Helgol Mar Res (1999) 53:2–8

ORIGINAL ARTICLE

Mercedes Conradi · Pablo J. López-González

The benthic Gammaridea (Crustacea, Amphipoda) fauna of Algeciras Bay (Strait of Gibraltar): distributional ecology and some biogeographical considerations

Received: 22 May 1997 / Accepted: 18 May 1998

Abstract The Gammaridea fauna of Algeciras Bay, located on the Mediterranean side of the Strait of Gibraltar, was studied with regard to the species composition, distribution and ecology. Of the 116 species identified, 13 are recorded for the first time along the Iberian Peninsula coast, 30 for the Spanish coast and 78 for the Andalusian coast. Two species, *Apherusa bispinosa* (Bate 1857) and *Idunella nana* (Schiecke 1973), were collected for the second time in the Mediterranean Sea; this represents the first record of *I. nana* since its original description. The abundances of the various species and their distribution in terms of bathymetry and type of substrate were analysed, as was the enlargement of the distributional range of some species in the Mediterranean Sea. With regard to biogeographical distribution, Algeciras Bay can be considered a typical Mediterranean locality despite being situated in the Strait of Gibraltar. This is in agreement with previous studies on the amphipod fauna of the Portuguese coast.

Key words Gammaridea · Distribution · Crustacea · Biogeography · Strait of Gibraltar

Introduction

The Mediterranean Amphipoda fauna has been widely studied, and can be considered one of the best known in the world, with a total of 452 recorded species. Knowledge of this order is not uniform throughout the entire Mediterranean, however, since 97% of species are known from the Western basin, 54% from the Oriental basin and 52% from the Adriatic Sea (Bellan-Santini and Ruffo 1995). Despite this fact, the Mediterranean coast of the Iberian Peninsula has been studied relatively infrequently, although the number of recorded species in this region has increased considerably since 1974. According to Jimeno (1993), there are 368 known species along the coast of the Iberian Peninsula, of which only 146 are from the Mediterranean side, while 272 species are from the Portuguese coast. Fifty-nine percent of these species are found only in the Atlantic Ocean, 30% in both the Atlantic and Mediterranean, and 11% exclusively in the Mediterranean Sea.

The Strait of Gibraltar is a biogeographic zone in which faunas of the Mediterranean and the Atlantic, along one axis, and of Europe and Africa along the other, overlap. Algeciras Bay is a conspicuous area situated on the Iberian side of the Strait of Gibraltar, being the most western zone of the Mediterranean Sea. Recently, Sanchez-Moyano et al. (1995) listed a total of 16 caprellidean species in this area, four of which were new records from the Iberian Peninsula and one species not reported previously. The present paper contributes to the knowledge of the gammaridean Amphipoda of the Iberian Peninsula coast.

M. Conradi
Departamento de Biología Animal, Vegetal y Ecología,
Fac. Ciencias del Mar, Univ. de Cádiz, Apdo. 40,
E-11510 Puerto Real (Cádiz), Spain

P.J. López-Gonzáles (✉)
Laboratorio de Biología Marina,
Departamento de Fisiología y Biología Animal, Fac. de Biología,
Univ. de Sevilla, Apdo. 1095, E-41080 Sevilla, Spain
e-mail: Jlopez@cica.es

Materials and methods

Algeciras Bay was divided into zones to facilite sampling (Fig. 1). Hard bottoms were sampled by scuba diving, pieces of the various substrata (seaweeds, bryozoans, hydrozoans, sponges, etc.) being collected in plastic bags containing seawater; the samples were then fixed with a 10% formalin-seawater solution. Soft bottoms were culled with a Van Veen dredge (0.046 m^2). These samples were sieved through a 0.5 mm sieve and the infauna was preserved in 5% buffered formaldehyde, containing a Rose Bengal solution as a staining agent to facilite sorting of organisms later on. The samples were obtained from intertidal zones up to the 30-m isobath. Amphipods were separated, sorted, preserved in 70% ethanol, and then identified to species level and counted. The system of classification followed was that proposed by Bellan-Santini et al. (1998).

