

25 Years of PICES: Celebrating the Past, Imagining the Future

November 2-13, 2016
San Diego, USA

North Pacific Marine
Science Organization
2016 Annual Meeting



Detection of a geographically fixed center of high abundance of macroinvertebrates along the west coast of Baja California

P. David Vega-García¹, Fiorenza Micheli², Héctor Reyes-Bonilla³, Salvador E. Lluch-Cota^{1*}

1 Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, B.C.S., México.

2 Hopkins Marine Station, Stanford University, United States of America.

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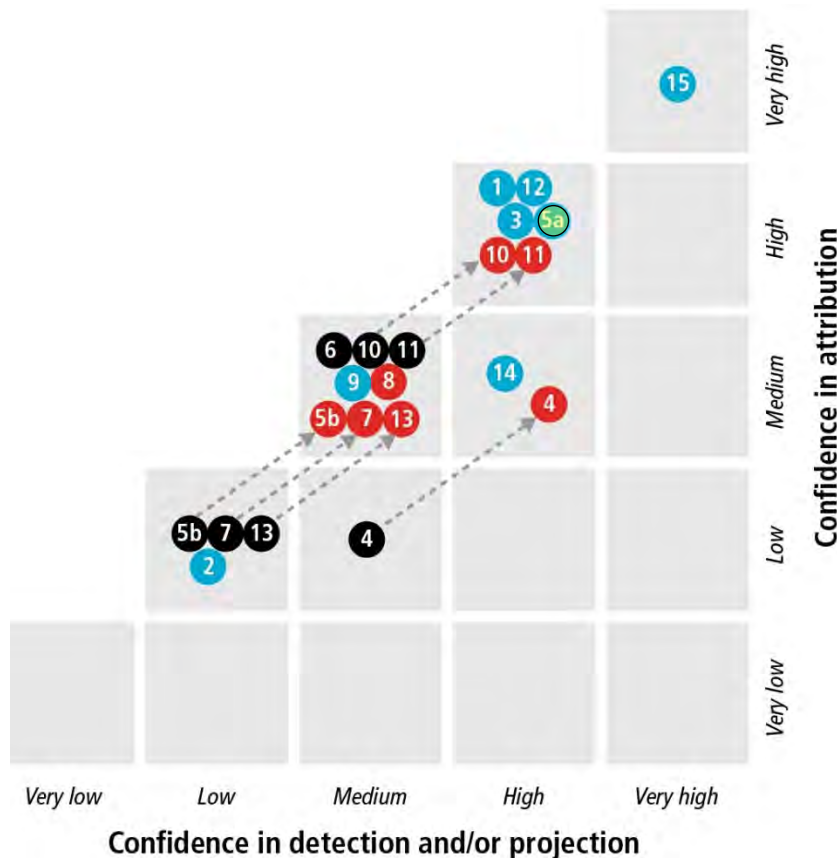
3 Universidad Autónoma de Baja California Sur, La Paz, B.C.S., México.

...or Two unsolved questions and a side project

Climate change causes latitudinal distribution shifts

From IPCC WG2 AR5 Ocean Chapter (Portner et al., 2014)

...numerous observations over the last decades in all ocean basins show global-scale changes including largescale distribution shifts of species (**very high confidence**).... The distribution and abundance of many fishes and invertebrates have shifted poleward and/or to deeper, cooler waters (**high confidence**). Poleward displacements of phyto- and zooplankton have occurred by hundreds of kilometers per decade (**high confidence**)...



