FOUR NEW CRUSTACEANS IN THE GUADALQUIVIR RIVER ESTUARY (SW SPAIN), INCLUDING AN INTRODUCED SPECIES.

J.A. Cuesta[1], L. Serrano[1], M.R. Bravo[2], J. Toja[1]

1. Departamento de Ecología, Facultad de Biologia, Universidad de Sevilla, Apdo. 1095, 41080 SEVILLA, SPAIN. e-mail: mariscal@cica.es
(2) Department of Aquatic Biosciences, Plankton Laboratory, Tokyo University of Fisheries, 4-5-7 Konan, Minato-Ku, TOKYO 108, JAPAN. e-mail: ad94205@tokyo-u-fish.ac.jp

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ABSTRACT

This work reports on the presence in the Guadalquivir River estuary of the mysids *Neomysis integer and Rhopalophthalmus mediterraneus* and well established populations of the isopod *Synidotea laevidorsalis* and the amphipod *Corophium orientale.* All species are new for the fauna of the Iberian Peninsula. S. *laevidorsalis* is reported here for the second in European waters. Their introductions are probably associated with aquaculture transplants, fouling on ship's hulls or with ballast water transport.

INTRODUCTION

The Guadalquivir River is situated in southern Spain. The lower part of the river has a gentle slope, which includes an estuary of about 100 km. and a strong tidal flow. Its average depth is 10 m. The salt water does not usually go beyond 20 km upstream (BAONZA *et al,* 1978), but due to intense present drought, salt water was extended further up.

Mercant ship and boat traffic extends up the Guadalquivir River estuary up to Sevilla Harbor. Sevilla has had a continous and active ship traffic since the 15th-century with the discovery of America. Water quality of the Guadalquivir River estuary is very much affected by urban and industrial wastes of organic origin (GUISANDE & TOJA, 1988).

Studies of invertebrates from the estuary of the Guadalquivir River are few. GUISANDE et al. (1986) studied the zooplanktonic communities of this estuary from February 1983 to March 1984 including Rotifers, Copepods and Cladocerans. They concluded that the zooplankton distribution was determined by environmental factors such as salinity and eutrophy.

The distribution of benthic invertebrates from the estuary of the Guadalquivir River is unknown. The present study deals with benthic Crustaceans including Isopods, Mysids and Amphipods recently Sound in this estuary.

MATERIALS AND METHODS

The estuary was sampled at one site located in one of the river channels 23 km from the river mouth. The salinity was measured with a densimetre and ranged from 16 $g.l^{-1}$ to 24 $g.l^{-1}$ during the sampling period.

Samples were collected from January 1991 to December 1994 at high tides over 4-6 hours periods. Specimens were collected by a nonspecific benthonic method: the whole water column was filtered through a mesh of 12 m long and 2 mm pore size fixed to a square of 2.5 m x 1 .5 m of filtering surface. This sort of mesh is employed by the tradicional eel larvae fisheries at river channels.

Samples were preserved in formaldehyde 4 % final concentration. The adult body lenghts of mysids were measured from the base of the eyestalk to the posterior end of the telson, excluding the setae. Isopods were measured from the anterior part of the cephalon to the posterior end of the pleotelson. Amphipods were measured from the extreme of the second antenna to the posterior end of the telson.

RESULTS

Rhopalophthalmus mediterraneus Nouvel, *1960*

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Rhopalophthalmus mediterraneus Nouvel, 1960: 225-231 pp.

Material.- 3 males and 16 females, February 1991; 4 females. June, 1993.

Body length.- Range 16.6 - 20.9 mm.

Ocurrence.- NOUVEL (1960) described this species from speciemens collected in 1940-41 off Alger Bay (Algeria, 36° N - 3° E). Until now, this was the only known record for this species (fig. 1). The present material is the first record of the species from Europe.

