Session 2: "Early life history and recruitment processes"

Distribution of anchovy and sardine egg and larvae in the Peru Current System (Humboldt) from 1961 to 2016: implications for recruitment

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ICES/PICES Symposium on Drivers of the dynamics of small pelagic fish resources
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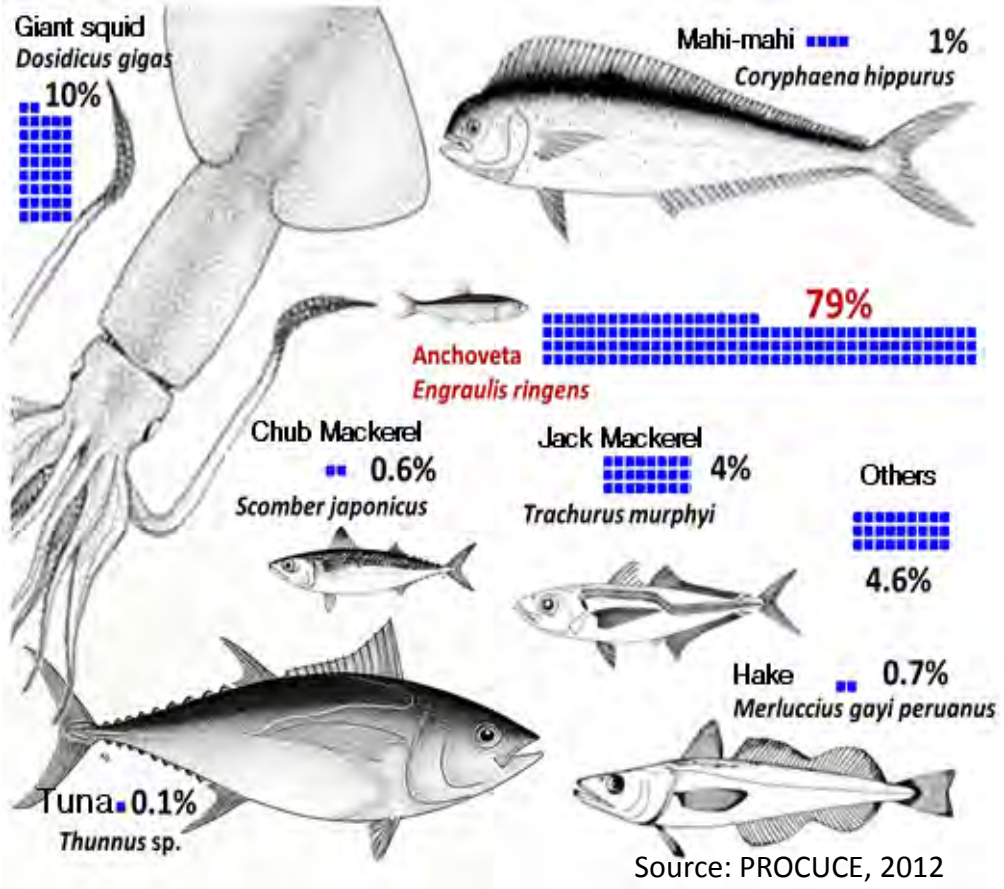
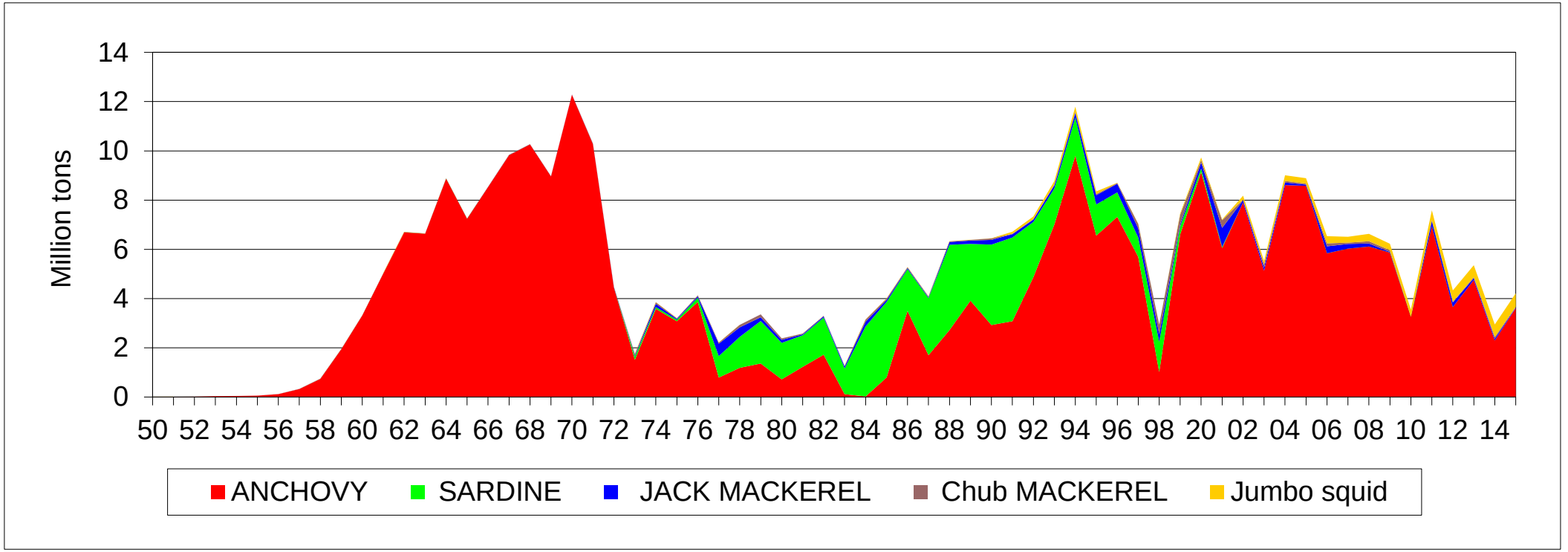
INTRODUCTION



