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Some notes on the intertidal gammarids (Crustacea, Amphipoda) from the Atlantic coast of the Iberian peninsula

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RÉSUMÉ

Pendant le mois d'Avril 1974 des prélèvements furent effectués dans la zone de marées le long de la côte Atlantique de l'Espagne et de la côte Portugaise. Figure 1 donne un aperçu des espèces provenant des stations visitées. Les tableaux II jusqu'à VI incl. montrent la nature du milieu, dans lequel les Gammarides furent trouvés.

Douze espèces furent rencontrées, dont *Gammarus salinus* est mentionné pour la première fois de l'Espagne et *Chaetogammarus stoenensis* de Portugal.

INTRODUCTION

During April 1974 samples of gammarid amphipods were collected in the tidal zone of the Atlantic coast of Spain and Portugal. Sampling was carried out during low tide. The animals were caught either by hand or with a dip net. At a number of collecting stations water samples were taken and the salinity was measured with the aid of a refractometer. Table I gives the positions of the localities which were visited and which yielded positive results.

RESULTS

The distribution of the gammarid species, which were collected at the various stations, is shown in figure 1. The tables II to VI summarize the nature of the biotopes, in which the different species occurred. The sampling localities are arranged according to the gammarids which were found. The following gammarid amphipods were collected:

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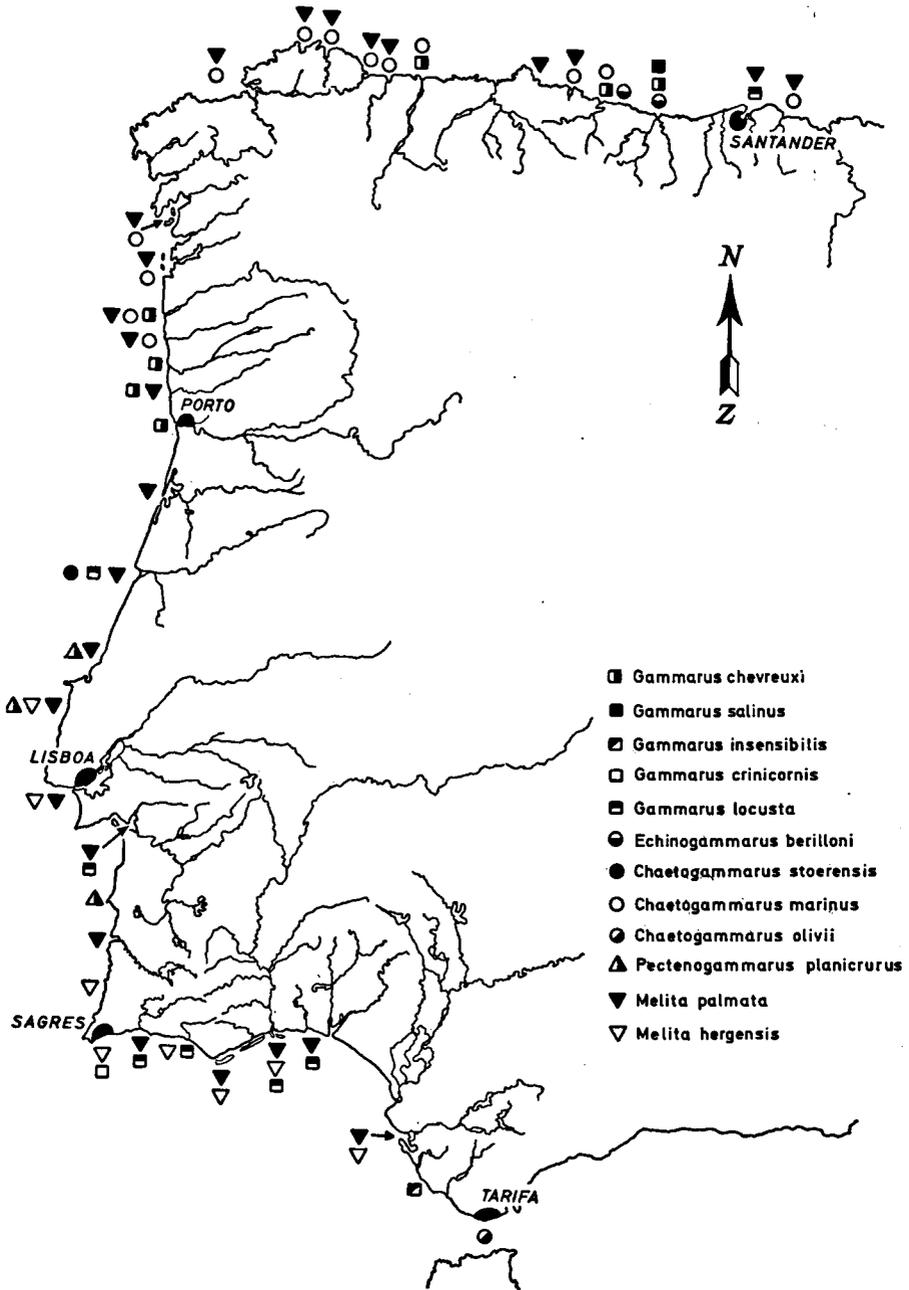


FIG. 1. The distribution of the gammarid Amphipoda along the Atlantic coast of the Iberian peninsula.

