Estuarine, Coastal and Shelf Science 149 (2014) 244–254

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Seasonal forcing of image-analysed mesozooplankton community composition along the salinity gradient of the Guadalquivir estuary

Simone Taglialatela*, Javier Ruiz, Laura Prieto, Gabriel Navarro

Department of Ecology and Coastal Management, Instituto de Ciencias Marinas de Andalucia, Consejo Superior de Investigaciones Científicas, 11510 Puerto Real, Cádiz, Spain

ARTICLE INFO

Article history:
Received 14 February 2014
Accepted 31 August 2014
Available online 16 September 2014

Keywords:
zooplankton
estuarine species
Spanish estuaries
Calanipeda aquaedulcis
Acartia clausi
automatic classification
ZooImage

ABSTRACT

The composition and distribution of the mesozooplankton was studied monthly from April 2008 to June 2009 in the Guadalquivir estuary using a fast image analysis technique as well as with traditional microscope counting. The mesozooplankton showed a very clear temporal and spatial pattern with peaks of abundance in late-Spring/early-Summer 2008 and Spring 2009 in the inner estuary. The abundances peaked at 135×10^3 ind. m^{-3}. *Calanipeda aquaedulcis* was the most abundant species in the fresh and brackish waters (salinity between 0.5 and 7), accounting in many cases for up to 100% of the individuals. *Acartia clausi* instead was identified as the most abundant species in the middle part of the estuary (salinity between 10 and 30). Cyclopoida of the family Cyclopidae (possibly *Acanthocyclops* spp.) were occasionally abundant there as well as some species of freshwater Cladocera. At the mouth, the mesozooplanktonic community included appendicularians, chaetognaths, copepods and Cladocera. Canonical Correspondence Analysis (CCA) indicates that the changes observed in the taxonomic composition along the estuary were strictly correlated with the salinity gradient. Furthermore, no evidence of seasonal species substitution was observed in the Guadalquivir estuary, whereas a clear spatial displacement of *C. aquaedulcis* and *A. clausi* populations was observed after large discharges from the dam in Alcala del Rio.

1. Introduction

The zooplankton in tidal estuaries, such as the Guadalquivir, plays a significant role in the local food webs, being the main food source for anadromus and resident fishes in the early developmental stages (Pace et al., 1992). The high variability of the physical environment in the estuaries strongly shapes their biological communities (Hynes, 1970; Cuesta et al., 2006). This is frequently manifest as very acute physical gradients that are modified at different time scales such as the seasonal and tidal cycles as well as interannual changes. The complexity of the estuarine ecosystem not only involves temporal and spatial variability of the physical environment but also the ecological interactions between the components of the community and their connection with the biogeochemical cycles. Thus, the understanding of the estuarine ecosystem demands disentangling the response of the chemical and biological components to the physical fields (Baranyi et al., 2002).

In the Guadalquivir estuary, as well as in most of the main European rivers, human activities shape the ecosystem; a synthesis of these modifications and their impact on estuarine dynamics can be found in Contreras and Polo (2010). They include large scale desiccation of tidal marshes and the isolation of the estuary course from the original tidal marshes, dredging for navigation, reduction of freshwater inputs and eutrophication from urban and agriculture waters. As consequence of these pressures, the environmental quality of the estuary has been largely affected and altered with a manifest effect on the turbidity levels of the water (Navarro et al., 2011, 2012) and also an increase in the nutrient concentration (Guisande and Toja, 1988; Prieto et al., 2009).

The highly variable physical environment and human pressures make the estuarine environment a challenging habitat for the biota (Uriarte and Villate, 2004; Biancalana et al., 2012). Despite this, the mesozooplankton biota and its response to stressors have been disregarded in most studies of the Guadalquivir estuary. A very small number of studies assess the tidal estuarine mesozooplanktonic community and its ecological role (see Guisande et al., 1986; Guisande and Toja, 1987) whereas many more publications focus on the young recruits of decapods,

* Corresponding author.
E-mail addresses: simone.taglialatela@icman.csic.es, simone.taglialatela@gmail.com (S. Taglialatela).

http://dx.doi.org/10.1016/j.ecss.2014.08.021
0272-7714/

isopods and marine fishes (Cuesta et al., 1996; Baldó et al., 2001, 2005; Drake et al., 2002; Cuesta et al., 2006; Fernández-Delgado et al., 2007; Vilas-Fernández et al., 2008; Vilas et al., 2008; González-Ortegón et al., 2010). Therefore, this study aimed to address the omission by analysing the spatio-temporal distribution and composition of the mesozooplankton community in the Guadalquivir estuary including the effects of the physical forcing on this community. The interest is focused mainly on the most abundant taxa such as the calanoid copepods inhabiting the inner and middle estuary. This study also provides a first insight of the effects of the ongoing changes of the estuarine environment on the mesozooplanktonic species distribution. A more extended analysis of the ecological implications of those changes will be the object of a future work.