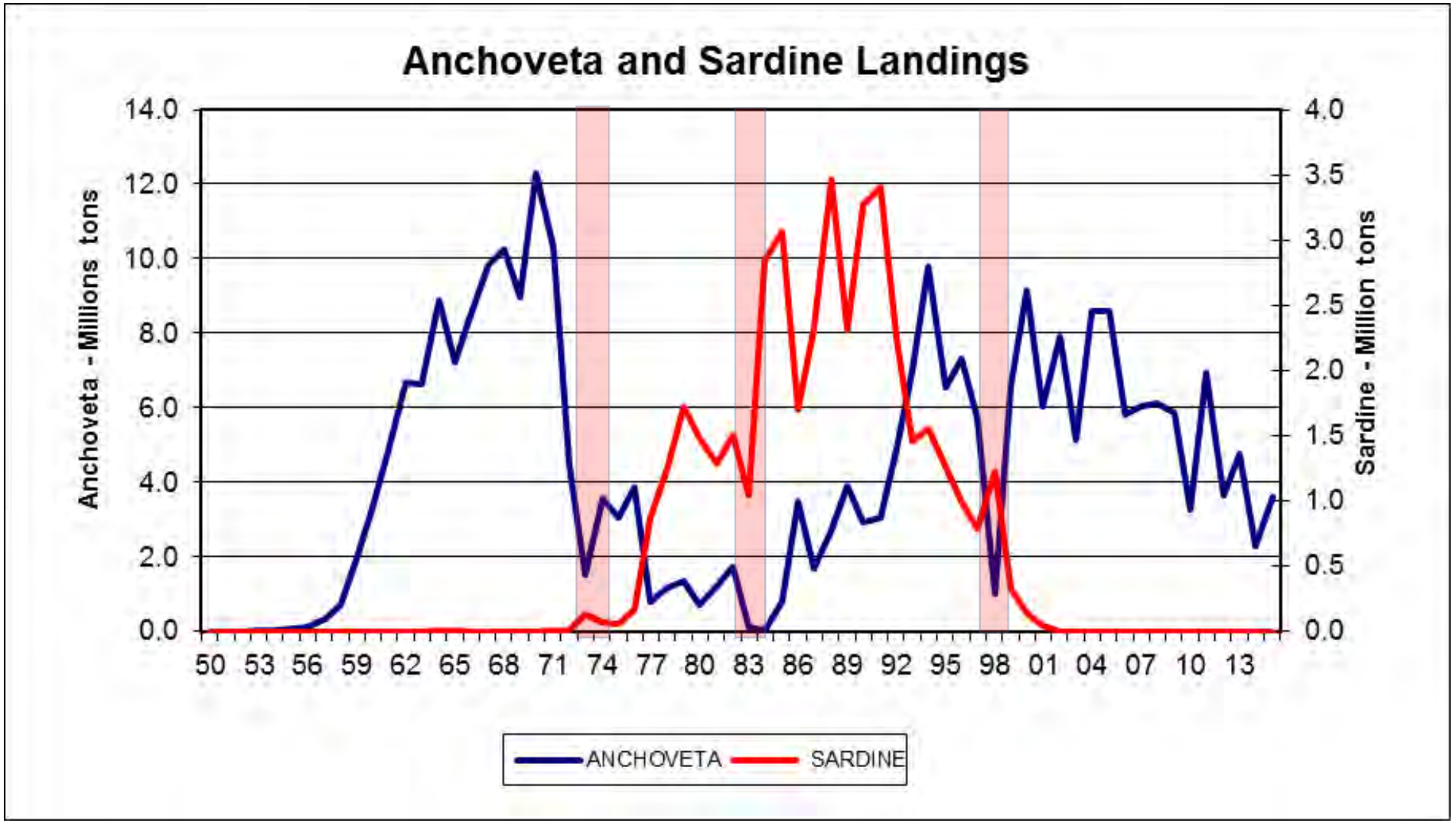
Source: PROCUCE, 2012

INTRODUCTION

Landings



INTRODUCTION



OBJECTIVE

Explore patterns of egg and larval abundance of anchovy and sardine in relation to:

