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Comparative life-histories, population dynamics and productivity of *Schistomysis* populations (Crustacea, Mysida) in European shelf environments

Carlos San Vicente *, Jean Claude Sorbe

C/Nou 8, 43839 Creixell, Tarragona, Spain
Station Marine, 2 rue Jolyet, 33120 Arcachon, France

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ABSTRACT

A biological study of suprabenthic mysids of genus *Schistomysis* (Crustacea, Mysida, Mysidae) was carried out based on quantitative samples collected in coastal waters of the SE Bay of Biscay (NE Atlantic) and the Catalan Sea (W Mediterranean). Aspects of the ecology of species noted during this study are summarized and the results of previous researches are incorporated. Small and large-scale environmental factors (swash and surf climate, depth, temperature, day–night and seasonal cycles) contributed significantly to population distributions. All *Schistomysis* populations are characterized by faster individual growth and earlier maturity at higher temperature, resulting in intensive recruitment during spring or summer seasons in combination with higher fecundity of genitors. Regarding productivity, our production and $P/\overline{B}$ estimates ranged between 2255–26,321 mg AFDW/100 m^3/year and 6.09–9.73, respectively. These production values are similar to those found for comparable marine mysids with two or three generations per year. The observed demographic heterogeneity and production of populations has ecological implications in the Bay of Biscay and Mediterranean areas, where *Schistomysis* species are dominant components of littoral and shelf suprabenthic communities.

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Contents

* Corresponding author at: C/Nou 8, 43839 Creixell, Tarragona, Spain. Tel.: +34 977 8022623
E-mail addresses: csanvicente@gencat.cat (C. San Vicente), sorbejc@gmail.com (J.C. Sorbe).

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1. Introduction

Mysid crustaceans are common macrobenthic animals, frequently reported from the benthic boundary layer and occurring in high abundance in European shelf ecosystems. Mysids are able to bioturbate fine sediments breaking the diffusive boundary layer with their feeding and swimming behavior, phenomenon of great importance on pelago-benthic fluxes exchanges (Sainte-Marie and Brunel, 1985; Vallet and Dauvin, 2001; Wildish et al., 1992) and through the remineralization of substantial environment detritus making it available to the higher trophic levels in the same or in other habitats (Carleton and McKinnon, 2007; Lesutiene et al., 2008). Furthermore, mysids are highly consumed by a great variety of benthic predators in coastal environments and play an important role in their trophodynamics (Fanelli, 2007; Hamerlynck et al., 1990; Mees and Harmelinck, 1992; Sorbe, 1981).

Despite their high abundance in most coastal benthic ecosystems, mysids are not frequently reported in benthic studies due to inadequate sampling methodology. Owing to their relative high natatory capacity, mysids often escape when benthic assemblages are sampled by traditional devices such as grabs or box cores. Their adequate sampling in the near-bottom environment can be more efficiently carried out with suprabenthic sledges (see San Vicente and Sorbe, 1993b; Sorbe, 1983) These devices are equipped with small mesh-size nets (generally 0.5 mm), with a closing–opening system and are towed over the bottom along a measurable distance (quantitative samplings). Recent studies confirm the efficiency of such samplers in the biodiversity coverage of suprabenthic mysids (San Vicente, 2010a; San Vicente and Cartes, 2011).

In neritic European waters, the genus *Schistomysis* Norman, 1892 (Mysida, Mysidae) is represented by five species from soft-bottom habitats: *Schistomysis assimilis* (G.O. Sars, 1877) from the western Mediterranean Sea, *Schistomysis kervillei* (G.O. Sars, 1885), *Schistomysis ornata* (G.O. Sars, 1864), *Schistomysis parkeri* Norman, 1892 and *Schistomysis spiritus* (Norman, 1860) from the north-eastern Atlantic Ocean. A sixth species, *Schistomysis elegans* G.O. Sars, 1907 is only known form muddy bottoms of the Caspian Sea, at depths ranging from 10 to >400 m (Daneliya and Petryashov, 2011; Parr et al., 2007).

In European waters, *Schistomysis* populations constitute a dominant component of suprabenthic communities, from beach swash-zones down to circalittoral bottoms (Beyst et al., 2001; Dewicke et al., 2003; San Vicente, 1996; Sorbe, 1984). Due to their high abundance, they were selected to investigate several aspects of their biology: population dynamics, fecundity, voltinism and secondary production. As a complement to the pioneering studies conducted by Mauchline (1967, 1970, 1971) on the biology of Scottish populations, this paper is a comparative biological study based on our own previous investigations on *S. ornata*, *S. kervillei*, *S. parkeri* and *S. spiritus* from the SE Bay of Biscay (by Sorbe, 1984, 1991 and San Vicente and Sorbe, 1990, 1993a, 1995) and *S. assimilis* (e.g. San Vicente and Sorbe, 2003) from the Catalan Sea.

