Trophic control in the Guadalquivir estuary and neighbouring waters of the Gulf of Cadiz

G.F. Carvalho-Souza [1,2], M. Llope* [1,3], F. Baldó [1], C. Vilas [4], P. Drake [5], E. González-Ortegón [1]

[1] Instituto Español de Oceanografía (IEO), Centro Oceanográfico de Cádiz, CEIMAR, Spain
[2] CAPES Foundation, Ministry of Education of Brazil, Brazil
[3] Centre for Ecological and Evolutionary Synthesis (CEES), University of Oslo, Norway
[4] IFAPA El Toruño, Spain
[5] Instituto de Ciencias Marinas de Andalucía (CSIC), Spain

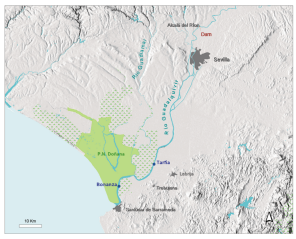
marcos.llope@cd.ieo.es*

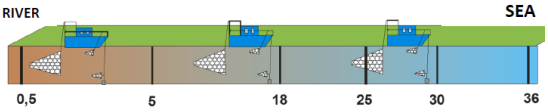
[INTRODUCTION]

The Guadalquivir estuary (SW Spain) is a non-stratified estuary with a gradual change in salinity. It supports an important biodiversity and functions as a nursery area for many marine species (e.g. anchovy) in the Gulf of Cadiz (GoC). The understanding of the interplay between the environmental and anthropogenic forcing as well as the trophic regulation is essential to understand its functioning in relation to the GoC fisheries. Here, we analyse the effect of external variables and predator-prey interactions (mysid-anchovy) with a particular focus on the zooplankton as key intermediaries between primary production and marine fish juveniles.

[STUDY AREA AND METHODS]

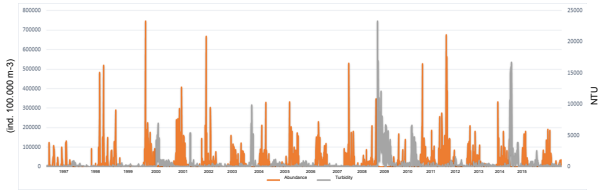
A long-term (18 yr) monitoring program has been carried out in two sites: Tarfia and Bonanza (32 km and 8 km distance from the river mouth respectively). In this study, we used the latter station as it samples well the marine water masses advected into the estuary during the ebb and flow. Our dataset includes mysids, anchovy larvae and juveniles, temperature, salinity, turbidity, freshwater discharges (FSW), precipitation and winds. We used time series-analysis (GAMs) to test the trophic, environmental and anthropogenic effects.



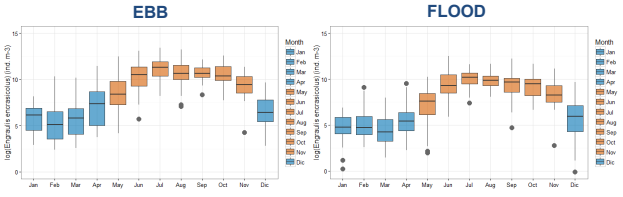


[HISTORICAL DATA]

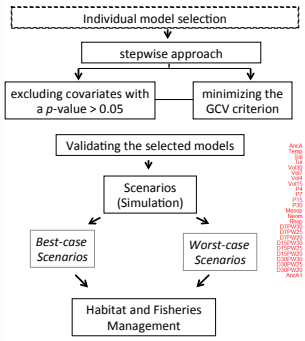
The temporal variability of anchovy juveniles (orange) and turbidity (gray) in the downer part of estuary.

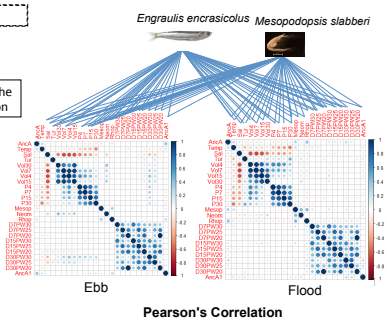


The density of anchovy juveniles shows a seasonal pattern with a high recruitment period between May and November (see below orange boxplots).



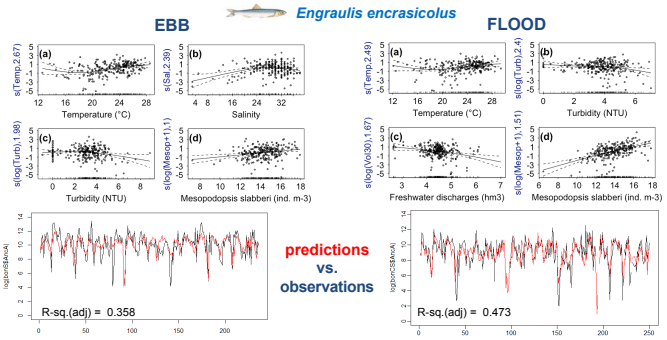
[STATISTICAL ANALYSES]



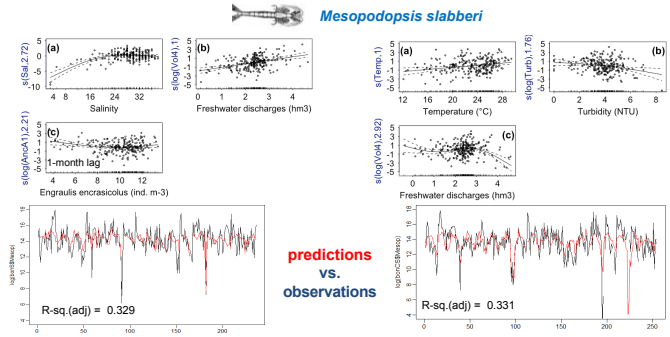


[RESULTS AND DISCUSSION]

The selected models in both tides (ebb and flow) showed positive effects of temperature and mysids on anchovy abundance, while turbidity and freshwater input had a negative effect, reducing fish abundance. These effects are proper of marines species in estuarine habitats.

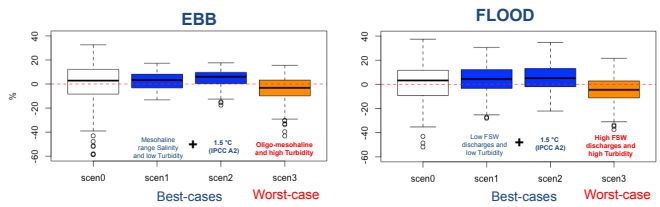


Mysids showed similar responses to the environment and also a negative effect of anchovy (predation) during ebb tide. The lack of top-down effect during flood tide (inner water mass) could reflect the higher performance of mysids in the mesohaline area as well as the slightly lower abundance of anchovies there. Both factors combined would free mysids from being top-down controlled within this water mass.



[SCENARIOS]

The anchovy models described above were run under two favourable and one unfavourable scenarios, and compared to observations (scenario 0). Good conditions (Scenarios 1 and 2) resulted in an increase in abundance of about 5-8% and less dispersion. By contrast the unfavourable scenario showed a decrease of about 5% and more dispersion than that seen under favourable conditions.



[CONCLUSIONS]

- Mysids have a bottom-up effect on anchovy and at the same time anchovy has a top-down effect on mysids (during ebb tide).
- Low salinities and high turbidities have detrimental effect on the abundance of anchovy and mysids.
- Freshwater discharges affect salinity and turbidity, thus water management has a clear influence on the nursery function of this estuary.
- Our study could contribute to implement an ecosystem approach to the anchovy fishery in the Gulf of Cadiz.