We have classified the species in geographical distribution groups, following Arístegui and Cruz (1986), although we have

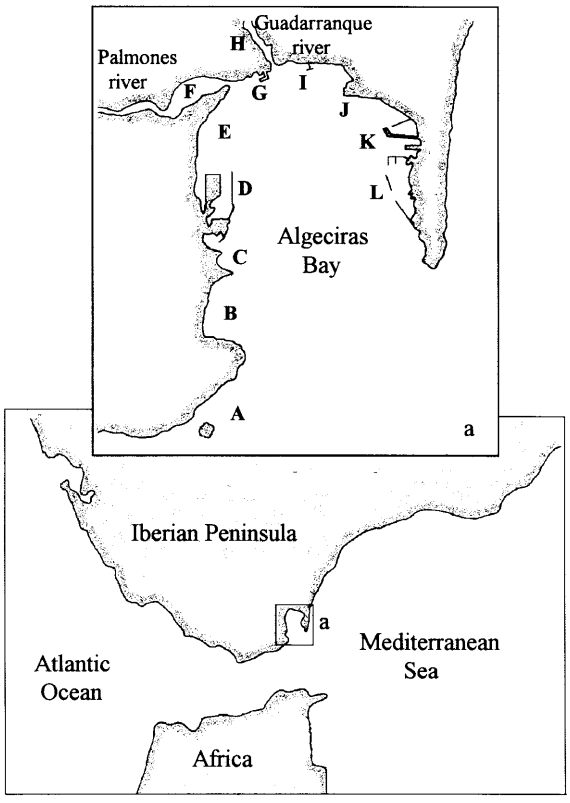

Fig. 1 Study area, showing sampled zones

slightly changed some of their categories. We have considered the biogeographical regions of the eastern Atlantic according to Fredj (1974), which were later modified by Bellan-Santini and Dauvin (1988a,b) and followed by Marques and Bellan-Santini (1990). The groups considered represent wide areas of distribution, designed in such a way that each species may be included in only one category. The groups considered are the following:

I: Endemic Mediterranean
II: North-eastern Atlantic, present in the Mediterranean.
  A. Boreotemperate
  B. Subtropical or warm-temperate
  C. Wide latitudinal distribution (A + B)
III: North-eastern Atlantic, absent in the Mediterranean
  A. Boreotemperate
  B. Subtropical or warm-temperate
  C. Wide latitudinal distribution (A + B)
IV: North-eastern, present in the Mediterranean and Indo-Pacific Ocean
V: Amphiatlantic
VI: Circumtropical
VII: Cosmopolitan

Results and discussion

A total of 131,706 individuals were identified and grouped into 116 different species belonging to 62 genera and 29 families (Table 1). Among these 116 species, 13 (12% of the total species) were recorded for the first time along the Iberian Peninsula, 30 (28%) along the Spanish coast and 78 (73%) along the Andalusian coast. The species marked with an asterisk were recorded along the Andalusian coast by Ruffo and Krapp-Schickel (personal communication), although these findings have not yet been published; therefore these are not considered as first records. One species, *Urothoe hesperiae*, was new to science (Conradi et al., 1995). Four species, *Apherusa alacris*, *Leucothoe occulta*, *Microjassa cumbrensis* and *Peltocoxa gibbosa*, were collected for the second time along the Iberian Peninsula.

Among 44 families present in the Mediterranean Sea, 29 (66%) were found in Algeciras Bay. The families best represented in this area were Corophiidae, Cressidae, Dexaminidae, Iphimediidae, Ischyroceridae and Liljeborgiidae. The most poorly represented families were Eusiridae, Lysianassidae, Melitidae and Oedicerotidae. The dominant family was Aoridae with 12% of the total species, followed by Corophiidae, Lysianassidae and Melitidae with 7%. In each of the following families, a single species was found: Colomastigidae, Gammaridae, Megaluropidae, Phliantidae, Pleustidae, Podoceridae and Talitridae.

