		
112 *Atylus vedlomensis*	X	X	X		X	X		X	X			
113 *Dexamine spiniventris*	X	X	X		X	X	X				X	
114 *Dexamine spinosa*	X	X	X		X	X	X	X	X		X	

	WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
115 *Dexamine thea*	X	X	X		X	X	X	X	X	X		
116 *Guernea coalita*	X	X			X	X	X	X			X	
117 *Tritaeta gibbosa*	X	X	X		X	X	X	X	X			
Epimeriidae												
118 *Epimeria cornigera*	X	X	X				X	X	X			
Eusiridae												
119 *Amphithopsis depressa*	X			X								
120 *Apherusa alacris*	X	X	X		X							
121 *Apherusa bispinosa*	X	X	X		X	X	X	X	X	X		
122 *Apherusa chiereghinii*	X	X	X	X								
123 *Apherusa mediterranea*	X	X			X							
124 *Apherusa ruffoi*		X	X	X								
125 *Apherusa vexatrix*	X	X	X	X								
126 *Dautzenbergia megacheir*	X				X		X	X	X	X	X	X
127 *Eusiroides dellavallei*	X	X	X		X	X	X					
128 *Eusirus longipes*	X	X	X		X	X	X	X	X			
129 *Leptamphopus massiliensis*	X			X								
130 *Rhachotropis caeca*	X	X					X					
131 *Rhachotropis glabra*	X						X					
132 *Rhachotropis grimaldii*	X	X			X		X					
133 *Rhachotropis inermis*	X			X								
134 *Rhachotropis integricauda*	X	X	X			X	X					
135 *Rhachotropis rostrata*	X	X	X		X		X	X				
Gammarellidae												
136 *Gammarellus angulosus*	X	X	X			X	X	X	X	X		
Gammaridae												
137 *Echinogammarus dahli*	X			X								
138 *Echinogammarus foxi*	X	X	X	X								
139 *Echinogammarus olivii*	X	X	X		X	X	X	X				
140 *Echinogammarus planicrurus*	X					X	X	X				
141 *Echinogammarus pungens*	X	X	X	X								
142 *Echinogammarus stocki*	X	X	X	X								
143 *Echinogammarus veneris*	X	X	X	X								
144 *Gammarus aequicauda*	X	X	X		X	X						
145 *Gammarus crinicornis*	X	X	X		X	X	X	OX				
146 *Gammarus insensibilis*	X	X	X		X	X	X	OX				
147 *Gammarus subtypicus*	X	X		X								
148 *Longigammarus bruni*	X			X								
149 *Longigammarus planasiae*	X			X								
150 *Lunulogammarus turcicus*		X		X								
151 *Neogammarus adriaticus*			X	X								
152 *Neogammarus festai*	X			X								
153 *Neogammarus nudus*	X			X								

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
154	*Rhipidogammarus karamani*	X	X	X	X								
155	*Rhipidogammarus rhipidiophorus*	X	X	X	X								
	Haustoriidae												
156	*Haustorius algeriensis*	X			X								
	Hyalidae												
157	*Hyale camptonyx*	X	X	X		X	X					X	
158	*Hyale crassipes*	X	X	X			X						
159	*Hyale grimaldii*	X	X	X			X						
160	*Hyale michelini*	X			X								
161	*Hyale perieri*	X	X	X		X	X	X	X				
162	*Hyale pontica*	X	X			X	X	X	X	X			
163	*Hyale schmidti*	X	X	X		X	X	X					
164	*Hyale stebbingi*	X	X	X		X	X	X	X				
165	*Micropythia carinata*	X		X		X	X						
166	*Parhyale aquilina*	X	X	X		X	X						
167	*Parhyale eburnea*	X	X	X	X								
168	*Parhyale plumicornis*	X		X		X							
169	*Parhyalella richardi*	X				X	X						
	Iphimediidae												