. Time

. Seasonal

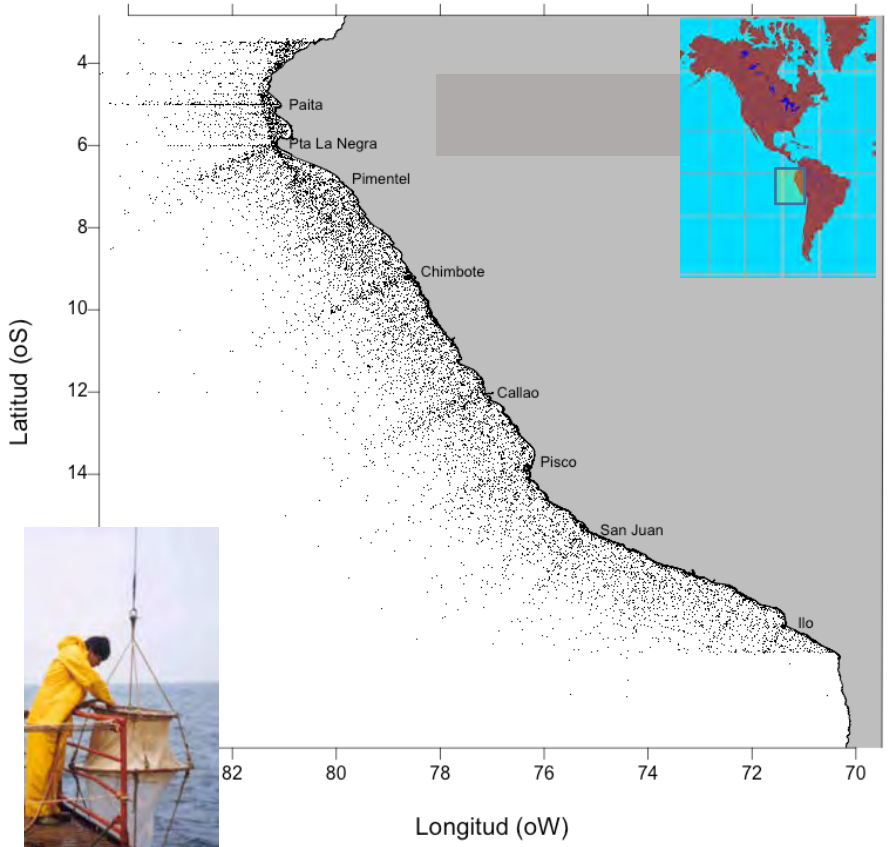
. Space

. Oceanographic factors (Temperature, Salinity)

- Anchovy Biomass - Recruitment

METHODOLOGY

STUDY AREA:



Period: 1961-2016

Surveys: 209 (~ 37000 samples)

Egg/larval Sampler: Hensen net (300 u 0-50m) / CalVET neT (300u). Abundance Standarized.

Preservation: Formaldehide buffered 2%

Variables:

- Oceanographic: SST, SSS → Water masses
- Shelf break: (200m isobath)
- Location: (Latitude, Longitude)

METHODOLOGY

T/S diagram: Anchovy and sardine larvae

Anchovy biomass: Length based VPA /Recruitment

Analysis method: GAM – Model regresion
- Temporal (years, months)
- Spatial: Shelf break, latitude
- Oceanographic conditions: SST, SSS
  Water Masses