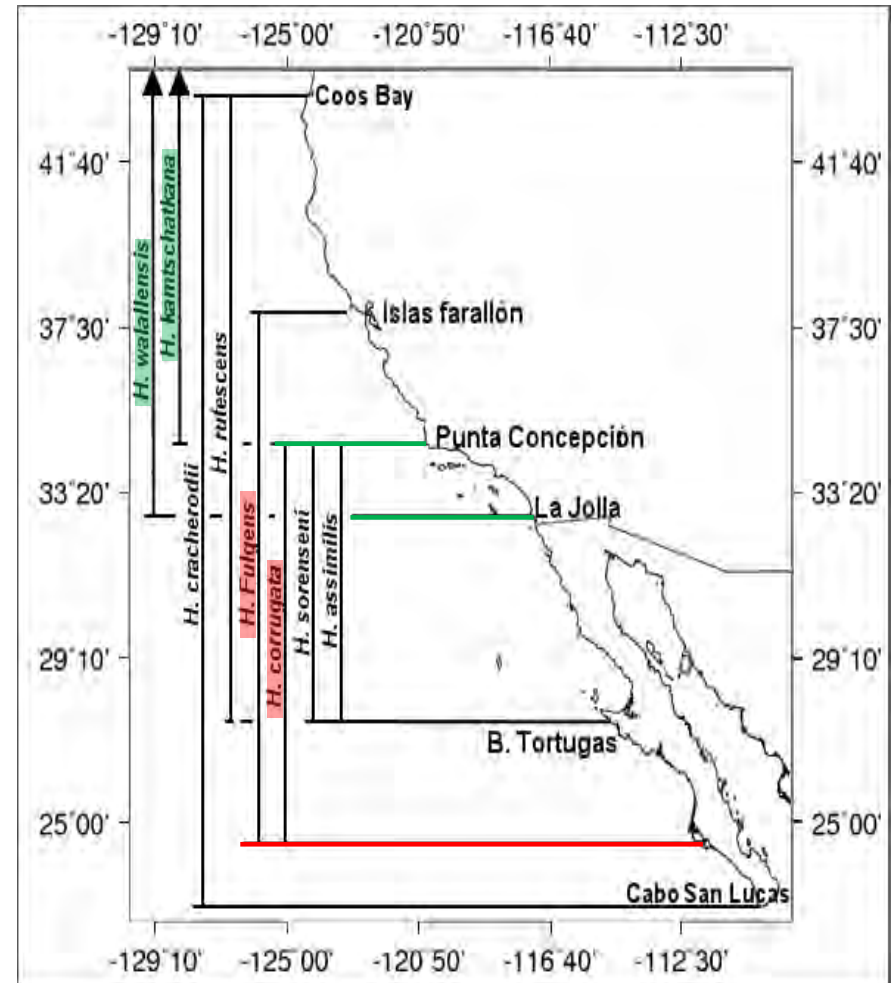
Broad categories

- 1 Abundance (AB) ●
 - 2 Biogeochemical Processes (BG) ●
 - 3 Community Composition (CC, under TE, HE, OAE) ●
 - 4 Ecosystem Services (ES) ● ●
 - 5a Fishery Catch Potential (FCP, species shifts) ●
 - 5b Fishery Catch Potential (FCP, changing NPP) ● ●
 - 6 Geological Record (GR, observations) ●
 - 7 Global Net Primary Production (gNPP) ● ●
 - 8 Harmful Algae Blooms (HAB) ●
 - 9 High-latitude Net Primary Production (hNPP) ●
 - 10 Hypoxia Effects (HE) ● ●
 - 11 Ocean Acidification Effects (OAE) ● ●
 - 12 Oxygen and Capacity Limited Thermal Tolerance (OCLTT) ●
 - 13 Synergistic Effects (SE) ● ●
 - 14 Species Richness (SR, Fish) ●
 - 15 Temperature Effects (TE) ●
- Detection
● Projection
● Detection and projection have the same levels of confidence

Abalones in the California Current have shifted distribution

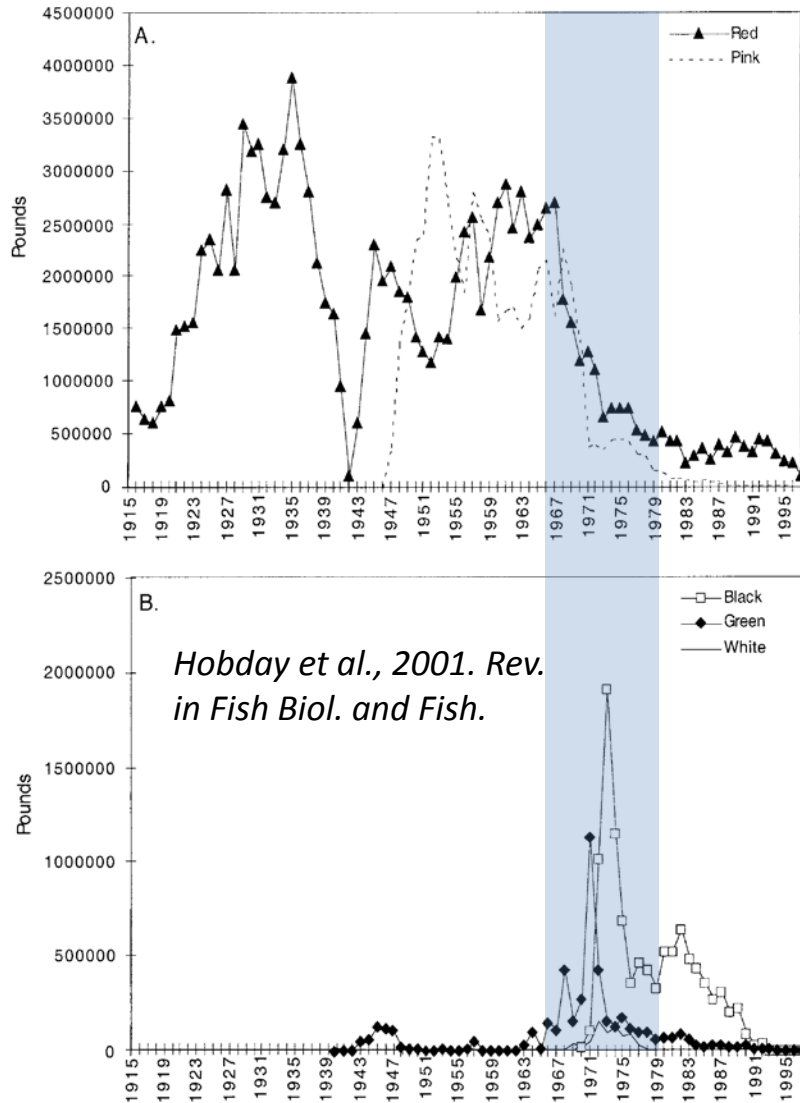
Rogers-Bennett, 2007. *Bull Mar Sci*.

- Abalone abundance surveys from the 1970s were repeated 30 yrs later following a period of increased sea surface temperatures along the Pacific coast of the United States.
- Northern abalone, *Haliotis kamtschatkana* once abundant...are now extremely rare in the southern portion of their range...They have also declined 10 fold in northern California in the absence of human fishing pressure.
- Flat abalone, *Haliotis walallensis* no longer occur in southern California, and in central California have declined...inside a marine reserve. The distribution of flat abalone appears to have contracted over time.