170	*Coboldus nitior*	X	X	X	X								
171	*Iphimedia brachygnatha*	X		X	X								
172	*Iphimedia carinata*	X	X	X	X								
173	*iphimedia eblanae*	X	X	X				X	X				
174	*Iphimedia gibbula*	X			X								
175	*Iphimedia jugoslavica*	X	X	X	X								
176	*Iphimedia minuta*	X	X	X		X	X	X	X	X			
177	*Iphimedia obesa*	X	X	X				X	X	X			
178	*Iphimedia quasimodus*	X	X		X								
179	*Iphimedia serratipes*	X	X		X								
180	*Iphimedia vicina*	X	X		X								
	Isaeidae												
181	*Cerapopsis longipes*	X	X			X	X						
182	*Cheiriphotis mediterraneus*		X		X								
183	*Gammaropsis crenulata*	X	X		X								
184	*Gammaropsis dentata*	X	X			X	X						
185	*Gammaropsis emancipata*	X			X								
186	*Gammaropsis maculata*	X	X	X		X	X	X	X	X			
187	*Gammaropsis ostroumowi*	X	X	X		X						X	
188	*Gammaropsis palmata*	X	X	X			X	X	X	X			
189	*Gammaropsis pseudostroumowi*	X			X								
190	*Gammaropsis sophiae*	X	X	X			X	X	X	X			
191	*Gammaropsis togoensis*		X									X	
192	*Gammaropsis ulrici*	X				X							

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
193	*Isaea montagui*	X		X			X	X	X				
194	*Megamphopus brevidactylus*	X	X		X								
195	*Megamphopus cornutus*	X	X			X	X	X	X	X			
196	*Megamphopus longicornis*	X	X				X	X					
197	*Microprotopus longimanus*	X				X	X	X	OX				
198	*Microprotopus maculatus*	X	X	X			X	X	X	X			
199	*Photis lamellifera*		X									X	
200	*Photis longicaudata*	X	X	X			X	X	X	X	X	X	X
	Ischyroceridae												
201	*Ericthonius argenteus*		X		X								
202	*Ericthonius brasiliensis*	X	X	X		X	X	X				X	X
203	*Ericthonius difformis*	X	X				X	X	X	X			
204	*Ericthonius punctatus*	X	X	X		X	X	X	X	X			
205	*Ischyrocerus inexpectatus*	X	X	X	X								
206	*Jassa marmorata*	X	X	X			X						
207	*Jassa ocia*	X	X	X		X	X	X	X				
208	*Microjassa cumbrensis*	X	X	X				X	X				
	Lafystiidae												
209	*Lafystius sturionis*	X						X	X	X			
	Lepechinella												
210	*Lepechinella manco*	X	X	X				X					
	Leucothoidae												
211	*Leucothoe euryonyx*	X	X	X		X							
212	*Leucothoe incisa*	X	X	X		X	X	X	X				
213	*Leucothoe lilljeborgi*	X	X	X			X	X	X	X			
214	*Leucothoe oboa*	X	X	X			X						
215	*Leucothoe occulta*	X	X			X	X						
216	*Leucothoe pachycera*	X	X	X	X								
217	*Leucothoe richiardii*	X	X	X			X						
218	*Leucothoe serraticarpa*	X	X	X	X								
219	*Leucothoe spinicarpa*	X	X	X		X	X	X	X	X	X	X	X
220	*Leucothoe venetiarum*	X	X	X			X						
	Liljeborgiidae												
221	*Idunella excavata*	X			X								
222	*Idunella nana*	X			X								
223	*Idunella pirata*	X	X	X	X								
224	*Liljeborgia dellavallei*	X	X	X		X							
225	*Liljeborgia psaltrica*	X	X	X	X								
	Lysianassoidea												
226	*Acidostoma obesum*	X	X	X				X	X				
227	*Acidostoma nodiferum (=sarsi)*	X	X	X		X		X	X	X			

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
