Natural and land-based factors in the Guadalquivir estuary affect the abundance of anchovy in the Gulf of Cadiz (SW Spain)

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Gulf of Cadiz socio-ecosystem

This particular system is characterised by a clear focal ecosystem component –the role of the estuary of the **Guadalquivir River** as a **nursery area**– that has an influence on the marine ecosystem and at the same time concentrates a great number of sectoral human activities (Baldó & Drake 2002; Drake et al. 2007; Llope 2017).

seasonal estuarine-resident (juvenile) anchovy abundance
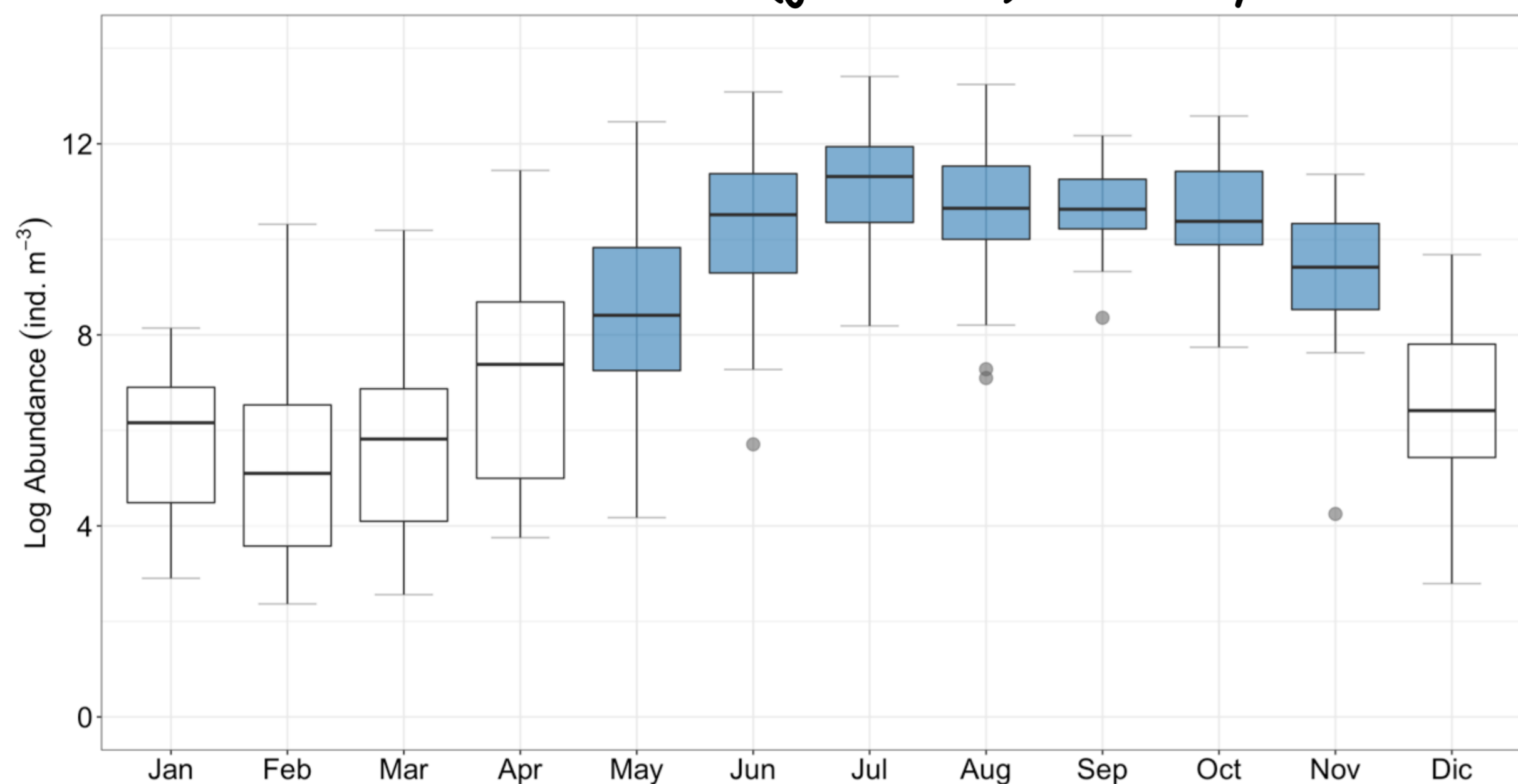