- Gammarus locusta* (Linnaeus, 1758)
Gammarus insensibilis Stock, 1966
Gammarus chevreuxi Sexton, 1913
Gammarus crinicornis Stock, 1966
Gammarus salinus Spooner, 1947
Pectenogammarus planicrurus (Reid, 1940)
Echinogammarus berilloni (Catta, 1878)
Chaetogammarus olivii (H. Milne Edwards, 1830)
Chaetogammarus storerensis (Reid, 1938)
Chaetogammarus marinus (Leach, 1815)
Melita palmata (Montagu, 1804)
Melita hergensis Reid, 1939

Table I. Position of the sampling stations along the Atlantic coast of the Iberian peninsula. * = sampling stations where no gammarids, but talitrids have been found.

| Station | Date (1974) | Position | Province |
|---------|-------------|---|--------------------|
| 1 | 1—IV | Tarifa, E. of the dike to the Isla de Las Palomas | Cadiz (Andalucia) |
| 2 | 2—IV | Conil, mouth of the Rio Salado | Cadiz (Andalucia) |
| 3* | 2—IV | Santi Petri, near river mouth | Cadiz (Andalucia) |
| 4* | 2—IV | Santi Petri, near river mouth | Cadiz (Andalucia) |
| 5 | 2—IV | Puerto de la Sta. Maria, near the mouth of the Rio Guadalete | Cadiz (Andalucia) |
| 6 | 3—IV | El Rompido, estuary of the Rio Piedra | Huelva (Andalucia) |
| 7 | 3—IV | Isla Christina, estuary of the Rio Guadiana (Portuguese-Spanish frontier) | Huelva (Andalucia) |
| 8 | 4—IV | Faro, lagoon | Algarve |
| 9 | 4—IV | Quarteira, the beach | Algarve |
| 10 | 4—IV | Albufeira, the beach near the cliff | Algarve |
| 11 | 5—IV | Ferragudo, harbour, estuary of the Ribeira de Odelouca | Algarve |
| 12 | 5—IV | Ferragudo, harbour, estuary of the R. de O. | Algarve |
| 13* | 5—IV | Lagos, the beach | Algarve |
| 14 | 5—IV | Sagres, the beach | Algarve |
| 15 | 6—IV | Aljezur, N.W. of, near the mouth of the Ribeira de Aljezur | Algarve |
| 16 | 6—IV | V.a N.a de Milfontes, estuary of the Rio Mira | Alentejo Baixo |
| 17 | 6—IV | Sines, the harbour | Alentejo Baixo |
| 18 | 7—IV | Setubal, S.E. of, estuary of the Rio Sado | Estremadura |
| 19 | 8—IV | Carcavélos, near the mouth of the Rio Tejo | Estremadura |
| 20 | 9—IV | Porto Novo, W. of Maceira, midway Ericeira and Peniche | Estremadura |

| Station | Date (1974) | Position | Province |
|---------|----------------|--|------------------------------|
| 21 | 10—IV | S. Martinho do Porto, harbour | Estremadura |
| 22 | 10—IV | Figueira da Foz, harbour, near the mouth of the Rio Mondego | Beira Litoral |
| 23 | 11—IV | Barra, W. of Aveiro, estuary of the Rio Vouga | Beira Litoral |
| 24 | 12—IV | Porto, left bank of the Rio Douro | Douro Litoral |
| 25 | 12—IV | Villa do Conde, right bank of the Rio Vizeta | Douro Litoral |
| 26 | 12—IV | Villa do Conde, right bank of the Rio Vizeta, more downstream than station 25 | Douro Litoral |
| 27 | 12—IV | Esposende, estuary | Minho |
| 28 | 12—IV | Esposende, estuary, more downstream than 27 | Minho |
| 29 | 12—IV | Viano do Castelo, estuary of the Rio Lima, left bank | Minho |
| 30 | 13—IV | Viano do Castelo, estuary of the Rio Lima, left bank | Minho |
| 31 | 13—IV | Caminha, left bank of the estuary of the Rio Minho (Spanish-Portuguese frontier) | Minho |
| 32 | 13—IV | Arcade, near the bridge, estuary of the Rio Verdugo (ceramics factory) | Pontevedra (Galicia) |
| 33 | 13—IV | Villagarcia de Arosa, Ria de Arosa | Pontevedra (Galicia) |
| 34 | 14—IV | Castro, near the bridge, estuary of the Rio Mero | La Coruña (Galicia) |
| 35 | 14—IV | Fiobre, near the bridge, estuary of the Rio de Betanzos | La Coruña (Galicia) |
| 36 | 14—IV | Ortigueira, W. of the harbour, Ria de Santa Maria | La Coruña (Galicia) |
| 37 | 15—IV | Vivero, large pool in connection with the harbour | Lugo (Galicia) |
| 38 | 15—IV | Foz, near the mouth of the Rio Masma | Lugo (Galicia) |
| 39 | 15—IV | Castropol, harbour, near the pier, estuary of the Rio Eo | Oviedo (Costa Cantabrica) |
| 40 | 15—IV | Navia, right bank of the Rio Navia | Oviedo (Costa Cantabrica) |
| 41 | 16—IV | Perlora, N.W. of, near river mouth | Oviedo (Costa Cantabrica) |
| 42 | 16—IV | Selorio, S.W. of, near the bridge, Ria de Villaviciosa | Oviedo (Costa Cantabrica) |
| 43 | 16—IV | Ribadesella, downstream of the bridge, left bank of the Rio Sella | Oviedo (Costa Cantabrica) |
| 44 | 16—IV | Playa de S. Antolín, near the mouth of Rio Bedón, in a pool | Oviedo (Costa Cantabrica) |
| 45 | 17—IV | Playa de la Franca, in and near the mouth of the Rio de las Cabras | Oviedo (Costa Cantabrica) |
| 46 | 18—IV | Pedreña, Bahía de Santander | Santander (Costa Cantabrica) |
| 47 | 19—IV | Treto, near the bridge, right bank of the Rio Asón | Santander (Costa Cantabrica) |

Table II shows some ecological data of the collecting stations, where *Chaetogammarus marinus* occurred. This species has been found as far south as the Rio Lima near Viano do Castelo (Portugal, Prov. of Minho). It was present mainly at localities with estuarine conditions (muddy substrate, reduced salinity). At all stations specimens in precopulation were observed. The accompanying gammarid fauna consisted of *Melita palmata* (in 11 localities) and of *Gammarus chevreuxi* (at 3 sampling stations).