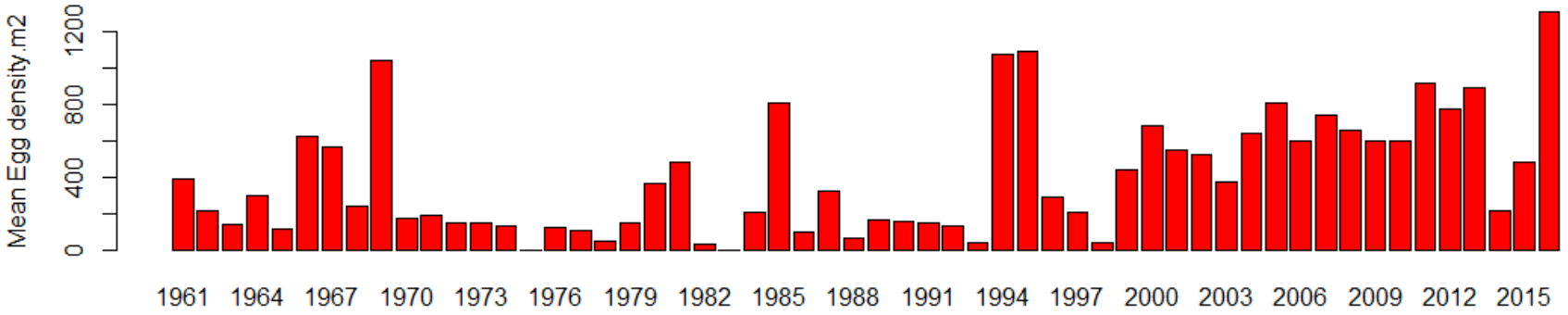
Cross correlation

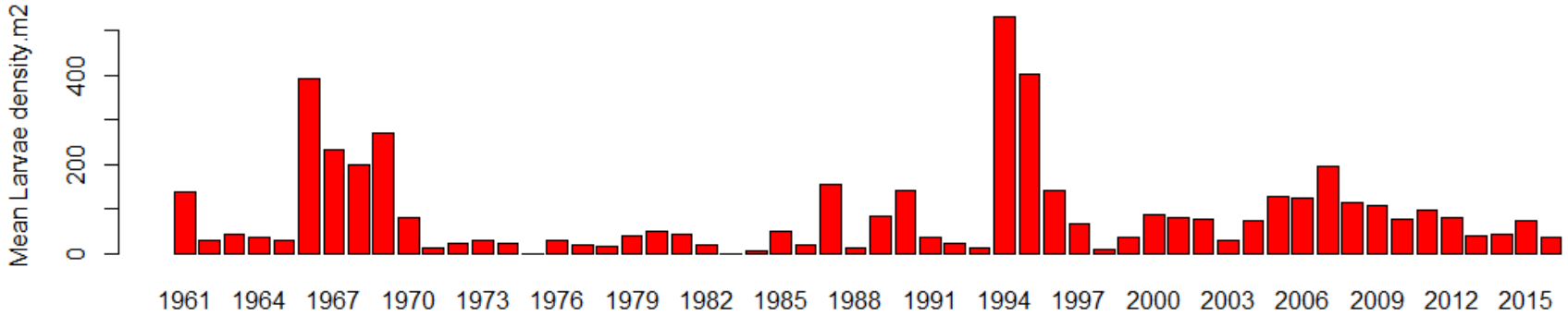
*Daily Egg Production: Egg number/area * Development time (SST)