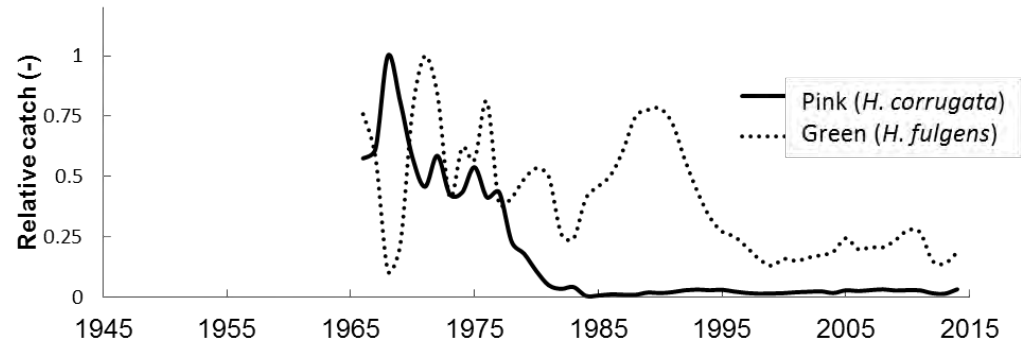
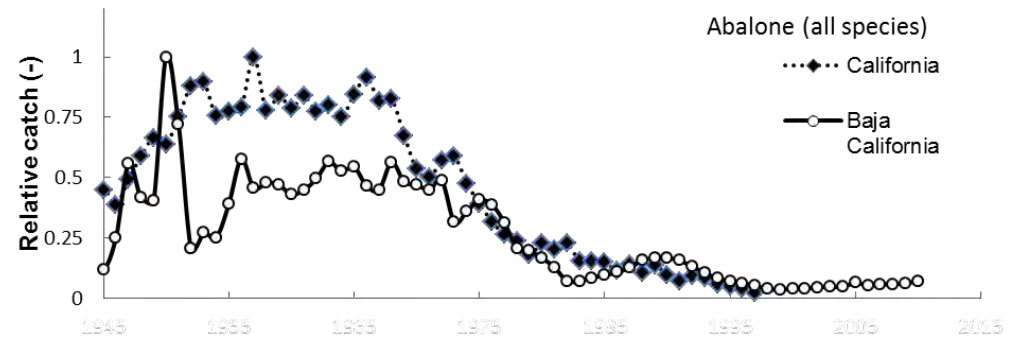
Question 1: Is latitudinal shift also apparent for other abalone species (fished in Mexico)?

Most, but not all abalones have sharply declined



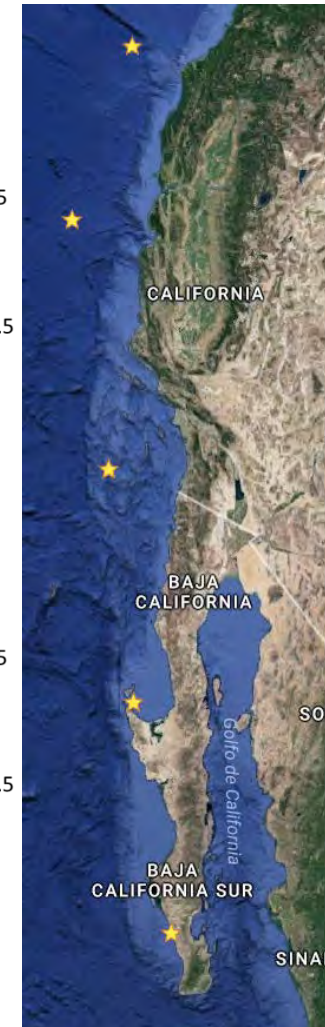
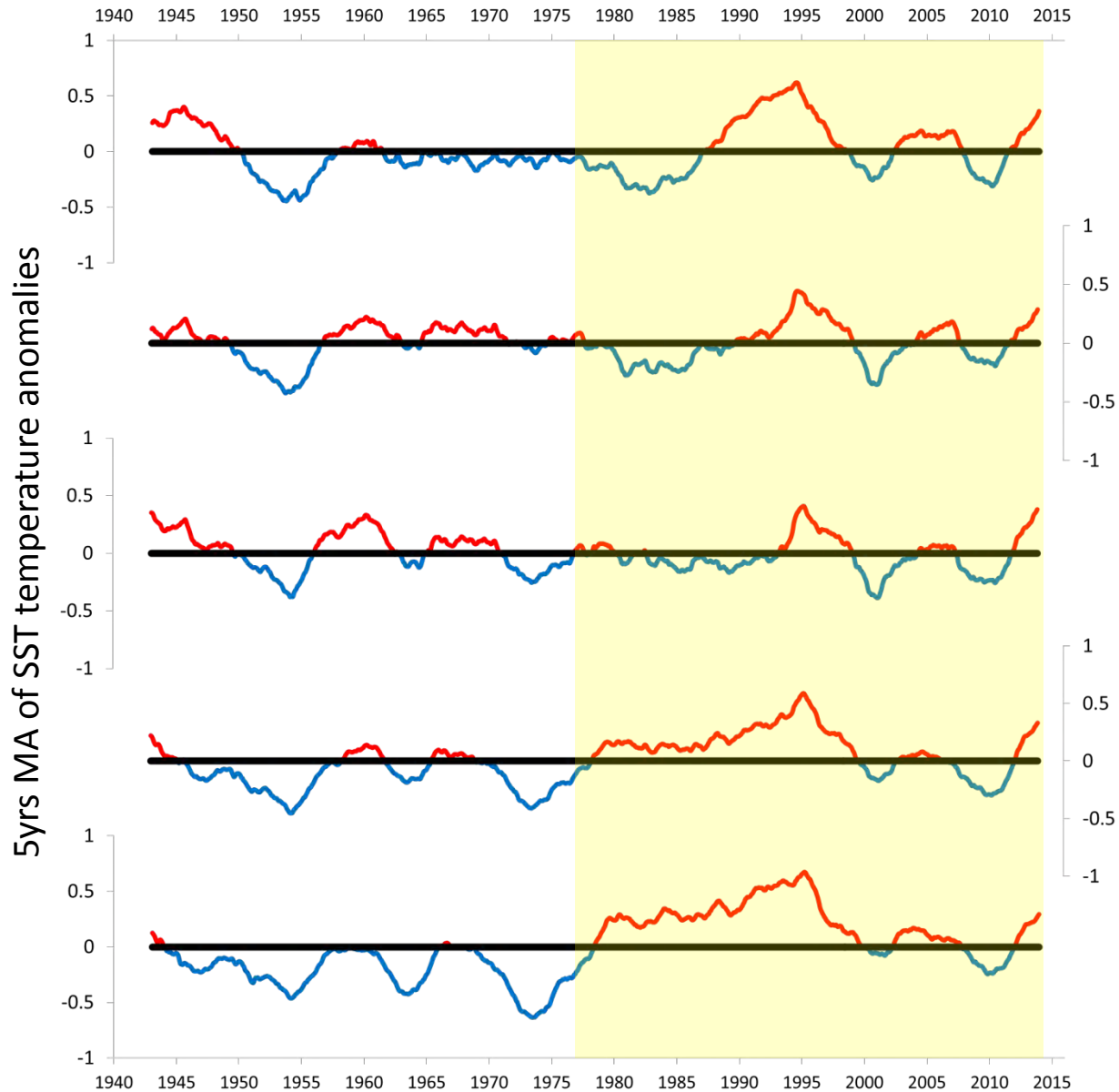
Cath time series show declines in all species off California (most of them in the 1970s)