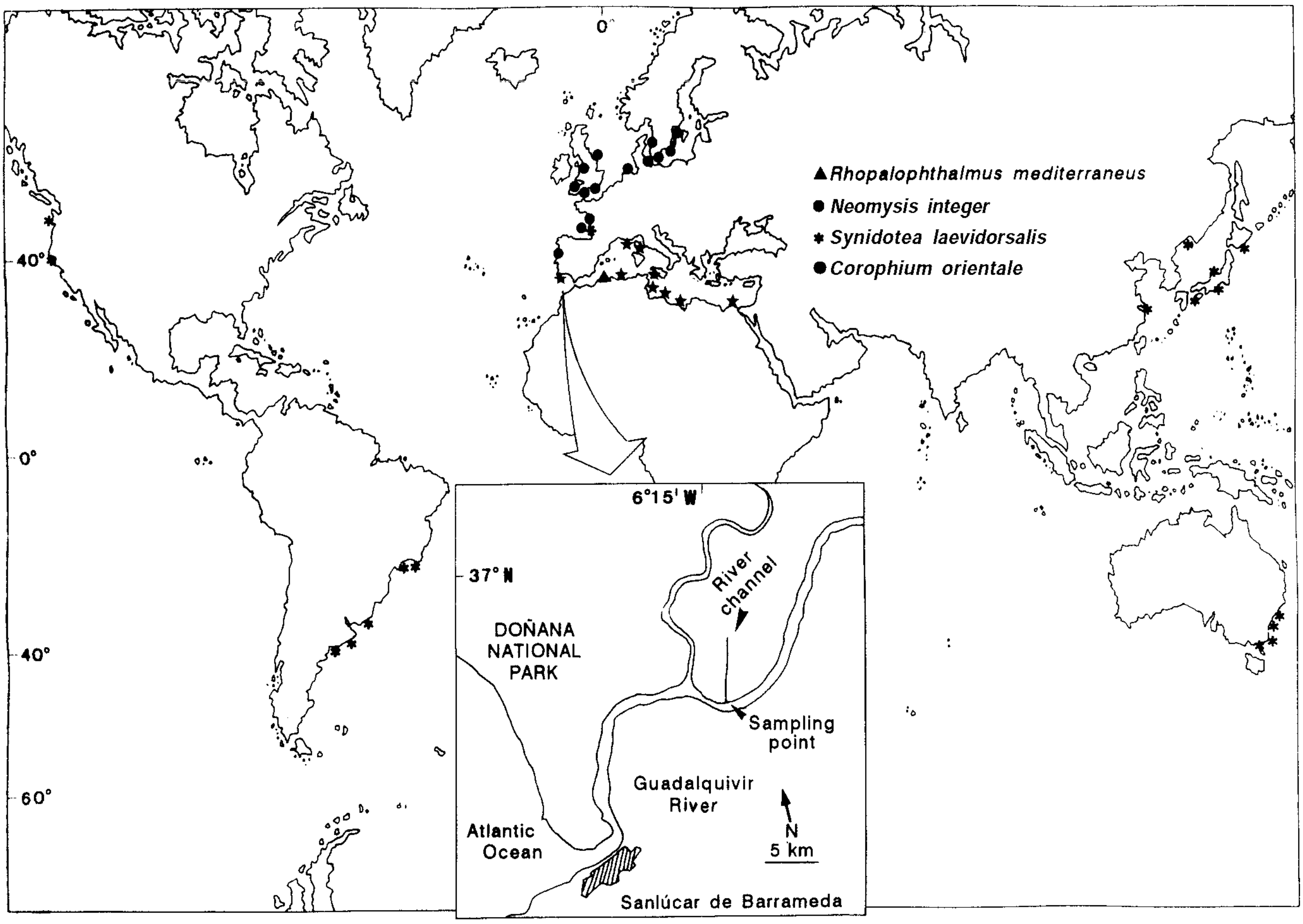

FIGURE 1. World distribution of *Synidotea laevidorsalis, Corophium orientale, Neomysis integer and Ropalophtalmus mediterraneus*. Locations are cited in the text.
FIGURA 1. Distribución mundial de *Synidotea laevidorsalis, Corophium orientale, Neomysis integer and Ropalophtalmus mediterraneus*. Las localidades se citan en el texto