With regard to the abundance of the species recorded in Algeciras Bay, six categories have been considered, according to the number of times the species was found in the total of samples: very common (more than 100 times), quite common (51–100 times), common (25–50 times), uncommon (10–25 times), rare (5–10 times) and quite rare (1–5 times). Twenty-seven species were found to be very common and 20 species quite rare. Only five species were quite common, 18 common, 16 uncommon and 10 rare. Two species, *Eusiroides dellavallei* and *Gammaropsis palmata*, uncommon in the Mediterranean Sea (Ledoyer 1982; Myers 1989), are quite common and common, respectively, in Algeciras Bay.

Thirty-nine species (33% of the total) are well distributed along the coast of Algeciras Bay, appearing in almost five different sampled zones (see Fig. 1). About the same number of species, 38, have been collected in just one of these zones. Some species, such as *Corophium acherisicum*, *C. insidiosum*, *C. orientale* and *Gammaropsis insensibilis*, were found only in the zones influenced by the rivers. Others, such as *Peltocoxa gibbosa*, *P. marioni*, *Apherusa alacris* and the four species belonging to the genus *Hyale*, were collected in the outer areas of the bay.

Species distribution according to the type of substrate

Fifty-five species (47%) were found exclusively in a particular type of substrate, 29 (25%) on soft bottoms and 26 (22%) on hard bottoms. Twenty-three species (about 20%) occurred on both hard and soft bottoms. Seventeen (14%) of the species studied were sampled once, and consequently their preferences for a type of substrate cannot be considered significant. Thirteen species (11%) were recorded exclusively on the bryozoan *Bugula neritina* (L., 1758). Ten species (about 9%) were ephyphite to algae and 13 (11%) were found in various types of substrata.

Table 1 Benthic marine gammarids from Algeciras Bay. *NS* Number of specimens studied; *Station* sampled zone; *Depth* in metres; *Substratum*: *AR Archinoe fictitius*; *B Bugula neritina*; *C Caulerpa prolifera*; *CO Codium vermilara*; *H Halopteris scorparia*; *L Laminaria* sp.; *M Mesophillum* sp.; *P Padina* sp.; *PH Phyllaria* sp.; *S Sphaerococcus* sp.; *SY Sydnium elegans*; *A* sand; *AC* sand and biodetrital; *AG* coarse sand; *AM* medium sand; *ARC* clayey bottom; *DE* detrital bottom; *F* mud; *FA* mud and sand; *FB* mud and biodetrital; *R* hard bottom; *New record*: *A* Andalusian coast; *E* Spanish coast; *MA* Mediterranean Andalusian coast; *PI* Iberian Peninsula; *BG* biogeographical group (see text); *species previously recorded along the Andalusian coast but not yet published (Ruffo and Krapp-Schickel, personal communication), and not considered as first record in the present study; 1°, 2°, 3°: first, second or third record for a determined geographical area

