the Gulf of Cadiz

Marcos Llope
Instituto Español de Oceanografía, Cádiz, Spain
marcos.llope@cd.ieo.es

location:

The Gulf of Cadiz (GoC) connects the Atlantic Ocean with the Mediterranean Sea (Fig. 1).

main processes:

i) Outflow of **Mediterranean water** on the bottom (Fig. 2).
ii) Wind-driven (westerlies vs. levanters) **upwellings** at the surface (Fig. 3).
iii) Guadalquivir estuary and adjacent marine zones are important **nursery areas** (Fig. 4).
iv) Retention cell off the Guadalquivir estuary due to regional circulation (Fig. 4).
v) **Guadalquivir river** influence (Fig. 5).

monitoring programs:

The GoC is a relatively data-poor system with sampling programs covering a time span of less than a couple of decades. However, the monitoring effort is increasing fast with more and more components being currently sampled. Some of these programs are described here (Figs. 6, 7 & 8).

socieconomics:

In 2012, fishing activities generated landed value of approximately €100 millions, 5,000 direct jobs and 30,000 indirect jobs.

fisheries:

Its commercial fisheries use mainly mixed-species low selectivity trawlers, purse seiners, and artisanal boats.

pressures:

Fishing is probably the most important pressure in the GoC. Fig. 9 show the trawl activity since 1993.

analyses:

The first food web model of the GoC is an Ecopath analysis published last year, Fig. 10 (Torres *et al.* 2013).

Some preliminary analyses following the REGNS approach (Kenny *et al.* 2009) have been carried out within the ICES Integrated Assessment group WGEAWESS, Fig. 11 (ICES 2013). The zooplankton component is currently being analyzed from recent and archived samples (Fig. 12).

references:

- García-Lafuente J *et al.* (2006) Water mass circulation on the continental shelf of the Gulf of Cádiz. *Deep-Sea Res. II* 53, 1182-1197.
- ICES (2013) Report of the Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS), 11–15 February 2013, Lisbon, Portugal. ICES CM 2013/SSGRSP:02. 159 pp.
- Kenny AJ *et al.* (2009) An integrated approach for assessing the relative significance of human pressures and environmental forcing on the status of Large Marine Ecosystems. *Prog. Oceanog.* 81, 132-148.
- Prieto L *et al.* (2009) Oceanographic and meteorological forcing of the pelagic ecosystem on the Gulf of Cadiz shelf (SW Iberian Peninsula). *Cont. Shelf Res.* 29, 2122-2137.
- Torres MA *et al.* (2013) Food-web structure of and fishing impacts on the Gulf of Cadiz ecosystem (South-western Spain). *Ecol. Model.* 265, 26-44.

Figure 1. Mediterranean Sea, Black Sea and Gulf of Cadiz (rectangle). NASA.

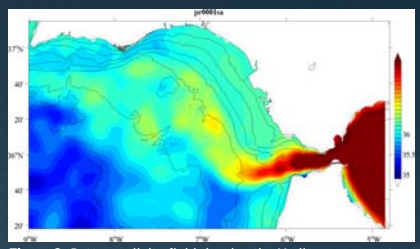

Figure 2. Bottom salinity field showing the Mediterranean water flow into the GoC through the Straight of Gibraltar. http://www.seadatanet.org

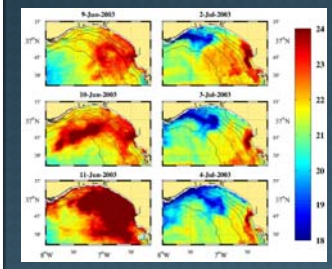

Figure 3. SST images corresponding to intense easterly winds (levanters) during 3 days in June and westerlies in July 2003. Prieto *et al.* (2009).

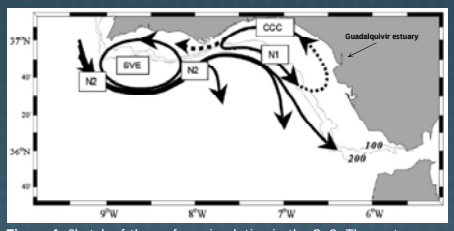

Figure 4. Sketch of the surface circulation in the GoC. The eastern shelf is dominated by a cyclonic circulation bounded by a shelf-break front (N1) at the south and a warmer coastal counter-current (CC). García-Lafuente *et al.* (2006).