The density of anchovy early stages shows a seasonal pattern with highest values (nursery period) between May and November (blue boxes).
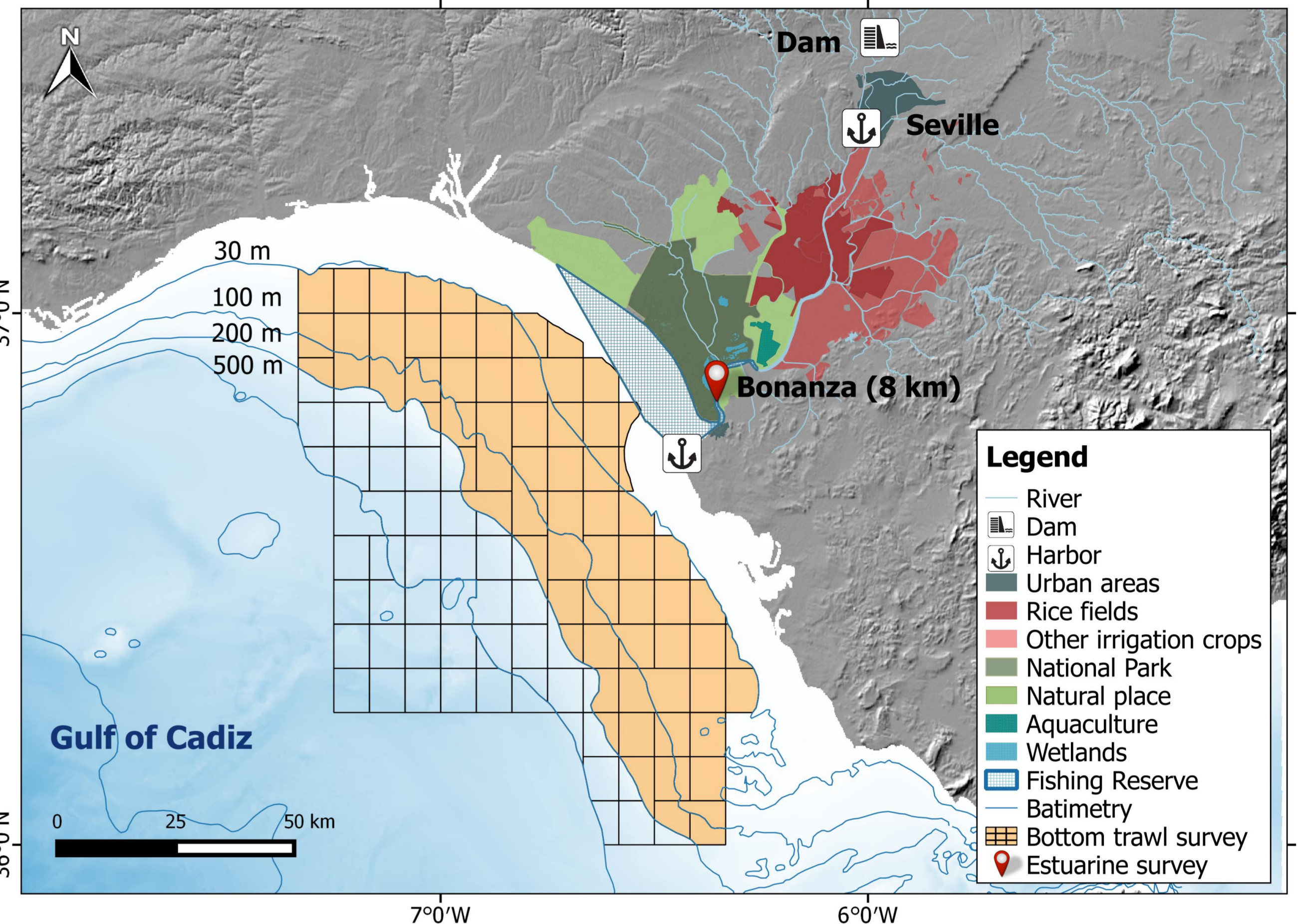
Socio-ecosystem map (above) : land uses & sampling stations
Dataset (below) compiled from several sources

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Guadalquivir estuary long-term ecological research program	• Monthly: 1997 - 2015
ARSA **bottom trawl survey**	• Annual: 1993 – 2015
Marine environmental (satellite) and **Fishery** (landings) **data**	• Annual: - 1997 - 2015

Estuarine effects

- Temperature (21% / 32%)
- Salinity (44.5% / 36%)
- Turbidity (12%)
- Discharges (22.5%)
- Trophic effects (12% / 20%)