Neomysis integer (Leach, 1814)

Pranus integer Leach, 1814.
Mysis scoticus J.V. Thompson, 1928; Bell, 1853; van Beneden, 1860; G.O. Sars, 1879.
Neornysis vulgaris, Czerniavsky, 1882-83; Norman, 1892; Zimmer, 1904, 1909.
Neomysis integer, W.M. Tattersall, 1912.
Material.- 2 males, June 1993.
Body length.- Range 7.2 - 10.1 mm.

Ocurrence.- TATTERSALL & TATTERSALL (1951) maintained that this species occurs on all Atlantic coasts of Europe, from Spain to the White Sea. However, MAUCHLINE & MURANO (1977) reported N. *integer* is widely distributed in European coasts of the North Atlantic Ocean, ranging from 66° N to 40° N latitude. Subsequently, it has been cited from West and East coasts of southern Sweden (JOHANSSON & HALLBERG, 1992); Kiel Bight, Germany (PUTZ & BUCHHOLZ, 1991); Frisian Lake District (BREMER & VIVEJBERG, 1982), Voordelta and Westerschelde, The Netherlands (MEES *et al*, 1993); Cullercoast District (BAMBER, 1986), Conwy Estuary, Severn Estuary (MOORE *et al*, 1979), Redbrige (ARMITAGE *et al.,* 1981) and Tamar Estuary, United Kingdom (MOFFAT & JONES, 1992); Gulf of Gascogne (BEAUDOUIN, 1979) and Gironde Estuary, France (MEES & FOCKEDEY, 1993) and Mondego River Estuary, Portugal (GONÇALVES, 1991). The present material is the first record of N. *integer* from the Guadalquivir River Estuary (37° N Lat.) (fig. 1) and the second for the Iberian Peninsula. Therefore, this finding implies that *N. integer* enlarge its meridional distribution limits.

Corophium orientale Schellenberg, 1928
Corophium volutator f. *orientalis* Schellenberg, 1928, Crawford, 1937.
Corophium orientalis Stock, 1960.
Corophium orientale Bellan-Santini et al, 1982

Material.. 115 males and 67 females, May, 1992; 120 males and 145 females, February, 1993; 59 males and 34 females July, 1993; 38 males and 43 females, March, 1994. 5 males and 2 females were found in freshwater samples of river sediments collected with an Elkman dredge from Seville Harbor (84 km from the river mouth) in December, 1994.
Body length.- Range 1.8 - 8.0 mm.
Ocurrence.- Mediterranean endemic. France: Saint-Tropez, Corsica: Porto Vecchio, Libya, Algeria: Jijel (BELLAN-SANTINI *et al*, 1982), Sicily: Selinunte (CHEVREUX, 1911), Egypt: Alexandria (STOCK, 1960). RODRIGUES & DAUVIN (1987) first reported it for Atlantic waters, Portugal: Ria de Alvor (fig. 1). This is the first record of C. orientale in the estuary of the Guadalquivir River and the second for the Iberian Peninsula and Atlantic waters.

Synidotea laevidorsalis (Miers, 1881)

Synidotea laticauda Bennedict, 1896.
Synidotea pacifica Nobili, 1906.
Synidotea marplatensis Giambiagi, 1922
Synidotea worliensis Joshi & Bal, 1959.
Synidotea brunnea Pires & Moreira, 1975.
Synidotea hanumantharoi Kumari & Shyamasundari, 1983.
Synidotea grisea Poore & Lew Ton, 1993.
Synidotea keablei Poore & Lew Ton, 1993.