Ecological data on the localities where *Melita palmata* was found are sum-

Table II. Some environmental factors in sampling stations where *Chaetogammarus marinus* was present. m = mud, s = sand, g = gravel, sh = shingle, c = cobbles, p.c. = specimens in precopulation present, ov. ♀♀ = ovigerous ♀♀.

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Substrate: | Further particulars: |
|-----------------|--------------|----------------|--|---------------------|--|
| 29 | 15.5 | 3 | <i>Fucus spec.</i> | m+s+c | p.c.; ov. ♀♀; slightly polluted |
| 30 | | | <i>F. spiralis</i> | m+s+c | present in the entire <i>Fucus</i> -zone; p.c. |
| 31 ^B | | | <i>F. ceranoides</i> + <i>Chaetomorpha</i> | quay-wall+ m | p.c. |
| 32 | | 4 | <i>F. ceranoides</i> + <i>F. spiralis</i> | quay-wall+ m+s+c | p.c.; under stones and among potsherds |
| 33 | 20 | | <i>Chaetomorpha</i> + <i>F. spiralis</i> + <i>F. ceranoides</i> | m+s+g+c | p.c. |
| 35 | 14.2 | 9 | <i>F. cer.</i> + <i>F. spir.</i> + <i>F. ves.</i> + <i>Chaetom.</i> + <i>Enteromorpha</i> | m+sh+c | p.c.; slightly polluted |
| 36 | 14 | 32 | <i>F. spir.</i> + <i>F. ves.</i> + <i>A. nodosum</i> + <i>Chaet.</i> + <i>Enteromorpha</i> | m+s+sh+c | p.c.; under and among stones |
| 37 ^A | 14.8 | fresh | <i>F. spir.</i> + <i>Ulva</i> + <i>Chaetomorpha</i> | s+sh+c | p.c.; many specimens |
| 38 | | 40 | <i>F. spir.</i> + <i>F. ves.</i> + <i>Chaet.</i> + <i>Ulva</i> | s+c | p.c.; ov. ♀♀; in tide pools |
| 39 | 18 | 16 | <i>F. ves.</i> + <i>Chaetom.</i> + <i>Enterom.</i> + <i>Ulva</i> | m+s+c | p.c.; cv. ♀♀ |
| 40 | | | <i>F. ceranoides</i> | m+s+c | p.c. |
| 42 ^A | 18.2 | fresh | <i>F. ves.</i> + <i>A. nod.</i> | m+c | under the algae on mud; p.c.; ov. ♀♀ |
| 43 | | fresh | <i>Chaetomorpha</i> | m+s+c | p.c.; under stones; slightly polluted; many <i>Sphaeroma</i> |
| 47 ^A | | 7 | <i>F. cer.</i> + <i>Enterom.</i> + <i>Chaetomorpha</i> | m+sh+c | among stones |
| 47 ^B | | | <i>F. ceranoides</i> | m+c | p.c.; ov. ♀♀; under algae |

marized in table III. Salinity measurements (at low tide) show a range for this species from fresh water up to a salinity of 41‰. The nature of the substrate (often muddy) and of the vegetation, present at the stations where *M. palmata* occurred, are indicative of estuarine conditions. This gammarid was found all along the Atlantic coast of the Iberian peninsula. When present, almost always ovigerous ♀♀ and/or specimens in precopulation were observed. South of the distribution limit of *Chaetogammarus marinus*, *Melita palmata* was found together with *Chaetogammarus stoerensis* (at Figueira da Foz) and was at 4 collecting stations accompanied by *Melita hergensis*. In 5 localities *Gammarus locusta* was the accompanying gammarid.

A survey of the conditions at the stations where *Gammarus locusta* was collected is shown in table IV^A. This species has not been found in localities with a very reduced salinity. It occurred mainly among *Ulva* and *Enteromor-*

Table III. Some environmental factors in sampling stations where *Melita palmata* occurred. m = mud, s = sand, shl = shells or shell grit, g = gravel, sh = shingle, c = cobbles, r = rock, d = detritus, p.c. = specimens in precopulation present, ov. ♀♀ = ovigerous ♀♀.