2. Materials and methods

2.1. Study areas

The *Schistomysis* populations herein studied were monthly sampled in different areas and at different periods: *S. kervillei*, *S. spiritus* and *S. ornata* on the bathymetric transect 44°31′N of the Aquitanian shelf off Arcachon Bay (SE Bay of Biscay) in 1981–1982; *S. parkeri* in the swash-zone of Hendaia beach (SE Bay of Biscay) and *S. assimilis* in the surf-zone of Creixell beach (Catalan Sea) in 1991–1992 (Fig. 1). Occasionally, further data (from complementary time-series and/or new sampling zones) were added in order to complete the standard sampling procedure. In each sampling area, these *Schistomysis* populations constitute resident components within their respective suprabenthic communities, ranking among the most abundant taxa (Fig. 2).

On the bathymetric transect 44°31′N, stations 1 and 3 were selected for detailed analysis of *Schistomysis* populations (although *S. ornata* was also present at stations 5 and 7). Station 1 is located south of the entrance of Arcachon Bay (ca. 31 m depth) on sandy sediments characterized by a median grain size of 0.168 mm and low silt–clay content (1–4% of dry weight sediment). In 1981–1982, the near-bottom water temperature fluctuated between 11.5 and 16.0 °C, with an annual mean of 13.1 ± 2.8 °C. In this sandy area, *S. kervillei* and *S. spiritus* respectively contributed to 18.3 and 3.8% of the annual mean density and 27.3 and 5.5% of the annual mean biomass of the suprabenthic community (Sorbe, 1984). Station 3 is located at ca. 91 m depth on muddy fine sands characterized by a median grain size of 0.143 mm and a silt–clay content of 9–19%. In 1981–1982, the near-bottom water temperature fluctuated between 11.7 and 14.0 °C with an annual mean of 12.3 ± 0.9 °C. In this muddy sand area, *S. ornata* contributed to 11.3% of the annual mean density and to 23.1% of the annual mean biomass of the suprabenthic community (Sorbe, 1984).

The Hendaia swash-zone station is situated in a hydrodynamically controlled environment, on sandy sediments characterized by a mean grain size of 0.195 mm and low silt–clay content (0.5–2.2%). In 1991–1992, the water temperature in the swash-zone fluctuated between 11.0 and 24.5 °C, with an annual mean of 15.8 ± 2.4 °C. In this submarine beach, *S. parkeri* contributed to 66.9% of the annual mean density of the suprabenthic community (San Vicente and Sorbe, 2001).

The Creixell population was sampled at five standard stations A–E (0.5–3.5 m depth, 5–100 m seaward), located along a bathymetric transect within the beach surf zone. These stations are situated in a hydrodynamically controlled environment, on sandy sediments characterized by a mean grain size of 0.185 mm and a low silt–clay content (<0.5%). Measured at station B (0.75 m depth), the near-bottom water temperature fluctuated between 12.4 °C and 26.1 °C in 1991–1992, with an annual mean of 17.2 ± 2.9 °C. In this submarine beach, *S. assimilis* contributed to 31.1% of the annual mean density of the suprabenthic community (San Vicente and Sorbe, 1999).

2.2. Sampling protocols

Depending on depth, quantitative samplings were carried out with two different suprabenthic sleds. At depths ≥30 m, we used a sled (weight: ca. 350 kg) towed over the bottom from a boat (towing speed: 1–2 knots), designed to collect the swimming fauna in the 0–50 cm and 50–100 cm near-bottom water layers (Sorbe, 1983). At shallower depths (swash-zone and surf-zone of beaches down to 10 m depth), we used a smaller sled designed to skim over the bottom and collect the motile fauna in the 0–20 cm near-bottom water layer, pushed by hand on the beach or during Scuba divings (San Vicente and Sorbe, 1993b). Both sleds are equipped with small mesh-size plankton nets (0.5 mm), each ending with a removable plastic bucket. Sampling methodology was detailed in previous publications (San Vicente, 1996; San Vicente and Sorbe, 1990, 1993a; Sorbe, 1982, 1984).

At shelf stations 1 and 3, samplings were carried out once a month during daytime from January 1981 to January 1982 (except in November and December). The volume of water filtered by the sled net during each haul was estimated by means of a TSK flow meter placed in its mouth (volume unit: 100 m^3).

At Hendaia submarine beach, quantitative samplings were carried out once a month, during daytime, from February 1991 to February 1992. Each sampling session in the swash-zone started 1 h before low-water tide and was completed in about 2 h. The standard procedure included 10 successive tows parallel to the shoreline (each 10 m

Fig. 1. Geographical origin of the different *Schistomysis* populations considered in this study: Aquitanian shelf stations 1 and 3 of the bathymetric transect 44°31′N (off Arcachon) and the swash-zone of Hendaia beach in the SE Bay of Biscay; littoral stations A–E along a bathymetric transect off Creixell beach (winter beach profile) in the NW Mediterranean.

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