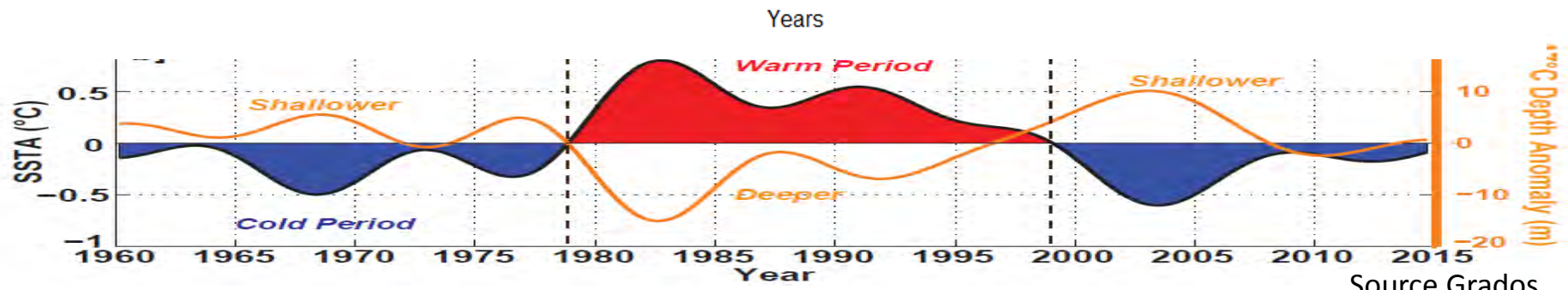
*Index retention: larval /egg shelf

*Anchovy

RESULTS: Anchovy Time Series