228	*Aristias neglectus*	X	X	X				X	X	X			
229	*Aroui setosus*	X	X		X								
230	*Ensayara carpinei*	X			X								
231	*Hippomedon ambiguus*	X	X	X	X								
232	*Hippomedon bidentatus*	X	X	X			X						
233	*Hippomedon massiliensis*	X	X	X	X								
234	*Hippomedon oculatus*	X	X	X				X					
235	*Ichnopus spinicornis*	X	X	X			X	X	X			X	
236	*Ichnopus taurus*	X	X	X						X			
237	*Kerguelenia reducta*	X			X								
238	*Lepidepecreum crypticum*	X			X								
239	*Lepidepecreum longicorne*	X	X	X		X	X	X	X	X			
240	*Lepidepecreum subclypeatum*			X	X								
241	*Lysianassa caesarea*		X		X								
242	*Lysianassa costae*	X	X	X		X							
243	*Lysianassa insperata*	X					X		OX				
244	*Lysianassa longicornis*	X	X	X	X								
245	*Lysianassa pilicornis*	X	X	X		X	X						
246	*Lysianassa plumosa*	X	X	X		X	X	X	X	X			
247	*Lysianella dellavallei*	X	X	X	X								
248	*Nannonyx propinquus*	X		X	X								
249	*Normanion abyssi*	X			X								
250	*Normanion chevreuxi*	X						X	X	X			
251	*Normanion ruffoi*	X			X								
252	*Onesimoides mediterraneus*	X			X								
253	*Orchomene grimaldii*	X	X	X	X								
254	*Orchomene humilis*	X	X	X		X	X	X	X	X			
255	*Orchomene massiliensis*	X	X	X	X								
256	*Orchomene similis*	X		X				X					
257	*Orchomenella nana*	X	X	X		X	X	X	X	X		X	
258	*Paracentromedon crenulatum*	X	X				X	X					
259	*Pardia punctata*	X	X			X							
260	*Perrierella audouiniana*	X	X	X		X	X	X	X	X			
261	*Podoprion bolivari*	X		X			X	X					
262	*Podoprionella fissicaudata*	X			X								
263	*Prachynella mediterranea*			X	X								
264	*Rhinolabia parthenopeia*	X		X	X								
265	*Scopelocheirus hopei*	X	X	X				X	X	X	X		
266	*Scopelocheirus polymedus*	X			X								
267	*Socarnes filicornis*	X	X	X			X	X	X			?X	
268	*Sophrosyne hispana*	X	X	X			X	X					
269	*Tmetonyx nardonis*	X	X	X		X							
270	*Tmetonyx similis*	X		X			X	X	X	X	X		
271	*Trischizostoma nicaeense*	X						X	X				
272	*Trischizostoma raschi*			X						X	X		
273	*Tryphosella caecula*	X	X				X			X	X		
274	*Tryphosella dilatata*	X			X								
275	*Tryphosella longidactyla*	X		X				X					

	WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
276 *Typhosella minima*	X	X			X		X					
277 *Typhosella nanoides*	X								X	X		
278 *Typhosella simillima*	X	X		X								
279 *Typhosites alleni*	X	X			X		X	X				
280 *Typhosites longipes*	X	X	X		X	X	X	X	X	X		
Megaluropidae												
281 *Megaluropus massiliensis*	X	X		X								
282 *Megaluropus monasteriensis*	X	X	X	X								
Melitidae												
283 *Abludomelita aculeata*	X				X							
284 *Abludomelita gladiosa*	X		X			X	X	X				
285 *Abludomelita obtusata*	X				X	X	X	X	X			X
286 *Ceradocus orchestiipes*	X	X	X		X	X						
287 *Ceradocus semiserratus*	X	X				X	X	X				
288 *Cheirocratus assimilis*	X	X				X	X	X	X			
289 *Cheirocratus monodontus*	X			X								