Marine effects

- Primary production (22%)
- Recruitment (45%)
- Predation (7%)
- Fishing mortality (26%)

% Partition deviance
Mysids
Anchovy
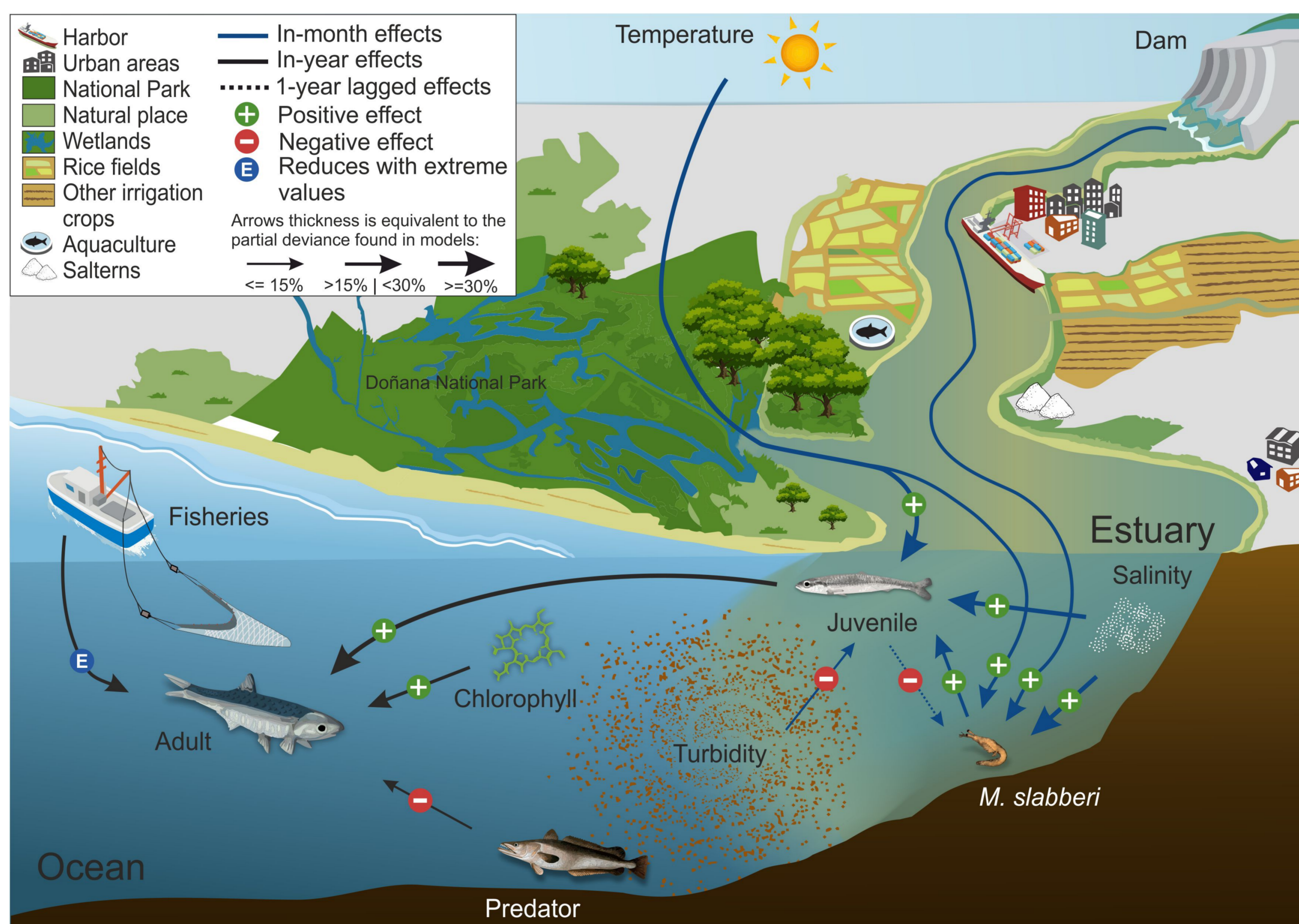
We used time series-analysis (GAMs) to quantify trophic, natural and anthropogenic effects on the anchovy dynamics, both within the estuary and at sea (see % on the left).

The relative importance of estuarine-resident anchovy as main predictor for autumn abundances at sea suggests that land-based activities, that affect estuarine conditions (salinity, turbidity) can cascade up to impact Gulf of Cadiz anchovy stock, both directly but also indirectly through effects (salinity, discharges) on its main prey (mysid sps. *M. slabberi*) .