Off Baja California the decline is only clear for pink abalone



Question 2: What is the reason behind the differences in Baja California abalones trends?

Not strongly different climate change signal

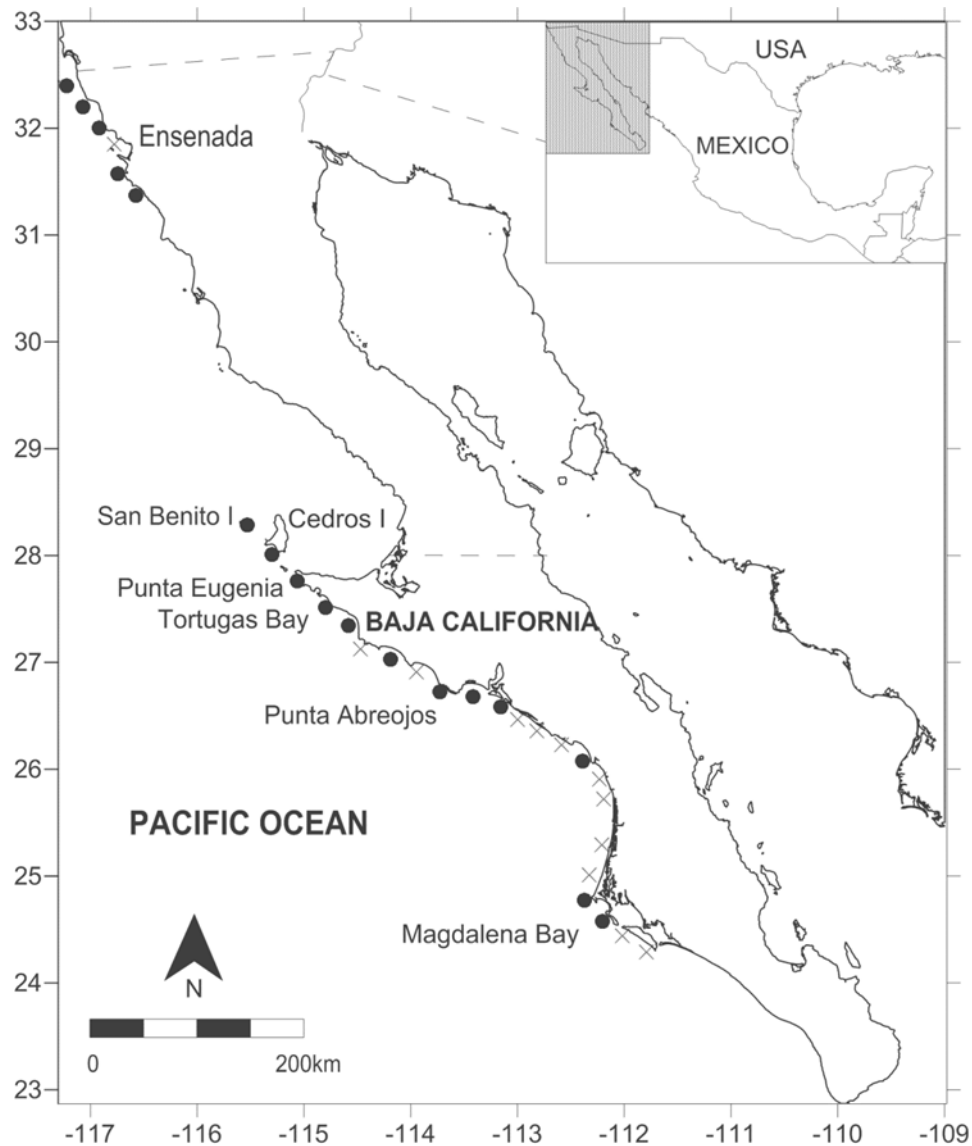


Intensive regional scale study

Searcy-Bernal et al., 2010. *J. Shellfish Res.*



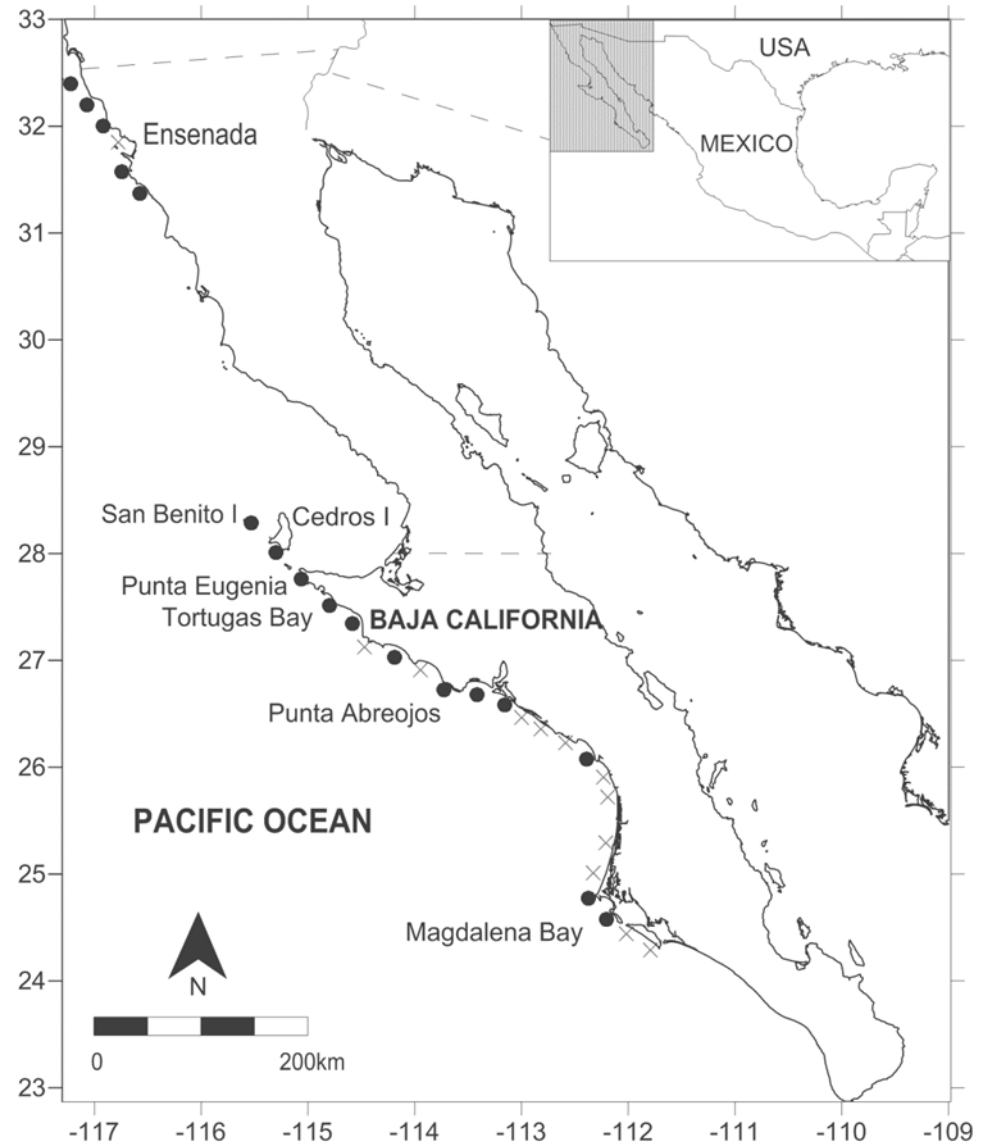
Figure 1. Abalone fishing cooperatives (numbers) and commercial farms (letters) in the states of Baja California (B.C.) and Baja California Sur (B.C.S.), México. Bold numbers indicate locations of cooperative hatcheries. See Tables 1 and 2 for details.