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Substrate: | Further particulars: |
|----------|--------------|----------------|--|--------------------|--|
| 5 | 17.6 | | <i>Chaetomorpha</i> | s+c+r+shl | |
| 6 | 16.5 | 41 | <i>Enteromorpha</i> <i>Chaetomorpha</i> | m+s+c m+s+c+shl | very polluted estuary, black mud layer near to the surface |
| 8B | 16.2 | | <i>Chaet.+Ent.+F. ves.+Ulva</i> | m+s+sh+c | on a boulder; pH=6; slightly polluted; black mud; ov. ♀♀ |
| 11 | | | <i>Ulva+Enterom.</i> | m+s | among the algae |
| 12 | | | <i>Chaetomorpha</i> | m+sh+c | under stones; moderately polluted; ov. ♀♀ |
| 16 | 15.9 | | <i>F. ves.+Chaet.</i> | m+s | very little <i>Fucus</i> |
| 18 | 21.5 | 25 | <i>Ulva+Enterom.+F. ves.</i> | m+s+c | p.c.; ov. ♀♀; under stones and among <i>Ulva</i> , on mud; slightly polluted |
| 19 | | 39 | <i>Chaetom.+F. ves.+Ulva</i> | m+shl+sh+s+c | p.c.; ov. ♀♀; black mud near to surface; under stones; few gamm.; many crabs, <i>Gobius</i> , <i>Mytilus</i> |
| 20 | 14.1 | 31 | — | g+c+r | under stones in tide pools; ov. ♀♀ |
| 21A | | | <i>Ulva+Chaetom.</i> | s+c | |
| 22 | 14 | 17 | <i>Chaetom.+Ent.</i> | s+shl+c | p.c.; ov. ♀♀; also <i>Sphaeroma</i> |

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Substrate: | Further particulars: |
|----------|--------------|----------------|---|-------------------|---|
| 23 | 13.4 | 39 | <i>Chaetom.</i> + <i>Ent.</i> + <i>F. spiralis</i> | m+s+c | ov. ♀♀; under stones |
| 26 | | | <i>F. vesiculosus</i> | g+r | ov. ♀♀; more exposed than station 25 |
| 29 | 15.5 | 3 | <i>Fucus spec.</i> | | slightly polluted |
| 30 | | | <i>F. spiralis</i> | m+s+c | |
| 31B | | | <i>F. ceranoides</i> + <i>Chaetomorpha</i> | quay-wall + m | |
| 32 | | 4 | <i>F. cer.</i> + <i>F. spir.</i> | quay-wall + m+s+c | under stones and among potsherds |
| 33 | 20 | | <i>Chaetom.</i> + <i>F. spir.</i> + <i>F. cer.</i> | m+s+g+c | |
| 34 | | | — | m+s+shl+c | ov. ♀♀; a few specimens; black mud near to surface |
| 35 | 14.2 | 9 | <i>F. ves.</i> + <i>F. cer.</i> + <i>F. spir.</i> + <i>Chaetom.</i> + <i>Enteromorpha</i> | m+sh+c | slightly polluted |
| 36 | 14 | 32 | <i>F. spir.</i> + <i>F. ves.</i> + <i>A. nod.</i> + <i>Chaetom.</i> + <i>Enteromorpha</i> | m+s+sh+c | p.c.; ov. ♀♀; under and among stones |
| 37A | 14.8 | fresh | <i>Chaetom.</i> + <i>Ent.</i> | m+sh+c | p.c.; ov. ♀♀; many specimens |
| 38 | | 40 | <i>Chaetom.</i> + <i>Ulva</i> + <i>F. spir.</i> + <i>F. ves.</i> | s+c | p.c.; ov. ♀♀; in tide pools |
| 39 | 18 | 16 | <i>F. ves.</i> + <i>Chaetom.</i> + <i>Ulva</i> + <i>Enterom.</i> | m+s+c | |
| 41 | | | — | g+c | ov. ♀♀; under stones in tide pools near river mouth |
| 42B | | | <i>Chaetom.</i> + <i>Fucus</i> | m+c | under stones; desiccated Fucoidea |
| 46A | | 8 | <i>F. spir.</i> + <i>F. cer.</i> + <i>Ulva</i> | m+s+d+c +r | ov. ♀♀; under stones |
| 47A | | 7 | <i>F. cer.</i> + <i>Enterom.</i> | m+sh+c | |

pha on a substrate that in most cases included mud. At a station, where *Gammarus locusta* was the only occurring gammarid (Quarteira, station 9), the beach was rather exposed and the substrate consisted of sand, shells and cobbles.

The nature of the biotopes in which *Gammarus chevreuxi* occurred is shown in table IV^B. At all collecting stations, specimens in precopulation and ovigerous ♀♀ were observed. This species was collected on muddy substrates and on coarser substrates (gravel, shell grit, shingle). *G. chevreuxi* was found in water of reduced salinity.

Table IV. Some environmental factors in stations where *Gammarus locusta* was present (A) and in sampling stations where *Gammarus chevreuxi* was present (B). m = mud, s = sand, shl = shells or shell grit, g = gravel, sh = shingle, c = cobbles, r = rock, p.c. = specimens in precopulation present, ov. ♀♀ = ovigerous ♀♀.