Taxon	NS	Station	Depth	Substratum	New record	BG
Ampeliscidae						
Ampelisca brevicornis (A. Costa 1853)	76	A, B, C, D, G, I	5–30	F, A, ARC, AF, DE	1ª A	VII
Ampelisca diadema (A. Costa 1853)	42	K, I, A, A	5–30	H, C, AC	1ª MA	IIc
Ampelisca gibba (G.O. Sars 1882)	5	D, E	5–15	AF, A	1ª E, 1ª A	IIc
Ampelisca sarsi (Chevreux 1888)	9	B, G	5–30	AM, DE	1ª E, 1ª A	IIc
Ampelisca spinipes Boeck 1861	1	A	8	H	1ª E, 1ª A	V
Ampelisca typica (Bate 1856)	39	B, D, E, I	5–30	AF, A, DE, ARC	1ª A	IIc
Amphilochidae						
Amphilochus brunneus Della Valle 1893	1	A	30	AC	1ªE, 1ªA	IV
Amphilochus neapolitanus Della Valle 1893	52	A, C, K	5–10	B, H, C	*	IV
Amphilochus picadurus J.L. Barnard 1962	752	A, B, C, D, G, I, K, L	3–10	B, H	1ªA	I
Gitana sarsi Boeck 1871	35	D, G, I, K, L	4–9	B	*	IIc
Peltocoxa gibbosa (Schiecke 1977)	8	C, L	9	B	1ª A, 2ª PI	I
Peltocoxa marioni Catta 1875	20	C, L	7–12	B, CO	*	IIc
Ampithoidae						
Ampithoe ferox (Chevreux 1902)	2	C	3–9	B	1ª A	IIc
Ampithoe ramondi Audouin 1826	155	B, C, D, G, A, KC,	4–12	H, M, S, B, CO	*	VII
Ampithoe riedli Schickel 1968	2	B	3	R	*	I
Aoridae						
Aora gracilis (Bate 1857)	17	B, D, G	3–5	PH, R, F	1ª A	IIa
Aora spinicornis Afonso 1976	362	A, B, C, D, E, G, H, I	5–30	F, AC, H, P, AF, CO, B	*	IIc
Lembos rubromaculatus Ledoyer 1973	1	C	9	B	1ª A	IIa
Lembos viguieri Chevreux 1911	22	B, G, I, K	5–30	C, F, AC, DE	1ª A	V
Lembos websteri Bate 1857	2770	K, A, C, D, J, G, H, L, I	3–30	B, C, H, F, R, FB, DE, A, CO	1ª A	I
Leptocheirus hirsutimanus (Bate 1862)	109	D, B	4–30	AM, AC, R	1ª E, 1ª A	IIc
Leptocheirus mariae G. Karaman 1973	3	B	30	AC	1ª PI, 1ª E, 1ª A	I
Leptocheirus pectinatus (Norman 1869)	1	I	15	FB	1ª E, 1ª A	IIa
Leprocheirus pilosus Zaddach 1844	3	I	5–30	FB, DE	1ª A	IIa
Microdeutopus algicola Della Valle 1893	1	D	5	ARC	1ª A	I
Microdeutopus armatus Chevreux 1887	101	A, B, D, H	3–12	CO, H	1ª E, 1ª A	IIa
Microdeutopus chelifer (Bate 1862)	2	J, E	3–5	H, PH	1ª A	IIa
Microdeutopus stationis Della Valle 1893	1	A	10	H	*	IIc
Microdeutopus versiculatus (Bate 1856)	45	A, B, E, G, I, K	5–30	C, FB, DE, F, A, AF, H	1ª MA	IIa
Colomastigidae						
Colomastix pusilla Grube 1861	35	A, C, G, K, L	6–9	B	*	VII
Corophiidae						
Corophium acherusicum A. Costa 1851	14	F	0–5	A, AF	1ª A	VII
Corophium acutum Chevreux 1908	10,594	A, B, C, D, E G, H, K, I, L	5–9 5–30	H, B, S, FB, CO	1ª A	VII
Corophium annulatum Chevreux 1908	131	B, C, D, E, G, I, K		C, FB, DE, F, A, AF, ARC, F, A, CO	1ª PI, 1ª E, 1ª A	I
Corophium insidiosum Crawford 1937	2	G, H	5–6	H, B	1ª A	VII
Corophium orientale Schellenberg 1928	17	F	0–5	A, AF	1ª E, 1ª A	I
Corophium runcicorne Della Va1le 1893	285	D, G, I	5–15	F, FB, ARC,	1ª E, 1ª A	IIa
Corophium sextonae Crawford 1937	1962	A, B, C, E, G, I, K, L	3–9	AF R, FB, CO	*	IIa
Siphonoecetes sp.	361	D, I, C, B, G	3–30	A, AF, FB, C, H, B		

Table 1 (continued)