290 *Cheirocratus sundevalli*	X	X	X			X	X	X	X	X		
291 *Degocheirocratus spani*			X	X								
292 *Elasmopus affinis*	X	X	X		X						X	
293 *Elasmopus brasiliensis*	X	X	X		X	X					X	
294 *Elasmopus pectenicrus*	X	X	X		X	X					X	
295 *Elasmopus pocillimanus*	X	X	X		X	X					X	
296 *Elasmopus rapax*	X	X	X		X	X	X	X	X		X	X
297 *Elasmopus vachoni*	X				X	X						
298 *Eriopisa elongata*	X	X	X			X	X	X	X	X	X	
299 *Eriopisella ruffoi*	X			X								
300 *Gammarella fucicola*	X	X	X		X	X	X	X			X	
301 *Gammarella garciai*	X			X								
302 *Linguimaera caesaris*	X	X									X	
303 *Maera grossimana*	X	X	X		X	X	X	OX				
304 *Maera hirondellei*	X	X	X		X	X						
305 *Maera pachytelson*	X	X		X								
306 *Maera schieckei*	X			X								
307 *Maera sodalis*	X		X	X								
308 *Maerella tenuimana*	X	X	X			X	X	X				
309 *Melita bulla*	X	X	X	X								
310 *Melita coroninii*	X	X	X		X							
311 *Melita hergensis*	X	X	X		X	X	X	X				
312 *Melita palmata*	X	X	X		X	X	X	X	X			
313 *Melita valesi*	X	X	X	X								
314 *Melita virgula*		X		X								
315 *Othomaera knudseni*	X				X							
316 *Othomaera othonis*	X				X	X	X	X	X			
317 *Othomaera schmidtii*	X	X	X	X								
318 *Psammogammarus caecus*	X		X			X						
319 *Psammogammarus gracilis*		X		X								

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw Arct		Ind-P	Cosm
320	*Pseudoniphargus adriaticus*	X		X	X								
321	*Pseudoniphargus africanus*	X			X								
322	*Quadrimaera ariadne*		X		X								
323	*Quadrimaera aurora*	X	X	X	X								
324	*Quadrimaera inaequipes*	X	X	X		X	X	X				X	
325	*Quadrimaera revelata*	X	X		X								
	Melphidippidae												
326	*Melphidippella macra*	X	X	X		X		X	X	X			
	Oedicerotidae												
327	*Arrhis mediterraneus*	X						X					
328	*Bathymedon acutifrons*	X						X					
329	*Bathymedon banyulsensis*	X			X								
330	*Bathymedon longirostris*	X			X								
331	*Bathymedon monoculodiformis*	X	X					X					
332	*Halicreion aequicornis*	X						X	X	X			
333	*Monoculodes acutipes*	X	X					X					
334	*Monoculodes carinatus*	X	X	X			X	X	X	X			
335	*Monoculodes gibbosus*	X	X	X				X					
336	*Monoculodes griseus*	X		X	X								
337	*Monoculodes latissimanus*	X									X		
338	*Monoculodes packardi*	X	X	X				X	X	X	X		
339	*Monoculodes subnudus*	X	X	X			X	X	X	X			
340	*Oediceroides pilosus*	X	X		X								
341	*Oediceropsis brevicornis*	X	X					X		X			
342	*Perioculodes aequimanus*	X	X	X		X						X	
343	*Perioculodes longimanus longimanus*	X	X	X		X	X	X	X	X		X	X
344	*Perioculodes longimanus angustipes*	X	X	X				X					
345	*Pontocrates altamarinus*	X	X			X	X	X	X	X			
346	*Pontocrates arenarius*	X	X	X		X	X	X	X	X			
347	*Synchelidium haplocheles*	X	X	X			X	X	X	X		X	
348	*Synchelidium longidigitatum*	X	X	X			X						
349	*Synchelidium maculatum*	X	X			X	X	X	OX				