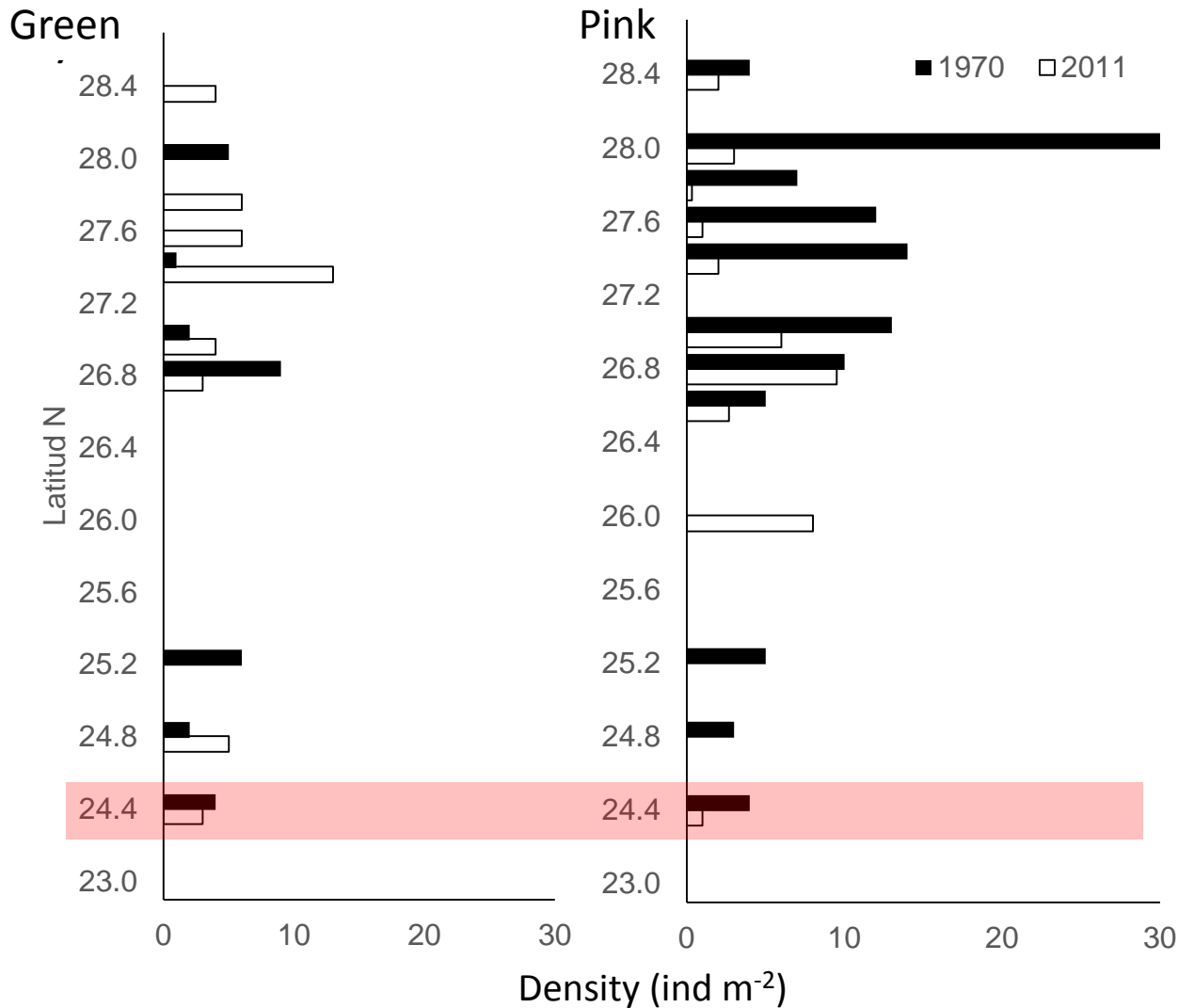
Intensive regional scale study

Replicating a study from 1969-1970 (*Guzmán-del Proo et al., 1972. INP*): 0 to 20 m depth transects perpendicular to the coastline, every 25km. At each transect 2 X 3 meters quadrats at three depths strata, : 3 to 10 m, 10 to 15m, and 15 to 20m.

- Historical climate analyses
- Fishing practices
- Abalone distribution, abundance, and density
- In field and lab ecophysiological experiments
- Feeding habits (gut contents and isotopes)
- Community structure



Answer 1: no latitudinal changes (inconclusive)



Caveats

- Not enough latitudinal resolution (or distribution limits reports are wrong)
- Delayed response in time (changes occurring but still not evident)
- The distribution limit is not related to temperature

Answer 2: No positive results (good, but hard to publish)

Mechanism	Result	Confidence
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Side project: latitudinal patterns in community structure

Similarity analysis resulted in 4 geographically coherent groups

60 mollusks
33 echinoderms
11 crustaceans

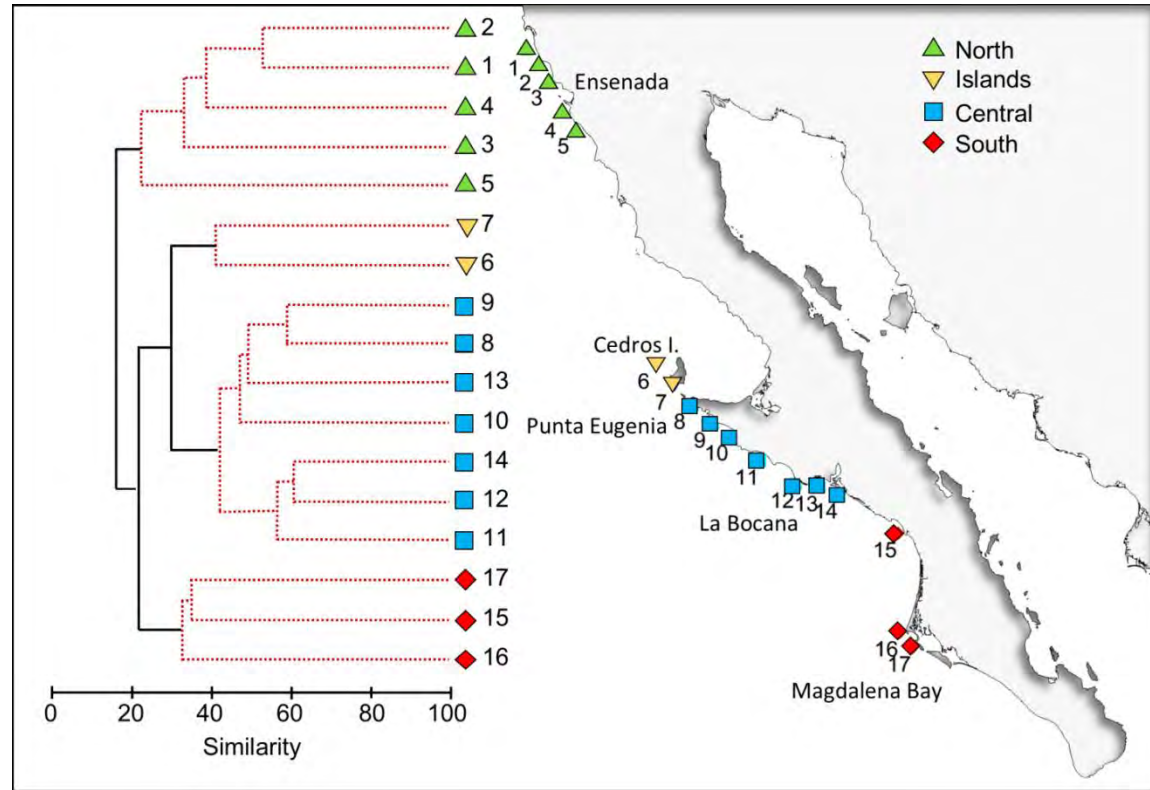
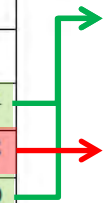


Table 1. Average richness, abundance, diversity and similarity of the regions of macroinvertebrate community identify.