Alternative Visions

(3) **healthy ecosystem** vision
(2) **land uses** vision
(1) **canal** vision
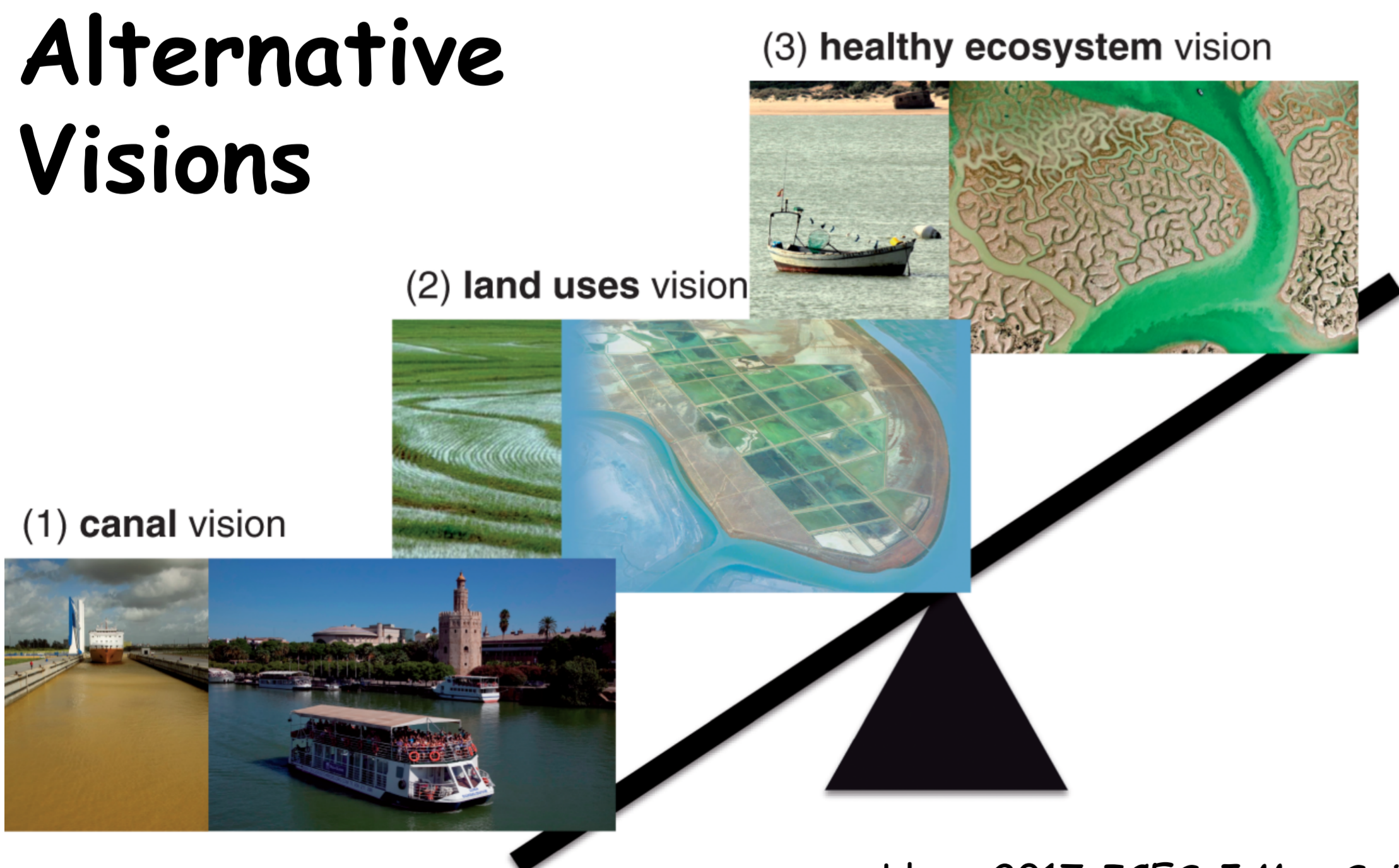
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Water management stands out as a key node where potentially conflicting interests (agriculture, power generation, aquaculture, fisheries) converge. Linking land-based activities to its impact on stock biomass represents the main challenge to ecosystem-based management in this particular regional sea.

Trade-offs

fresh
water
balance

• *salinity*
• *turbidity*