350	*Westwoodilla caecula*	X	X			X	X	X	X	X			
351	*Westwoodilla rectirostris*	X	X	X		X	X	X					
	Pardaliscidae												
352	*Arculfia trago mediterranea*	X	X		X								
353	*Halice abyssi*	X	X	X				X		X	X		
354	*Halice walkeri*	X	X	X	X								
355	*Nicippe tumida*	X	X	X		X	X	X	X	X	X		
356	*Pardalisca brachydactyla*	X			X								
357	*Pardalisca mediterranea*	X						X					
358	*Pardaliscella boeckii*	X								X	X		
359	*Pardaliscoides stebbingi*	X			X								
360	*Pardaliscoides tenellus*	X										X	

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw	Arct	Ind-P	Cosm
Phliantidae													
361	*Pereionotus testudo*	X	X	X		X	X	X	OX				
Phoxocephalidae													
362	*Harpinia agna*	X			X								
363	*Harpinia ala*	X	X		X								
364	*Harpinia antennaria*	X		X		X	X	X	X	X	X		
365	*Harpinia crenulata*	X	X	X			X	X	X	X	X		
366	*Harpinia dellavallei*	X	X	X				X					
367	*Harpinia pectinata*	X	X	X		X	X	X	X	X			
368	*Harpinia truncata*	X		X						X	X		
369	*Harpinia zavodniki*	X			X								
370	*Metaphoxus fultoni*	X	X	X			X	X	OX				
371	*Metaphoxus gruneri*	X	X	X	X								
372	*Metaphoxus simplex*	X	X	X		X	X	X	X				
373	*Paraphoxus oculatus*	X	X	X			X		X	X	X		
374	*Phoxocephalus aquosus*	X			X								
Pleustidae													
375	*Pleustoides mediterraneus*	X			X								
376	*Stenopleustes nodifer*	X						X	X	X			
Podoceridae													
377	*Dulichiopsis nordlandicus*	X	X							X	X		
378	*Laetmatophilus ledoyeri*	X	X	X	X								
379	*Parunciola seurati*	X			X								
380	*Podocerus chelonophilus*	X					X						
381	*Podocerus schieckei*	X	X		X								
382	*Podocerus variegatus*	X	X	X		X	X	X	OX				
Pontoporeiidae													
383	*Bathyporeia guilliamsoniana*	X	X	X			X	X	X	X			
384	*Bathyporeia leucophthalma*	X			X								
385	*Bathyporeia lindstromi*	X	X		X								
386	*Bathyporeia megalops*	X		X	X								
387	*Bathyporeia nana*	X						X	X				
388	*Bathyporeia phaiophthalma*	X		X	X								
389	*Bathyporeia pseudopelagica*	X			X								
390	*Bathyporeia sardoa*	X			X								
391	*Bathyporeia sophiae*	X			X								
392	*Bathyporeia sunnivae*	X	X		X								
Sebidae													
393	*Seba aloe*	X	X	X	X								
Stegocephalidae													
394	*Mediterexis mimonectes*	X		X				X					

		WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw Arct		Ind-P	Cosm
395	*Pseudo pseudophippsia*		X		X								
396	*Stegocephaloides christianiensis*	X	X	X				X	X	X	X		
	Stenothoidae												
397	*Stenothoe antennulariae*	X	X		X								
398	*Stenothoe bosphorana*	X	X	X			X						
399	*Stenothoe cavimana*	X	X					X					
400	*Stenothoe dollfusi*	X	X	X			X						
401	*Stenothoe eduardi*	X	X			X	X	X	OX				
402	*Stenothoe elachista*	X	X		X								
403	*Stenothoe gallensis*	X	X			X						X	
404	*Stenothoe mandragora*	X	X	X	X								
405	*Stenothoe marina*	X	X			X	X	X	X	X			