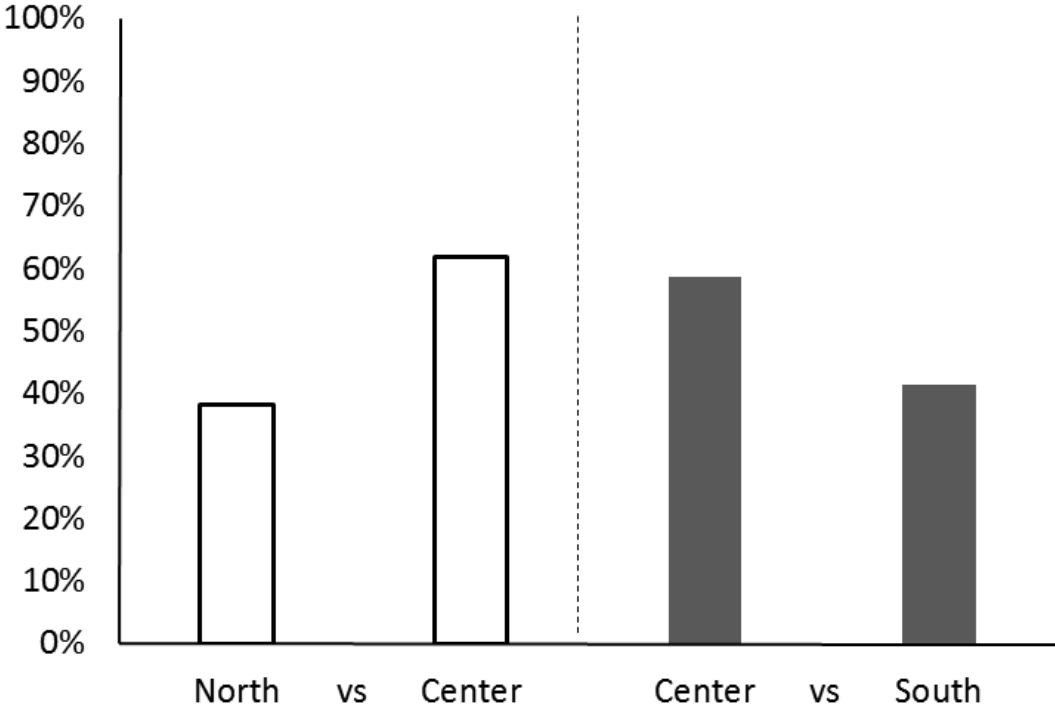
		Regions			
		North	Islands	Central	South
S	Richness	16	11	23	14
N	Abundance	115	44	164	58
α	Fisher Diversity	6.10	4.73	7.47	6.00

Expected (biogeographical border effect)