Material.- This species was the most abundant species in ever sampling. It was common to find more than 1,000 individuals per sample.
Body length.- Range 3.9 - 25.3 mm.
Ocurrence.- CHAPMAN & CARLTON (1991) reviewed the ocurrence of this species that ranges from the North American West coast (from San Francisco Bay, California and Willapa Bay, Washington), the South Atlantic coast of South America (Ingeniero White and Mar del Plata, Argentina, Puerto de la Paloma, Uruguay; Baia da Ihla Grande and Santos, Brazil) and the North Pacific continental coasts of Asia (Sanghai, China; Vladivostock, Rusia; Seto Island Sea, Ise-wan, Tateyama Bay, Tokoyama Bay and Hokadate, Japan). Recently it has been recorded from Sydney Harbor (Australia) (CHAPMAN & CARLTON, 1994) and the Gironde Estuary (France) (MEES & FOCKEDEY, 1993) (fig. 1). The present material is the first record for the Iberian Peninsula and the second record for European waters.

REMARKS

Long range dispersal of marine organisms that do not have free-living larval stages, such as the peracaridan crustaceans is limited. Additionally, many estuarine species develop retention mechanisms to reduce the risk of being carried out to sea. Cargo-vessel ballast water, fouling, rafting, and even the transportation together with commercial shellfish (especilly oysters) and fish can be basic factors contributing to the dispersal of such estuarines species (CARLTON, 1985; 1987).

Cargo-vessel ballast water was first suggested as a vector in the dispersal of non-indigenous marine species nearly 90 years ago (HALLEGRAEFF & BOLCH, 1992). Isopods and amphipods are susceptible of being transported alive by ballast water (KELLY, 1993; WILLIAMS *et al*, 1988) as well as mysids (CARLTON, 1985). Additionally, isopods and amphipods (such as *Corophium spp*) are dispersed by fouling (CARLTON & HODDER, 1995).

Several studies have shown that it is possible for sessile adults to disperse on the order of several to many thousand kilometers by rafting on debris in ocean currents (HELMUTH *et al*., 1994). Many peracarids are dispersal by rafting on drifting materials such as algae and marsh grass (CAINE, 1980; FRANZ & MOHAMED, 1989). However, discoveries of the estuarine species reported herein have not been discover on deep-sea drift materials.

Tha lack of data from the north African coast and the scarcity of records from the south Atlantic European coast make difficult the determination of the main dispersal factor of these organisms in our case.

Historically, dispersal associated with shipping may be an important factor for the introduction of new species in the Guadalquivir estuary, Sevilla Harbor has received active ship traffic since 1503 when it was declared the last stop for the "Carrera de Indias" (the route for the American trade). Fouling and, more recently, ballast water are likely to have introduced many species in the Guadalquivir River.

Local ship traffic may be responsible for secondary introductions. For example, *N. integer and R. mediterraneus* were found in tidal channels and marshes from Cádiz (SW Spain) (DRAKE, unpublished data).

Other species introduced in the Guadalquivir River estuary are the fish *Fundulus heteroclitus* since 1970 (FERNANDEZ-DELGADO, 1987), the crab *Rhithropanopeus harrisii* (CUESTA *et al*., 1991) and the sea anemone *Haliplanella lineata* (CUESTA, unpublished data). The latter species has a cosmopolitan worldwilde distribution due to accidental ship transport (LOPEZ-GONZALEZ, 1993).

S. *laevidorsalis* and *C. orientale* were always found associated with masses of hydroids, bryozoans and algae. Other common associated species were the Mysid *Mesopodopsis slabberi*, the amphipod *Ampithoe ferox*, the isopod *Lekanesphaera hookeri*, the decapods *Palaemonetes varians*, *Palaemon serratus*, *Crangon crangon* and *Carcinus maenas*, and the fish species *Syngnathus sp*. and *Potnntoschistus microps*.

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