Taxon	NS	Station	Depth	Substratum	New record	BG
Cressidae						
Cressa cristata Myers 1969	5	A	9	CO	1[a] A	I
Cressa mediterranea Ruffo 1979	1139	C, G, K, L	7–9	B	*	IIb
Dexaminidae						
Atylus swammerdami (MilneEdwards 1830)	217	B, G, I	5–15	FB, AM, F	*	VII
Atylus vedlomensis Bate and Westwood 1862	29	B	30	AC	1[a] E, 1[a] A	IIa
Dexamine spiniventris (A. Costa 1853)	49	A, B, C, D, H, I, K, L	4–10	H, B, FB	*	II
Dexamine spinosa (Montagu 1813)	100	A, B, D, I, G	3–12	H, B, CO, L, FB, F	*	IIc
Guernea coalita (Norman 1868)	8	A	10	H	1[a] A	IIc
Tritaeta gibbosa (Bate 1862)	276	B, C, D, E, G, I, K, L	5–12	B, SY, S, AR, CO	1[a] A	IIc
Eusiridae						
Apherusa alacris Krapp-Schickel 1969	31	A, B	5–10	H	1[a] E, 1[a] A, 2[a] PI	IIb
Apherusa bispinosa (Bate 1857)	211	A, B, C, D, G	5–15	FC, H, CO, B		IIc
Apherusa chiereghinii Giordani-Soika 1950	36	A, B, D, H, I	4–10	H, B	1[a] A	I
Eusiroides dellavallei Chevreux 1899	111	C, D, K, L	6–9	B	1[a] MA	IIc
Gammaridae						
Gammarus insensibilis Stock 1966	132	F	0–5	A, AF	1[a] E, 1[a] A	IIa
Haustoriidae						
Haustorius sp.	1	F	0–5	A		
Hyalidae						
Hyale camptonyx (Heller 1866)	18	A	10	H	*	IV
Hyale crassipes (Heller 1866)	6	C	4	H	1[a] PI, 1[a] E; 1[a] A	IIc
Hyale perieri (Lucas 1849)	35	B	4–10	B	*	IIc
Hyale schmidti (Heller 1866)	1	A	10	H	*	I
Iphimediidae						
Coboldus nitior Krapp-Schickel 1974	2	B	4	H	1[a] PI, 1[a] E, 1[a] A	I
Iphimedia brachygnatha Ruffo and Schiecke 1979	2	A	10	H	1[a] A	I
Iphimedia minuta G.O. Sars 1882	227	B, C, D, G, I, K, L	6–9	B, H, CO	1[a] A	IIc
Iphimedia obesa Rathke 1843	42	A, J	5–10	H	1[a] A	I
Iphimedia sp.	12	L	9	B		
Iphimedia vicina Ruffo and Schiecke 1979	1	C	9	B	1[a] PI, 1[a] E, 1[a] A	I
Isaeidae						
Gammaropsis maculata (Johnston 1827)	6544	A, B, C, D, E, G, H, I, KL S,	3–30	R, FB, B, CO, H, A, DE, AC		IIa
Gammaropsis palmata (Stebbing and Robertson 1891)	92	A, B, D	9–12	B, CO	1[a]PI, 1[a] E, 1[a] A	IIa
Megamphopus cornutus Norman 1869	153	A, B, G, D, E, G, I	9–30	F, B, A, AF, DE, H, CO	1[a] A, 2[a] E	IIa
Microprotopus sp.	1653	A, B, C	9–12	B, H, CO		
Photis longipes (Della Valle 1893)	134	A, B, C, G, I	4–30	H, AG, A, G, AF, F, FB	1[a] A	IIc
Ischyroceridae						
Ericthonius brasiliensis (Dana 1855)	857	B, D, E, G, K, I, L	3–12	B, H, CO		IIc
Ericthonius punctatus (Bate 1857)	3	D	9	S	*	IIc
Ischyrocerus inexpectatus Ruffo 1959	21,899	G, K, D, I, L, C	5–9	B, C, CO	*	IIa
Jassa marmorata Holmes 1903	46,376	G, I, K, G, D, L, F	3–9	B, FB, A, AF, CO	*	I
Microjassa cumbrensis Stebbing and Robertson 1891	8018	B, C, D, G, I, K, L	5–12	B, CO	1[a] A, 2[a] PI	IIa
Leucothoidae						
Leucothoe oboa G.S. Karaman 1871	91	D, I, B, G, E AF, A, C	3–30	F, FC, AC, R,	1[a] E, 1[a] A	IIa
Leucothoe occulta Krapp-Schickel 1975	7	G, D	5	A, AF	1[a] E, 1[o] A, 2[a] PI	VII
Leucothoe spinicarpa (Abildgaard 1789)	282	A, C, E, D, G, K, L, I	3–12	SY, PO, B, A, R, H, CO	*	IIb
Liljeborgiidae						
Idunella nana (Schieckel 1973)	2	B	30	AC	1[a] PI, 1[a] E, 1[a] A	I
Liljeborgia dellavallei Stebbing 1906	7	D, K, I	3–20	R	*	I