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Substrate: | Further particulars: |
|----------|--------------|----------------|---|---------------|---|
| A) 6 | 16.5 | 41 | <i>Enteromorpha</i> | m+s+c | |
| 7 | | 41 | <i>Chaetomorpha</i> | m+s+shl+c | very polluted estuary; black mud near to surface |
| 9 | 14.5 | | <i>Chaetomorpha</i> | s+shl+c | p.c.; also <i>Mytilus</i> |
| 11 | 18.2 | 19 | <i>Ulva+Enterom.</i> | m+s | ov. ♀♀; among the algae |
| 18 | 21.5 | 25 | <i>Ulva+Enterom.</i> (+ <i>F. ves.</i>) | m+s+c | p.c.; under stones and among <i>Ulva</i> ; slightly polluted |
| 22 | 14 | 17 | <i>Chaetom.+Ent.</i> | s+shl+c | p.c.; also <i>Sphaeroma</i> |
| 46B | | | <i>Ulva+Chaetom.</i> | m+s+r | among the algae, in tide pool |
| B) 24 | 13.8 | fresh | <i>Ent.+F. spir.+F. cer.</i> | m+g+c | p.c.; ov. ♀♀; black mud near surface; a few gamm; many <i>Sphaeroma</i> , <i>Nereis</i> , <i>Anguilla</i> |
| 25 | 14 | fresh | <i>Chaetom.+F. spir.+F. cer.</i> | g+c | many specimens; p.c.; ov. ♀♀ under stones |
| 27 | | 4 | <i>Enterom.+F. spiralis</i> | m+s+c | p.c.; ov. ♀♀; among the algae |
| 28 | | | <i>F. vesiculosus</i> | g+c | more downstream than 27; p.c.; ov. ♀♀ |
| 31A | 14.5 | 3 | <i>F. ceranoides</i> | m+s+r | p.c.; ov. ♀♀ |
| 31B | | | <i>Chaetom.+F. cer.</i> | quay-wall + m | p.c.; ov. ♀♀ |
| 40 | | | <i>F. ceranoides</i> | m+s+c | p.c.; ov. ♀♀ |
| 43 | | fresh | <i>Chaetom. (+F.)</i> | m+s+c | p.c.; ov. ♀♀; under stones; slightly polluted; many <i>Sphaeroma</i> |
| 45A | 12 | fresh | <i>Chaetomorpha</i> | sh+c | clear, moderately running stream; depth: 0.15 m; width: 10 m; many specimens |
| 45B | | fresh | — | sh+c | p.c.; ov. ♀♀; under and among stones |

The data on *Melita hergensis*, summarized in table VA, show the occurrence of this gammarid on rather exposed beaches on a substrate consisting at most stations of coarser elements. In four localities (of which two had a muddy

substrate) *Melita palmata* was also present and in one *Gammarus locusta* as well. At Sagres the accompanying species was *Gammarus crinicornis* and at station 20, *Melita hergensis* occurred along with *Pectenogammarus planicrurus*. The latter species was found in still two other localities (table V^B).

Table V. Some environmental factors in sampling stations where *Melita hergensis* occurred (A) and in stations where *Pectenogammarus planicrurus* was present (B). m = mud, s = sand, g = gravel, shl = shells or shell grit, sh = shingle, c = cobbles, r = rock, p.c. = specimens in precopulation present, ov. ♀♀ = ovigerous ♀♀.

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Further particulars: | Substrate: |
|----------------|--------------|----------------|---|----------------------|---|
| A) 5 | 17.6 | | <i>Chaetomorpha</i> | s+shl+c+r | |
| 8 ^B | 16.2 | | <i>Chaetom.</i> + <i>Ent.</i> + <i>F. ves.</i> + <i>Ulva</i> | m+g+c | on stones, being situated on black mud; pH =6; slightly polluted |
| 10 | | | <i>Chaetomorpha</i> | s+shl+c+r | p.c.; ov. ♀♀; under stones; also <i>Mytilus</i> |
| 14 | 13 | | — | s+c | under stones in tide pools |
| 15 | 13.8 | 40 | — | s+sh+r | in rock pool; exposed beach |
| 19 | | 39 | <i>Chaetom.</i> + <i>F. ves.</i> + <i>Ulva</i> | m+s+sh+shl+c | p.c.; ov. ♀♀; under stones; black mud near surface; many crabs, sea-anemones, worms, <i>Gobius</i> , <i>Mytilus</i> ; a few gamm. |
| 20 | 14.1 | 31 | — | g+c+r | under stones in tide pools; rather exposed beach |
| <hr/> | | | | | |
| B) 17 | | | — | s+sh+c | p.c.; ov. ♀♀; on pro-lapsed quay |
| 20 | 14.1 | 31 | — | g+c+r | under stones in tide pools; ov. ♀♀ |
| 21A | | | <i>Ulva</i> + <i>Chaetom.</i> | s+c | |

Echinogammarus berilloni has been collected at two stations in the province of Oviedo in N. Spain: On the Playa de San Antolin, occurring alone in a pool near the river mouth, on the beach, and on the Playa de la Franca, co-existing with *Gammarus chevreuxi* and *Gammarus salinus* (table VI^A).

Table VI (B-F) shows a survey of the data obtained on the gammarid species, which were sampled only in one locality.

Some of the sampling stations which were visited did not yield any results. At most of these stations, pollution was moderate to heavy. Also, on some very exposed parts of the coast or on sandy beaches entirely devoid of stones

Table VI. Some environmental factors in stations with the following species: A) *Echinogammarus berilloni*, B) *Chaetogammarus stoerensis*, C) *Gammarus crinicornis*, D) *Gammarus insensibilis*, E) *Chaetogammarus olivii*, F) *Gammarus salinus*. s = sand, g = gravel, shl = shells or shell gritt, sh = shingle, c = cobbles, p.c. = specimens in precopulation present, ov. ♀♀ = ovigerous ♀♀.

| Station: | Temp. in °C: | Salinity in ‰: | Vegetation: | Substrate: | Further particulars: |
|----------|--------------|----------------|----------------------|------------|---|
| A) 44 | 13.8 | fresh | <i>Chaetomorpha</i> | s+c | p.c.; ov. ♀♀; many specimens |
| 45A | 12 | fresh | <i>Chaetomorpha</i> | sh+c | clear, moderately running water; 0.15 m deep; 10 m wide; ov. ♀♀ |
| 45B | | fresh | — | sh | under and among stones in shallow water; p.c.; ov. ♀♀; many specimens |
| B) 22 | 14 | 17 | <i>Chaetom.+Ent.</i> | s+shl+c | p.c.; ov. ♀♀; also <i>Sphaeroma</i> |
| C) 14 | 13 | | — | s+c | under stones in tide pools; p.c.; ov. ♀♀ |
| D) 2 | 19.8 | 42 | <i>Enteromorpha</i> | m+s+c | under stones; depth: 0.10 m; rather poll. p.c.; ov. ♀♀ |
| E) 1 | 14.2 | | <i>Enteromorpha</i> | g+c | p.c.; ov. ♀♀; under stones; rather exp. beach; many <i>Sphaeroma</i> |
| F) 45B | 12 | fresh | — | sh+c | ov. ♀; under and among stones in shallow water |

and vegetation, no gammarids were found (i.e. the coast region of Ericeira, prov. of Estremadura, Portugal).