Unexpected

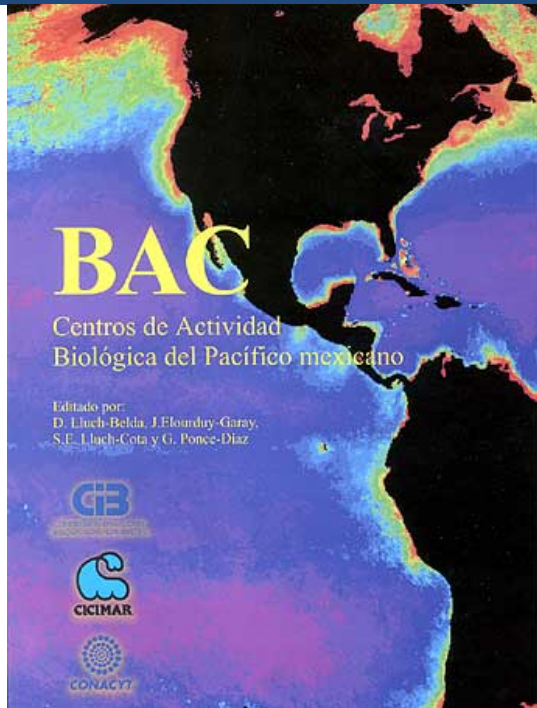


News: Abundance for most species is higher in the central zone

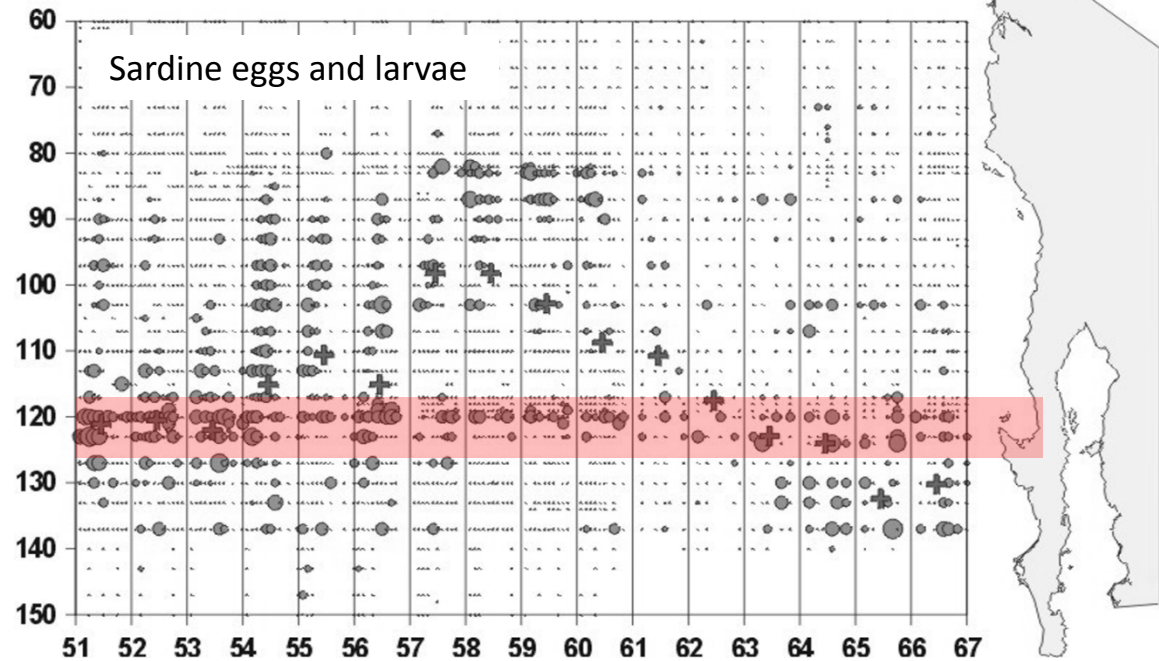


Proportion of coincident species showing higher abundance

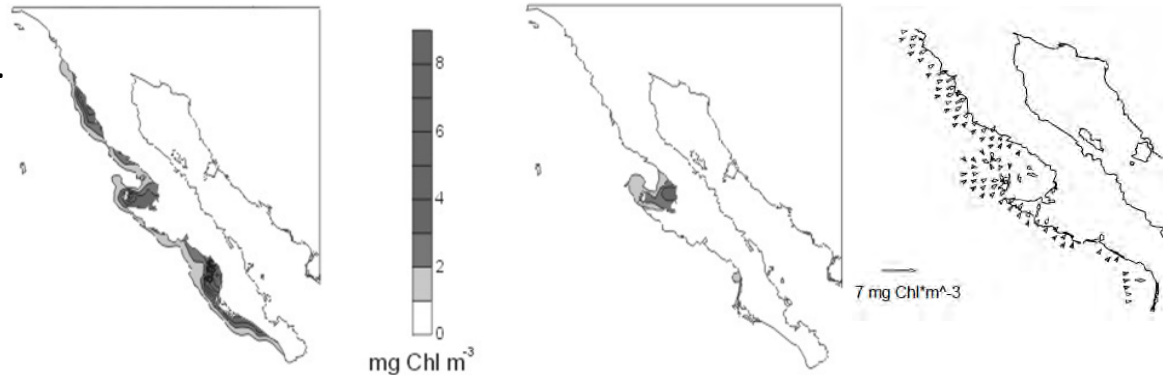
This pattern has already been described for the pelagic realm



Lluch-Belda et al., 2003. *J. of Ocean.*



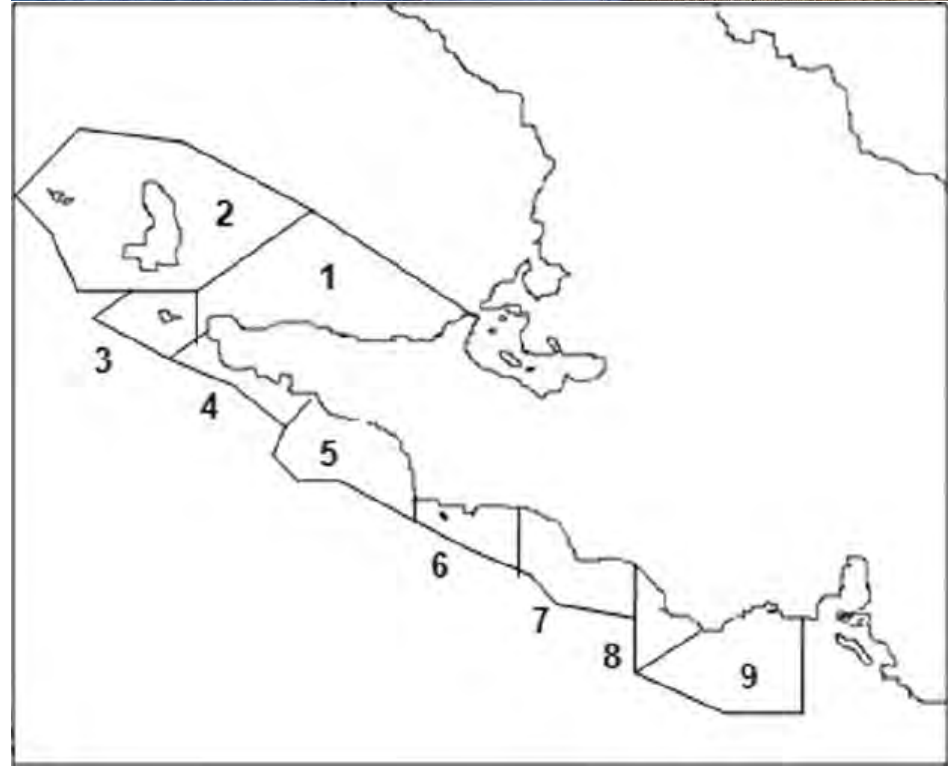
- Sebastián Vizcaíno-Punta Eugenia has higher productivity than the rest of the coastal area throughout the year.
- Related to upwelling, but there are evidences of higher productivity retention than the rest of the coast.
- Driven by topography.



Why this is relevant

- Abalone fishery is of paramount importance for local communities (cooperatives)
- Fishing areas for abalone are consessed to cooperatives in a long term (10yrs) perspective (which favors resposible involvement)

1. Tradeoff between conservation and socially relevant fishery (abundance and diversity)
2. Because BACs are linked with geophysically fixed features, there is no need to modify fishing areas consessions (climate change adaptation)



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