Table 1 (continued)

Taxon	NS	Station	Depth	Substratum	New record	BG
Lysianassidae						
Hippomedon massiliensis Bellan-Santini 1965	41	B, D, E, G	4–30	A, F, DE, B	1ª PI, 1ª E, 1º A	IIc
Lepidepecreum crypticum Ruffo and Schiecke 1977	1	D	19	AG	1ª PI, 1ª E, 1ª A	IIa
Lysianassa costae Milne Edwards 1830	209	A, B, C, D, G, K, L	9–30	AC, H, B, DE, CO	1ª A	IIa
Lysianassa longicornis Lucas 1849	3	C, D	3–9	B, R	1ª A	IIc
Lysianassa pilicornis Heller 1866	9	L, C	9–25	R	1ª A	IIc
Orchomene sp.	31	C, D, E, G, J	5–30	H, DE, B		
Orchomenella nana (Kröyer 1846)	4	B	5–15	A	1ª MA	IIc
Tryphosites longipes (Bate and Westwood 1861)	12	B, G, I	5–15	A, F	1ª E, 1ª A	IIc
Megaluropidae						
Megaluropus massiliensis Ledoyer 1976	23	B, G	5–15	A, AF, F	1ª PI, 1ª A	I
Melitidae						
Ceradocus orchestiipes A. Costa 1853	6	C	9	B	1ª PI, 1ª E, 1ª A	IIc
Cheirocratus sundevalli (Rathke 1843)	13	A, D, G	5–30	H, DE, AF	1ª E, 1ª A	IIc
Elasmopus sp.	1433	B, C, D, E, K, I, L	3–10	B, A, M, H, CO		
Gammarella fucicola (Leach 1814)	42	E, G, I, H, K	5–15	C, A, F, DE	*	V
Maera grossimana (Montagu 1808)	3	I	30	DE	*	IIc
Maera inaequipes (A. Costa 1857)	119	D, C	3–9	R	*	IIc
Melita gladiosa Bate 1862	18	C, D	9	B	1ª A	IIa
Melita palmata (Montagu 1804)	618	C, F, I	5	FB, B	1ª MA	VII
Oedicerotidae						
Monoculodes carinatus (Bate 1857)	8	D, G, E	5	ARC, AF, A	1ª A, 2ª E	IIa
Perioculodes longimanus (Bate and Westwood 1868)	48	B, D, F, G, I, E	4–30	AC, A, FB, DE, F	1ª A	IIc
Pontocrates arenarius (Bate 1858)	40	B, D, E, G, I	0–30	A, DE	1ª A	IIa
Synchelidium longidigitatum Ruffo 1947	46	B, A, D, G, L, I, E, H	3–30	AG, H, F, A, AF, DE, B	1ª A, 2ª E, 3ª PI	IIc
Phliantidae						
Pereionotus testudo (Montagu 1808)	19	A, B, C, L	4–10	M, H	*	V
Phoxocephalidae						
Harpinia sp.	22	B, E, K	5–30	C, AC		
Metaphoxus fultoni (Scott 1890)	4	K, B	6–30	C, AC	1ª A, 2ª E	IIa
Paraphoxus sp.	1	D	5	ARC		
Pleustidae						
Stenopleustes sp.	22	I	3–6	B		
Podoceridae						
Podocerus variegatus Leach 1814	9671	A, C, D, G, I, K, L	5–12	B, H, CO	1ª A	IIc
Pontoporeiidae						
Bathyporeia guilliamsoniana (Bate 1857)	57	A, G, E	5	AM, A	1a E, 1ª A	IIc
Bathyporeia megalops Chevreux 1911	1	D	5	F	1ª PI, 1ª E, 1ª A	I
Bathyporeia nana Toulmond 1966	3	A, E	5	AM	1ª PI, 1ª E, 1ª A	IIa
Stenothoidae						
Stenothoe dollfusi Chevreux 1887	1976	C, D, I, K, L	6–9	B	1ª A	IIc
Stenothoe eduardi Krapp-Schickel 1976	1700	C, D, I, K, L	5–9	B	1ª E, 1ª A	IIc
Stenothoe gallensis Wa1ker 1904	1	G	15	F	*	VI
Stenothoe monoculoides (Montagu 1813)	1276	A, B, C, G, H, I, J, K, L, D	3–10	B, H, FB, A	*	IIc
Stenothoe tergestina (Nebeski 1880)	7295	C, G, I, K, L	3–9	B	*	IIa
Talitridae						
Talitrus saltator (Montagu 1808)	9	B, K, G	5–6	C, FB, AM	1ª A	IIc
Urothoidae						
Urothoe hesperiae Conradi et al. 1995	22	C	3–30	A		
Urothoe sp. 1	41	B	5–15	A		
Urothoe sp. 2	11	E		A		
No. of individuals	131,706					