DISCUSSION

The occurrence of *Chaetogammarus marinus* at widely varying salinities is not in disagreement with the data mentioned in literature on this species (den Hartog, 1964; Vader, 1965; van Maren, 1974). Until now the southernmost locality from which it was recorded, is the Bassin d'Arcachon near Bordeaux in France (Labourg et al., 1971).

At collecting station 43, the estuary of the Rio Sella (prov. of Oviedo), *Ch. marinus* occurred together with *G. chevreuxi* under stones in a rather

dry habitat of muddy sand. Crawford (1937) mentions the coexistence of these two species in one locality. But it seems improbable that they were found in one habitat. During investigations in the Dourduff estuary (Brittany, France) both gammarids were observed, however not in the same micro-biotope: *G. chevreuxi* was found in the riverbed, while *Ch. marinus* occurred on the mudflats among the Fucoidea (van Maren, 1974).

According to Vader (1965) *Ch. marinus* shows a preference for muddy substrates. The present data are in agreement with this. In the northern range of its distribution area, *Chaetogammarus marinus* is recorded as occurring together with *Eulimnogammarus obtusatus* (Dahl, 1938) in the tidal zone of the more exposed beaches (den Hartog, 1964; Vader, 1965) and it is accompanied by *Gammarus duebeni duebeni* Lilljeborg, 1852 in the *Fucus*-zone of the Norwegian fjords (Dennert, 1973). During the present investigation, *Ch. marinus* was found to occur, at most of the sampling stations, in coexistence with *Melita palmata*. This combination of species seems to be much rarer in the northern range of its distribution.

The presence of specimens of *Ch. marinus* in precopulation, in the month of April, is in agreement with the data of den Hartog (1964).

Salinities, measured in localities with *Melita palmata*, are much lower than those given by den Hartog (1964). These data confirm, however, the salinity observations which were made in the Dourduff estuary (van Maren, 1974).

Schellenberg (1942) records the occurrence of *M. palmata* as far south as Senegal and the Canary Islands. Thus the present investigations do not extend the known distribution area of this gammarid.

According to den Hartog (1964), reproduction of *M. palmata* takes place in the summer. Contrary to the present investigations, he did not find ovigerous ♀ ♀ in April.

The fact that *Gammarus locusta* has been sampled only in localities with a high salinity, is in accordance with the data mentioned by den Hartog (1964) for this gammarid. Also its occurrence on muddy substrate is recorded by this author. Jones (1948) states that *G. locusta* shows a preference for sandy substrates. The vegetation at the Iberian collecting stations consisted of euryhaline algae like *Ulva*, *Enteromorpha* and *Chaetomorpha*. However, both den Hartog (1964) and Goodhart (1941) found it to occur mainly in the sublittoral.

Stock (1967) records *Gammarus locusta* as far south as Setubal (Portugal). It has been found, during the present investigations, near this locality as well as at five other stations south of Setubal, to El Rompido (prov. of Huelva, Spain).

The nature of the biotopes in which *Gammarus chevreuxi* was observed in Spain and Portugal is in agreement with the data in the literature (Gras & Maasen, 1971; van Maren, 1974). According to Sexton (1924), this gammarid shows reproductive activity throughout all seasons.

Since Karaman (1935) records *Gammarus chevreuxi* from the coast region of Algeria, the present investigations do not extend its distribution area.

Until now, little is known about the distribution and ecology of *Melita*

hergensis. Reid (1939), who described the species for the first time, records its occurrence from several localities in England, from the island of Guernsey, and from Naples (Stebbing collection). Jones (1948) found this gammarid also in the littoral of the Isle of Man, Truchot (1962) on the coast of Brittany (France). In disagreement with the data of Reid (1939) and of Truchot (1962), recording this species in the *Fucus serratus*-zone or lower still on the beach, is the presence of this gammarid among algae like *F. vesiculosus*, *Ulva*, *Chaetomorpha* and *Enteromorpha* in several localities in Spain and Portugal.

Although it is difficult to draw any conclusions on the ecology of *M. hergensis* from the few records available, the present data might indicate that it has a preference for less muddy substrates than *Melita palmata*.

In a note on *Melita hergensis*, David (1956) stressed that the finger of the second gnathopod hand of the male specimens, found in England, is not raised as in the original description by Reid, but lowered and fitting in a depression of the palm, partially overlain by a loose felt of fine hairs. The shape of the second gnathopod hand of the male specimens, sampled on the Iberian peninsula, meets entirely this description.

Pectenogammarus planicrurus is for the first time recorded from the coast of Portugal. This species was already known from Great Britain (Reid, 1940), including the Isle of Man (Jones, 1948) and from Ireland (Duhig & Humphries, 1955). The occurrence of this gammarid in the Mediterranean is mentioned by Kant, Pinkster & Stock (1968). From the few samples that are available, it is impossible to conclude anything on the ecology of *Pectenogammarus planicrurus*. According to Morgan (1970) salinity is of little importance for the distribution of the present species, but the nature of the substrate is of primary interest. The fact that this gammarid has been found, during the present investigations, on coarser substrates agrees with Morgan's data.