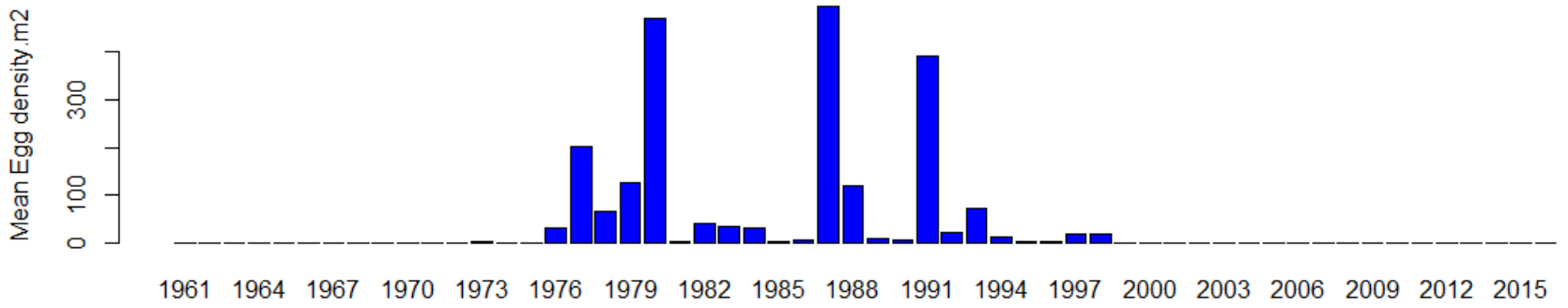


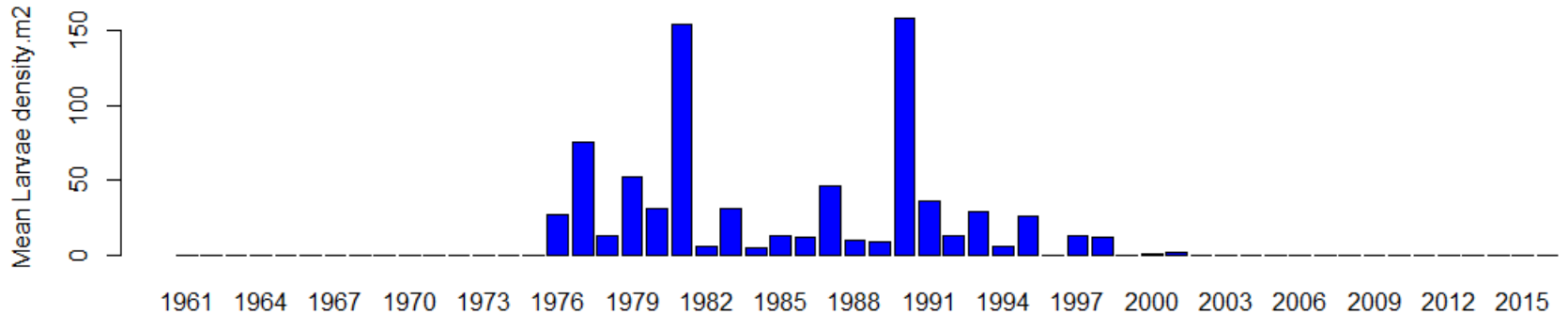


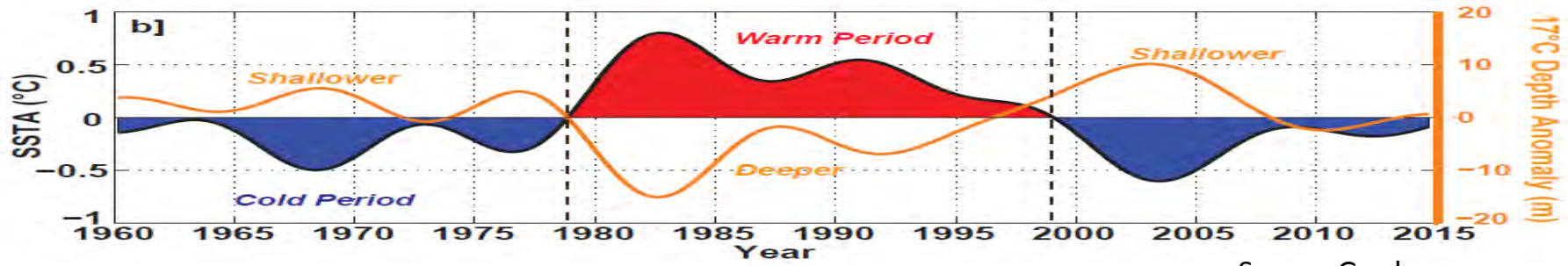