Some species were collected in substrata which are atypical in the Mediterranean Sea. *Ampelisca gibba*, *Iphimedia obesa*, *Leucothoe oboa*, *Melita gladiosa* and *Orchomenella nana* are well-known species of muddy bottoms (Bellan-Santini 1982; Karaman 1982; Ruffo and Schiecke 1982; Diviacco and Ruffo 1989; Krapp-Schickel 1989a), while we found them, respectively, in fine sand, epyphite to *Halopteis scorparia* (L.) Sauvag, in various types of substrata, associated with the bryozoan *Bugula neritina*, and on sandy bottoms. *Corophium annulatum* has been recorded in soft grey mud (Myers 1982b) and *Megamphorus cornutus* on sandy bottoms (Myers 1989). However, we collected both species in a great variety of substrata. *Atylus swammerdami*, *Perioculodes longimanus* and *Pontocrates arenarius* live especially on sandy bottoms (Bellan-Santini 1982; Ledoyer 1993) but we recorded *A. swammerdami* and *P. longimanus* on muddy bottoms and *P. longimanus* and *Pontocrates arenarius* on detrital bottoms.

Vertical distribution of species

Four species, *Corophium annulatum*, *Microdeutopus chelifer*, *Podocerus variegatus* and *Stenothoe gallensis*, rarely appear at depths of less than 6 m (Myers 1982a,b; Krapp-Schickel 1993; Ruffo 1993) in the Mediterranean Sea. We recorded them in deeper waters than those in which they normally appear. Five species, *Lembos rubromaculatus*, *Coboldus nitior*, *Gammaropsis palmata*, *Leucothoe oboa* and *Ceradocus orchestiipes*, which are typical of deep waters (Karaman 1982; Myers 1982a, 1989; Ruffo and Schiecke 1982; Krapp-Schieckel 1989a), were found in shallow waters.

Enlargement in the Mediterranean distribution

Among the species recorded in Algeciras Bay, *Lembos rubromaculatus*, *L. viguieri* and *Leptocheirus hirsutimanus* are distributed only in the western region of the Mediterranean Sea, the present record being the westernmost locality. Hitherto, the species *Leptocheirus mariae* was essentially limited to the north-central region of the Mediterranean (Myers 1982a). Three species, *Corophium annulatum*, *Bathyporeia nana* and *Iphimedia obesa*, do not have a well-known distribution because records of these are scarce.