The occurrence of *Echinogammarus berilloni* in the estuarine part of streams in the province of Oviedo (Spain) was already known from the data recorded by Pinkster (1973). The watersamples, taken at low tide, show a very reduced salinity. However, it has been demonstrated by Vincent (1966, 1967, 1971) that *E. berilloni* is very well able to withstand the high salinities occurring at high tide in these estuaries. (At both our stations the specimens have been collected on the beach, in and near the river mouth). According to Pinkster (1973), *E. berilloni* could penetrate in the estuarine regions, only when brackish water species, like *Gammarus chevreuxi*, are absent. In the estuary of the Rio de las Cabras (at Playa de la Franca), however, *G. chevreuxi* was present (as was *Gammarus salinus*). Both *E. berilloni* and *G. chevreuxi* occurred in large numbers and specimens in precopulation and ovigerous ♀♀ of these species were observed. These data do not agree with those obtained for the Dourduff estuary in Brittany (van Maren, 1974): only during the period in which the numbers of *Gammarus chevreuxi* were reduced, *Echinogammarus berilloni* seemed to be able to maintain itself in the estuarine part of the river. Moreover a difference in reproduction period between the latter species and *G. chevreuxi* was established.

The occurrence of *Chaetogammarus stoerensis* under stones, on a substrate of sand and shell grit, at a reduced salinity (17‰) is in agreement with the data recorded in the literature (Steen, 1951; den Hartog, 1964; Vader, 1964). Up to now no mention has been made of the occurrence of this species in Portugal.

The only station, where *Gammarus crinicornis* was sampled, was at Sagres, the very S.W. point of the European continent. From the Atlantic coast of Europe, this gammarid has been recorded as far south as the Bassin d'Arcachon in France (Labourg et al., 1971). In the above mentioned Portuguese locality, specimens in precopulation and ovigerous ♀♀ were observed (temp. 13°C), which is in accordance with the data of Dumay (1973).

Stock (1967) records the occurrence of *Gammarus insensibilis* at two stations in Brittany (France). Labourg et al. (1971) mention this species from the Bassin d'Arcachon. No further data on its distribution along the Atlantic coast of the European continent are available. The fact that the sample from Conil (prov. of Cadiz, Spain) consists of rather small specimens, is in accordance with the data on the difference in size between the Atlantic and Mediterranean representatives of this species (Stock, 1967).

The gammarids collected at Tarifa, the southern-most locality of the Iberian peninsula, meet the re-description of *Chaetogammarus olivii* by Stock (1968) and of its junior synonym *Marinogammarus atlanticus* as given by Dahl (1958). This species did not occur in any of the samples from the Atlantic coast of Spain and Portugal. The only station along the Atlantic coast of the European continent, from which *Ch. olivii* (under the name of *Gammarus olivii*) is recorded, is Etel (S. Brittany, France) (Chevreux & Fage, 1925). It should be noted, however, that the occurrence of this species there was not established by Chevreux and Fage themselves, but was taken from a letter by Dr. Vauthier. Recent collecting at Etel did not yield any specimens of *Chaetogammarus olivii* nor did the many samples taken all along the rest of the coast of Brittany. Reid (1940) records *Gammarus olivii* from the River Afon in Great Britain. Though, he states that the specimens from this locality do not fit exactly the description given by Chevreux and Fage (1925).

The southernmost locality from which *Gammarus salinus* is recorded up to now, is Port de Goulée (dept. Landes, France) (Stock, in lit.). Stock et al. (1966) established the following distribution of species in the river Slack (N. France): *Echinogammarus berilloni*, more downstream replaced by *Gammarus zaddachi*, which in its turn is replaced by *Gammarus salinus* and other polyhaline gammarids in the mesohaline parts of the estuary. The coexistence of *Gammarus salinus* with *E. berilloni* and *G. chevreuxi* in the estuary of the Rio de las Cabras in Spain, might be explained by the fact that *Gammarus zaddachi* was absent. According to den Hartog (1964) *G. salinus* and *G. zaddachi* show an interspecific competition.

The occurrence of ovigerous ♀♀ of *G. salinus* in April agrees with the observations of den Hartog (1964).