Source,Grados

RESULTS: Sardine Time Series

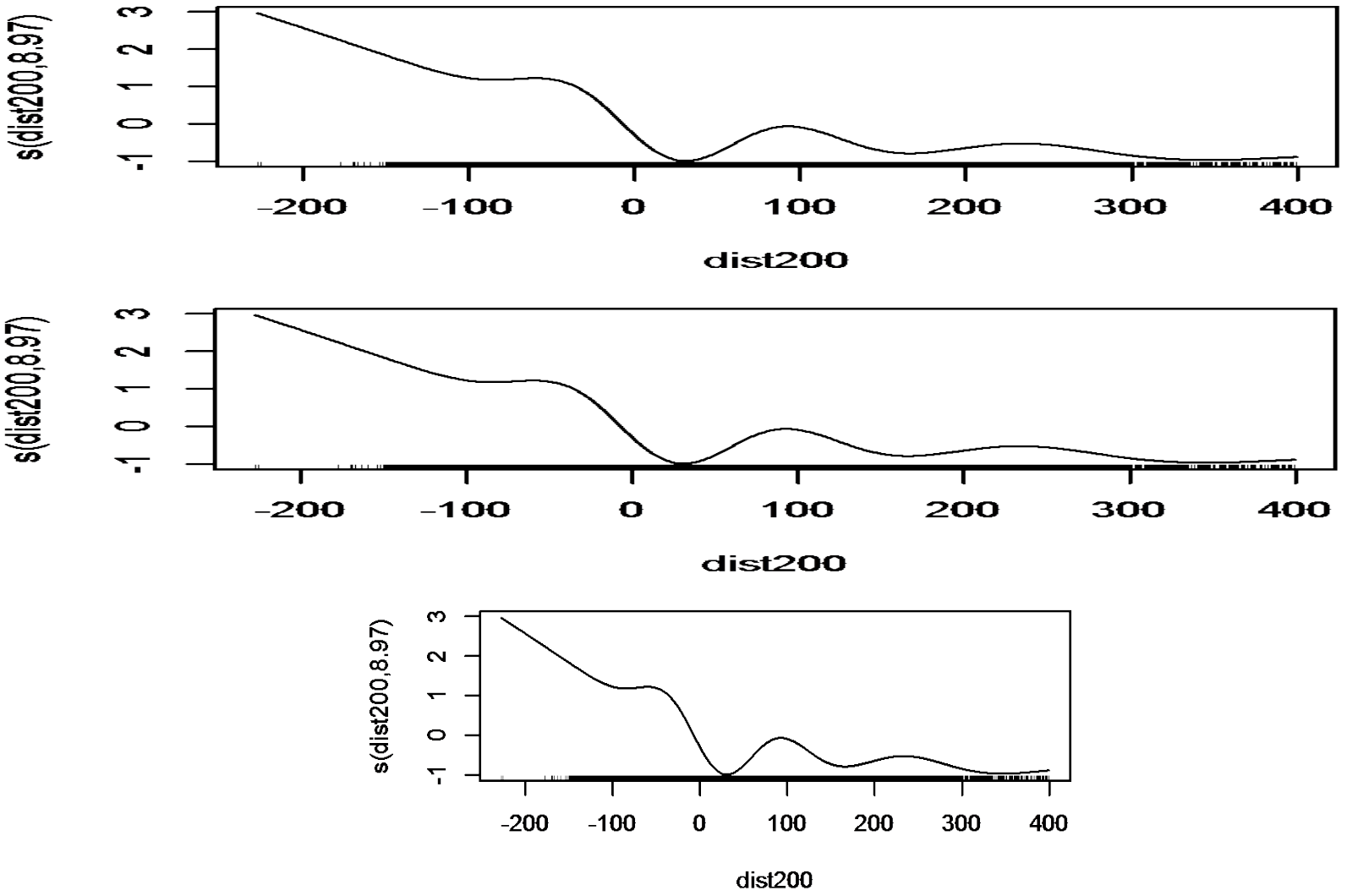