2. Material and methods

2.1. Site description

The estuarine part of the Guadalquivir River, a temperate well mixed estuary with a sharp salinity gradient (Vanney, 1970), is located SW of Spain (36°45′ – 37° 15′ N, 6° 00′ – 6° 22′ W) (Fig. 1). The river flows for 680 km from its source and is the major freshwater input to the Gulf of Cadiz. Little remains of tidal marshes, deltas and secondary channels in the original estuary. Human modifications transformed the habitat in a tidal (~1 m amplitude and 3.5 m tidal range at the mouth in spring tides; Díez-Minguito et al., 2012) channel of 110 km from the mouth to the dam in Alcala del Rio which is the last of a network of dams that heavily

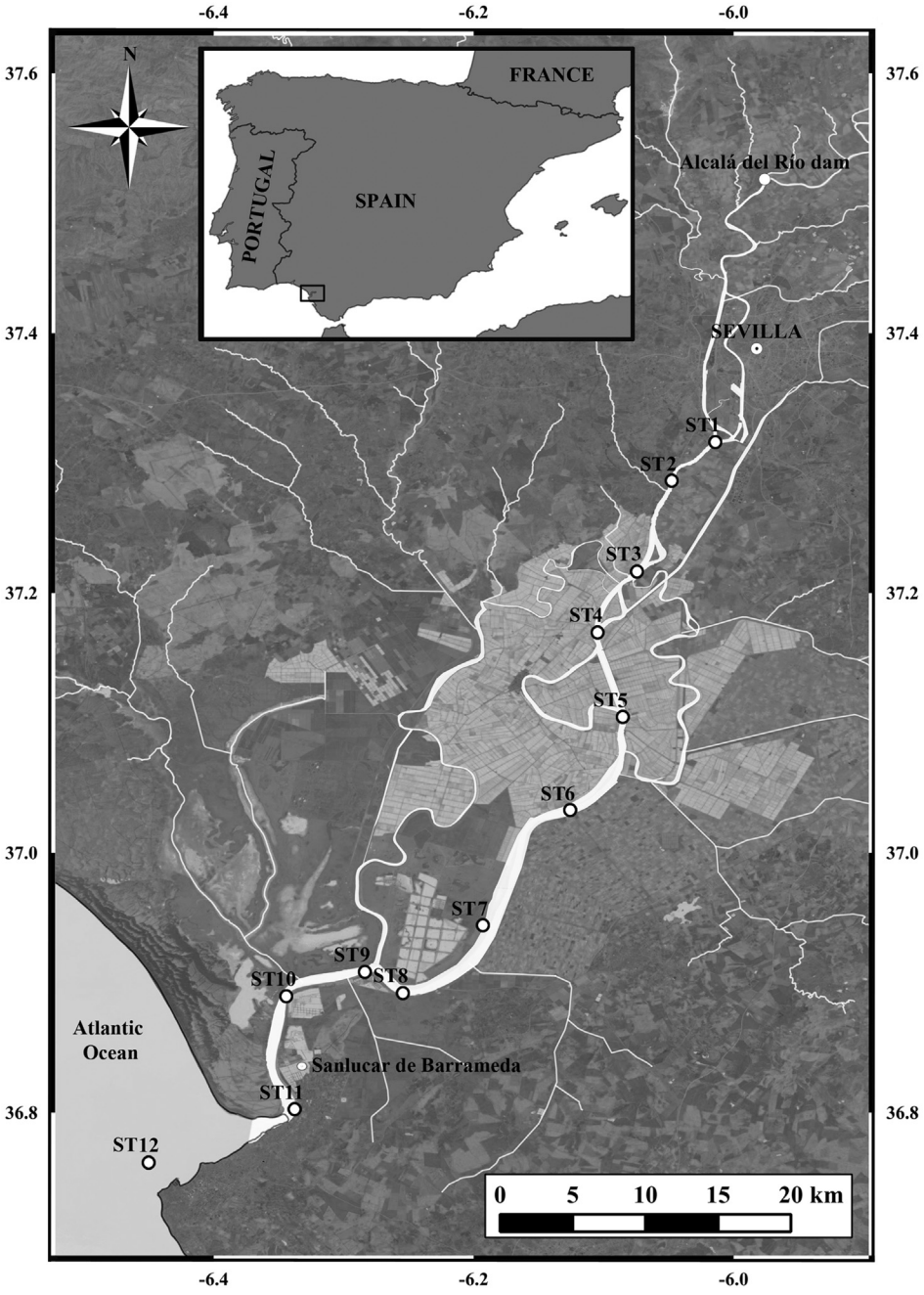

Fig. 1. Map of the Guadalquivir estuary and location of the sampling stations (white dots).