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REFERENCES

- CHEVREUX, E. & L. FAGE
1925 Amphipodes. — Faune de France, 9 : 1—488.
- CRAWFORD, G. I.
1937 The fauna of certain estuaries in West England and South Wales, with special reference to the Tanaidaceae, Isopoda and Amphipoda. — J. mar. biol. Ass. U.K., 21: 647—662.
- DAHL, E.
1958 Fresh and brackish water Amphipoda from the Azores and Madeira. — Boletim Mus. munic. Funchal, 11 (27) : 5—25.
- DAVIS, A.
1956 A note on *Melita hergensis* Reid (Crustacea, Amphipoda). — Ann. Mag. nat. Hist., (22) 9 : 511—512.
- DENNERT, H. G.
1973 Notes on some euryhaline gammarids (Crustacea, Amphipoda) from the West-coast of Norway. — Bijdr. Dierk., 43 (2) : 160—172.
- DENNERT, H. G., A. L. DENNERT, S. PINKSTER & J. H. STOCK
1969 Upstream and downstream migrations in relation to the reproductive cycle and to environmental factors in the amphipod *Gammarus zaddachi*. — Bijdr. Dierk., 39 : 11—43.
- DUHIG, M. & C. HUMPHRIES
1955 *Amphilochus brunneus* Della Valle, an Amphipod new to Britain and Ireland and notes on other amphipods not previously recorded in Irish coastal waters. — Proc. Roy. Irish Acad., (B) 57 (8) : 123—129.
- DUMAY, D.
1973 Etude comparée de la fécondité de deux espèces du groupe 'locusta': *Gammarus crinicornis* Stock, 1966 et *Gammarus subtypicus* Stock, 1966 (Amphipoda). — Téthys, 4 : 975—980.
- GOODHART, C. B.
1941 The ecology of Amphipoda in a small estuary in Hampshire. — J. Anim. Ecol., 10 : 306—322.
- GRAS, J. M. J. F. & A. M. J. MAASEN
1971 Les Gammaridés des eaux continentales et saumâtres du Sud-Est de la région Armoricaïne et du Nord du bassin d'Aquitane. — Bijdr. Dierk., 41 (1) : 52—60.
- HARTOG, C. DEN
1964 The amphipods of the deltaic region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area, 3. The Gammaridae. — Neth. J. Sea Res., 2 (3) : 407—457.
- JONES, N. S.
1948 The ecology of the Amphipoda of the south of the Isle of Man. — J. mar. biol. Ass. U. K., 27 (2) : 400—439.
- KANT, P., S. PINKSTER & J. H. STOCK
1968 Sur la présence, en Méditerranée, de *Pectenogammarus planicrus* Reid, 1940. — Vie Milieu, 19 (1—A) : 206—209.

- KARAMAN, S.
1935 *Rivulogammarus gautieri* n. sp. nouvel Amphipode dulçaquicole d'Algérie. — Bull. Soc. Hist. nat. Afr. Nord, **26** : 47—53.
- KINNE, O.
1952 Zum Lebenszyklus von *Gammarus duebeni* Lillj., nebst einigen Bemerkungen zur Biologie von *Gammarus zaddachi* Sexton ssp. *zaddachi* Spooner. — Veröff. Inst. Meeresforsch. Bremerhaven, **1**: 187—203.
- LABOURG, P. J., S. PINKSTER & J. H. STOCK
1971 Les Amphipodes du genre *Gammarus* dans le Bassin d'Arcachon. — Bijdr. Dierk., **41**: 31—36.
- MAREN, M. J. VAN
1974 Répartition et écologie d'Amphipodes (surtout Gammaridés) dans le bassin et l'estuaire de la rivière du Dourduff (Bretagne). — Bull. Zool. Mus. Univ. Amsterdam, **3** (22) : 189—209.
- MORGAN, E.
1970 The effect of environmental factors on the distribution of the amphipod *Pectenogammarus planicrurus* with particular reference to grain size. — J. mar. biol. Ass. U. K., **50** (3) : 769—785.
- PINKSTER, S.
1973 The *Echinogammarus berilloni*-group, a number of predominantly Iberian amphipod species (Crustacea). — Bijdr. Dierk., **43** (1) : 1—38.
- REID, D. M.
1939 *Melita hergensis*, sp. n. (Crustacea, Amphipoda). — Ann. Mag. nat. Hist., (11) **4** : 278—281.
1940a On *Gammarus* (*Pectenogammarus*) *planicrurus* subgen. et sp. n. (Crustacea, Amphipoda). — Ann. Mag. nat. Hist., (11) **6** : 287—292.
1940b Three species of Amphipoda (Crustacea) new to Britain. — Ann. Mag. nat. Hist., (11) **6** : 335—337.
- SCHELLENBERG, A.
1942 Flohkrebe oder Amphipoda. — Tierw. Deutschl., **40** : 1—252.
- SEXTON, E. W.
1924 The moulting and growth stages of *Gammarus*, with description of the normals and intersexes of *G. chevreuxi*. — J. mar. biol. Ass. U. K., **13** (2) : 340—401.
- STEEN, E.
1951 Ecological observations on some *Gammarus*- and *Marinogammarus* species on the Scandinavian West coast. — Oikos, **3** : 232—242.
- STOCK, J. H.
1967 A revision of the European species of the *Gammarus locusta*-group. (Crustacea, Amphipoda). — Zool. Verh. Leiden, **90** : 1—56.
1968 A revision of the European species of the *Echinogammarus pungens*-group (Crustacea, Amphipoda). — Beaufortia, **16** (211) : 13—78.
- STOCK, J. H., H. NUSSEN & P. KANT
1966 La répartition écologique des Amphipodes de la famille Gammaridae dans la Slack et son estuaire. — Bull. Zool. Mus. Univ. Amsterdam, **1** (3) : 19—30.
- TRUCHOT, J. P.
1963 Etude faunistique et écologique des amphipodes des faciès rocheux intertidaux de Roscoff. — Cah. Biol. Mar., **4** : 121—176.
- VADER, W.
1964 *Marinogammarus stoerensis* in Nederland. — Levende Nat., **67** : 158—162.
1965 Het biotoop van de Nederlandse *Marinogammarus*-soorten. — Levende Nat., **68** : 205—212.
- VINCENT, M.
1966 Vie en eau de mer diluée de quelques Gammaridés d'eau douce. Comparaison des glandes antennaires. — C. R. Soc. Biol., **160** : 637—641.

- 1967 Aspects de la régulation ionique chez *Echinogammarus berilloni* (C.) —
C. R. Soc. Biol., **161**: 2248.
- 1971 Ecologie et écophysologie des Gammaridés épigés du centre ouest. — Thèse
Fac. Sci. Univ. Limoges, 5513 : I—VI, 1—132.

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