Figure 5. Satellite picture capturing an extreme discharge event in November 2012. NASA.

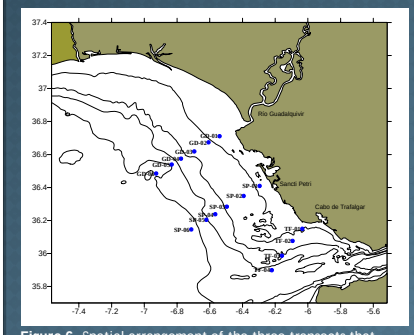

Figure 6. Spatial arrangement of the three transects that make up the STOCA time series. This monitoring program collects hydrographical and plankton information 3 times per year since 2009. http://www.gocats.es.

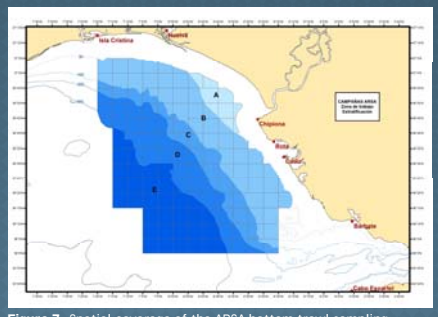

Figure 7. Spatial coverage of the ARSA bottom trawl sampling program, running twice a year since 1993. IEO.

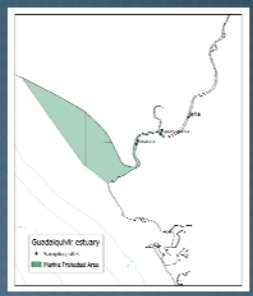

Figure 8. Guadalquivir estuary sampling strategy. Three stations sampled every new moon since 1997. IEO.

Figure 9. Days fished, bottom trawl fishing activity per year. ICES (2013).

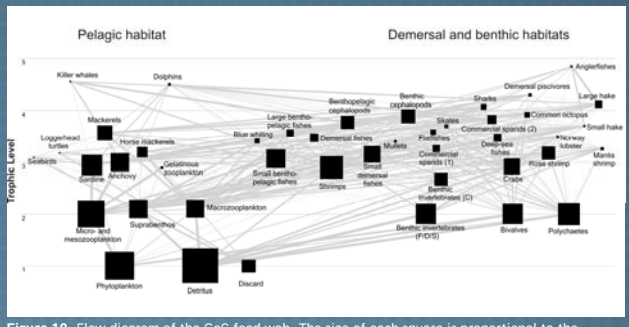

Figure 10. Flow diagram of the GoC food web. The size of each square is proportional to the biomass of the functional group. All the functional groups are represented according to their trophic level on the y-axis (TL) and connected to each other through lines representing prey-predator interactions. Torres *et al.* (2013).

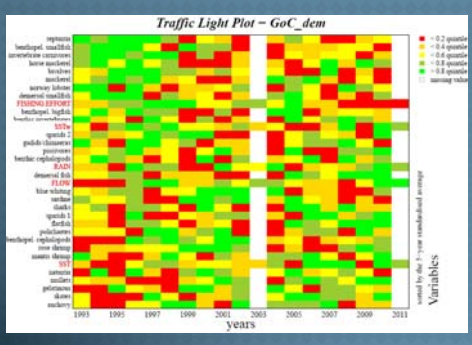

Figure 11. Traffic-light plot representing the development of the GoC demersal ecosystem over the last couple of decades. Trophic levels/functional groups are labelled in black whereas environmental variables and fishing effort are in red. Time-series were transformed into quintiles and sorted according to PC1; red represents high values while green represents low values of the respective variable. ICES (2013).

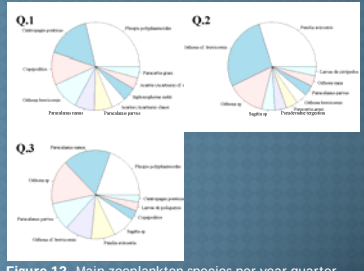

Figure 12. Main zooplankton species per year quarter (Q1-Q3) at a STOCA station located off the Guadalquivir mouth. ICES (2013).