406	*Stenothoe monoculoides*	X	X	X		X	X	X	X	X		X	
407	*Stenothoe pieropan*	X			X								
408	*Stenothoe tergestina*	X	X	X		X	X	X	OX				
409	*Stenothoe valida*	X	X	X		X	X	X	OX				X
	Synopiidae												
410	*Bruzelia typica*	X	X	X				X	X	X			
411	*Ileraustroe ilergetes ilergetes*	X	X		X								
412	*Pseudotiron bouvieri*	X	X		X								
413	*Syrrhoe affinis*	X	X	X		X		X					
414	*Syrrhoe angulipes*	X			X								
415	*Syrrhoites barnardi*	X			X								
416	*Syrrhoites capricornia*	X			X								
417	*Syrrhoites cornuta*	X			X								
418	*Syrrhoites pusilla*	X						X		X			
	Talitridae												
419	*Deshayesorchestia deshayesi*	X	X	X			X	X	X				
420	*Macarorchestia remyi*	X	X		X								
421	*Orchestia cavimana*	X	X	X			X	X	X				
422	*Orchestia gammarella*	X	X	X		X	X	X	X	X	X		
423	*Orchestia kosswigi*		X		X								
424	*Orchestia mediterranea*	X	X	X		X	X	X	X				
425	*Orchestia montagui*	X	X	X	X								
426	*Orchestia stephenseni*	X	X	X	X								
427	*Platorchestia platensis*	X	X	X		X	X		X				X
428	*Sardorchestia pelecaniformis*	X			X								
429	*Talitrus saltator*	X	X	X		X	X	X	X	X			
430	*Talorchestia brito*	X	X			X	X	X	X				
431	*Talorchestia ugolinii*	X			X								
	Urothoidae												
432	*Urothoe corsica*	X	X	X	X								

	WM	EM	Adr	ME	Afr	Ib	Fr	Br	Norw Arct	Ind-P	Cosm
433 *Urothoe elegans*	X	X	X		X	X	X	X	X	X	
434 *Urothoe esperiae*	X			X							
435 *Urothoe grimaldii*	X	X	X		X		X			X	
436 *Urothoe intermedia*	X	X		X							
437 *Urothoe poseidonis*	X					X	X	X			
438 *Urothoe pulchella*	X	X	X		X	X	X	X			
Valettiidae											
439 *Valettietta punctata*		X		X							
Ingolfiellidae											
440 *Ingolfiella ischitana*	X			X							
Caprellidae											
441 *Caprella acanthifera*	X	X	X		X	X	X	X			
442 *Caprella andreae*	X	X	X			X	X				X
443 *Caprella danilewskii*	X	X	X		X	X	X				X
444 *Caprella dilatata*	X	X			X						
445 *Caprella equilibra*	X	X	X		X	X	X	X	X	X	X
446 *Caprella grandimana*	X	X			X						
447 *Caprella hirsuta*	X	X			X						
448 *Caprella lilliput*	X			X							
449 *Caprella liparotensis*	X	X	X		X	X					
450 *Caprella mitis*	X	X		X							
451 *Caprella penantis*	X	X	X		X	X					
452 *Caprella rapax*	X	X				X					
453 *Caprella santosrosasi*	X			X							
454 *Caprella scaura*			X							X	
455 *Caprella telarpax*	X			X							
456 *Parvipalpus linea*	X	X	X	X							
457 *Parvipalpus maior*	X	X					X				
458 *Pseudolirius kroyeri*	X	X	X	X							
Pariambidae											
459 *Deutella schieckei*	X			X							
460 *Liropus elongatus*	X			X							
461 *Liropus minimus*	X			X							
462 *Pariambus typicus*	X	X	X		X	X	X	X	X		
463 *Pedoculina bacescui*	X			X							
464 *Pedoculina garciagomezi*	X			X							
465 *Pseudoprotella phasma*	X	X	X		X	X	X	X			
Phtisicidae											
466 *Phtisica marina*	X	X	X		X	X	X	X	X		