The records of *Apherusa bispinosa* and *Idunella nana* are important, because this is the second time that these species have been found in the Mediterranean. Moreover, *I. nana* was recorded for the first time since its original description in 1973 (Krapp-Schickel 1989b).

Biogeographical considerations

The classification of species in geographical distribution groups (Fig. 2, Table 1) shows that most species have an Atlantic-Mediterranean distribution (groups I and II, 83.7%), with 18.3% being endemic Mediterranean species, which are at their known western limit. Group II is the best represented, comprising 65.4% of the species. This group is divided into three subgroups: species with wide distribution (IIc, 36.5%); boreotemperate species (IIa, 26%) and subtropical or warm-temperate species (IIb, 2.9%). This shows that Algeciras Bay has fauna more common to northern European faunas than to a geographically closer African fauna. No endemic Atlantic species were found in the Mediterranean (group III). The number of species present in the north-eastern Atlantic, Mediterranean and Indo-Pacific Ocean (group IV) is low (1.9%). The amphiatlantic species (group V) represent 3.8% of the total, and the cosmopolitan species (group VII) 9.6%. Only one species, *Stenothoe gallensis*, has a circumtropical distribution (group VI, 1%).

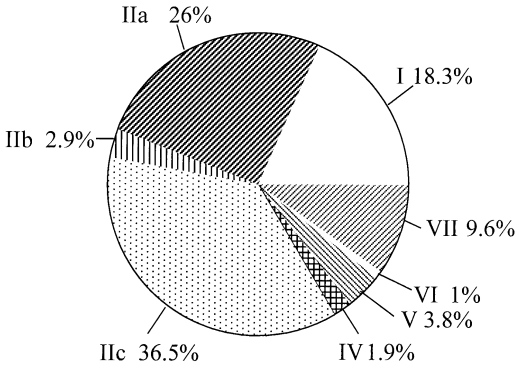

Fig. 2 Percentage of species in the zoogeographical groups considered

With regard to the Gammaridea fauna of Algeciras Bay, this zone can be considered a typical Mediterranean locality despite being situated in the Strait of Gibraltar. This is mainly due to the high number of Mediterranean endemisms and the lack of Atlantic ones. This is in agreement with the study of Marques and Bellan-Santini (1990), which shows that the Mediterranean influence extends beyond the Strait of Gibraltar, and, therefore, the amphipod fauna of the Portuguese coast should be considered Atlantic-Mediterranean.

The Gammaridea fauna of the Algeciras Bay is, in accordance with the data of Bellan-Santini and Ruffo (1995) (but excluding data on Ingolfiellidea and Caprellidea) very similar to that of the entire Mediterranean. However, the percentage of endemic Mediterranean species is lower in the area we studied (18.3%) than in the Mediterranean Sea (38%). This may be due to the higher number of endemisms present in the eastern Mediterranean in comparison with the western Mediterranean (Jimeno 1993), and to the higher percentage of Atlantic-Mediterranean species recorded in Algeciras Bay (65.4%) compared with those observed in the Mediterranean Sea (57%).

The main difference between the Gammaridea fauna of Algeciras Bay and that of the boreal area (data ob-

tained from Lincoln 1979 for the British Isles) is, excluding the absence or presence of Atlantic and Mediterranean endemisms (30% of Atlantic endemisms in the British Isles and 18.3% of Mediterranean endemisms in Algeciras Bay), the percentage of Atlantic-Mediterranean species (group II, 35% in the British Isles and 65% in Algeciras Bay). Thus, Algeciras Bay is clearly characterized by the presence of an important warm-temperate component of Atlantic-Mediterranean species that do not reach the boreal areas.

Acknowledgements This research has been partially supported by the project "Fauna Iberica III" (DGICYT PB92-0121). We are grateful to CEPSA (Compañía Española de Petróleos, S.A.), Fundación Sevillana de Electricidad, Excmo. Ayuntamineto de los Barrios and Mancomunidad de Municipios del Campo de Gibraltar for financial support of this work.

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Communicated by H.-D. Franke