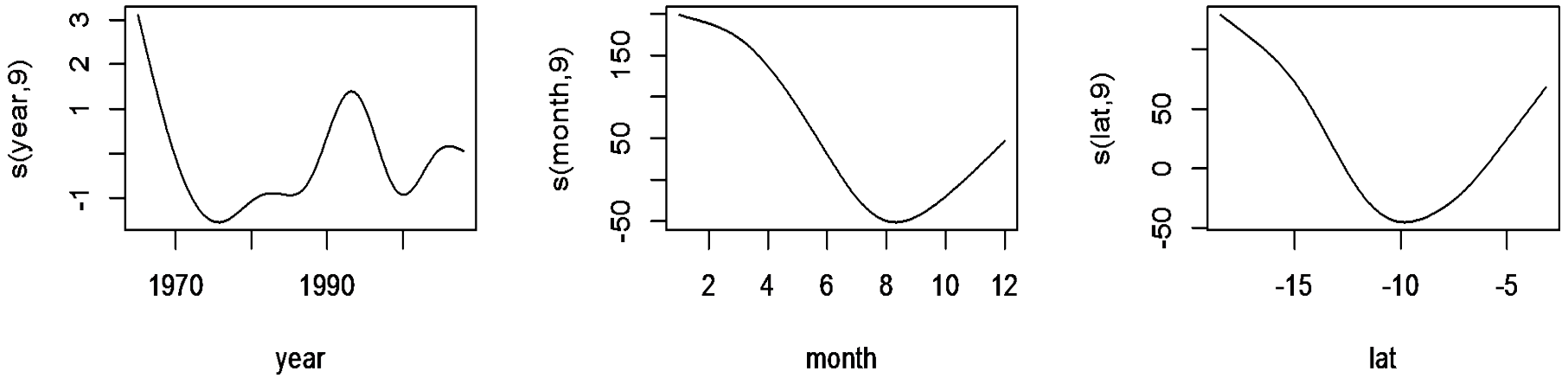


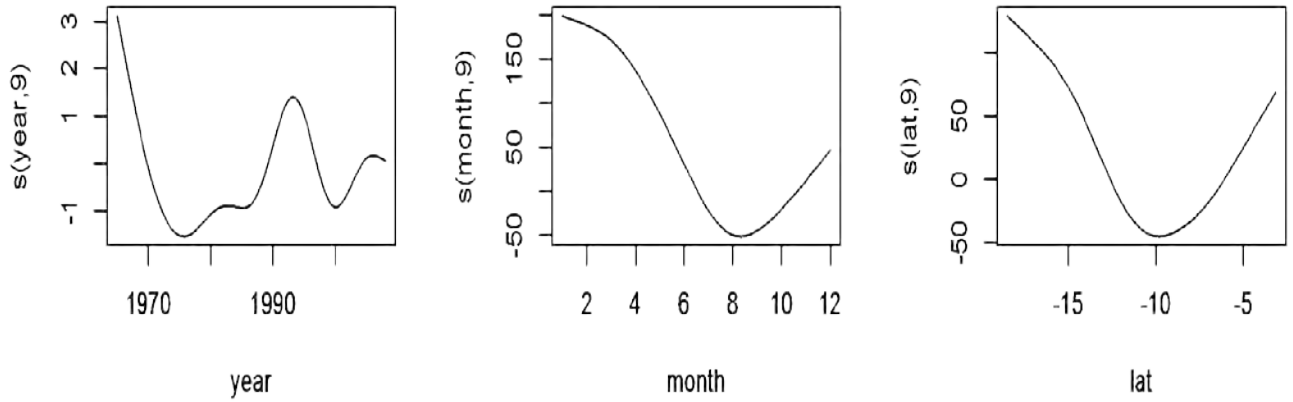
Source,Grados

RESULTS: GAM anchovy eggs

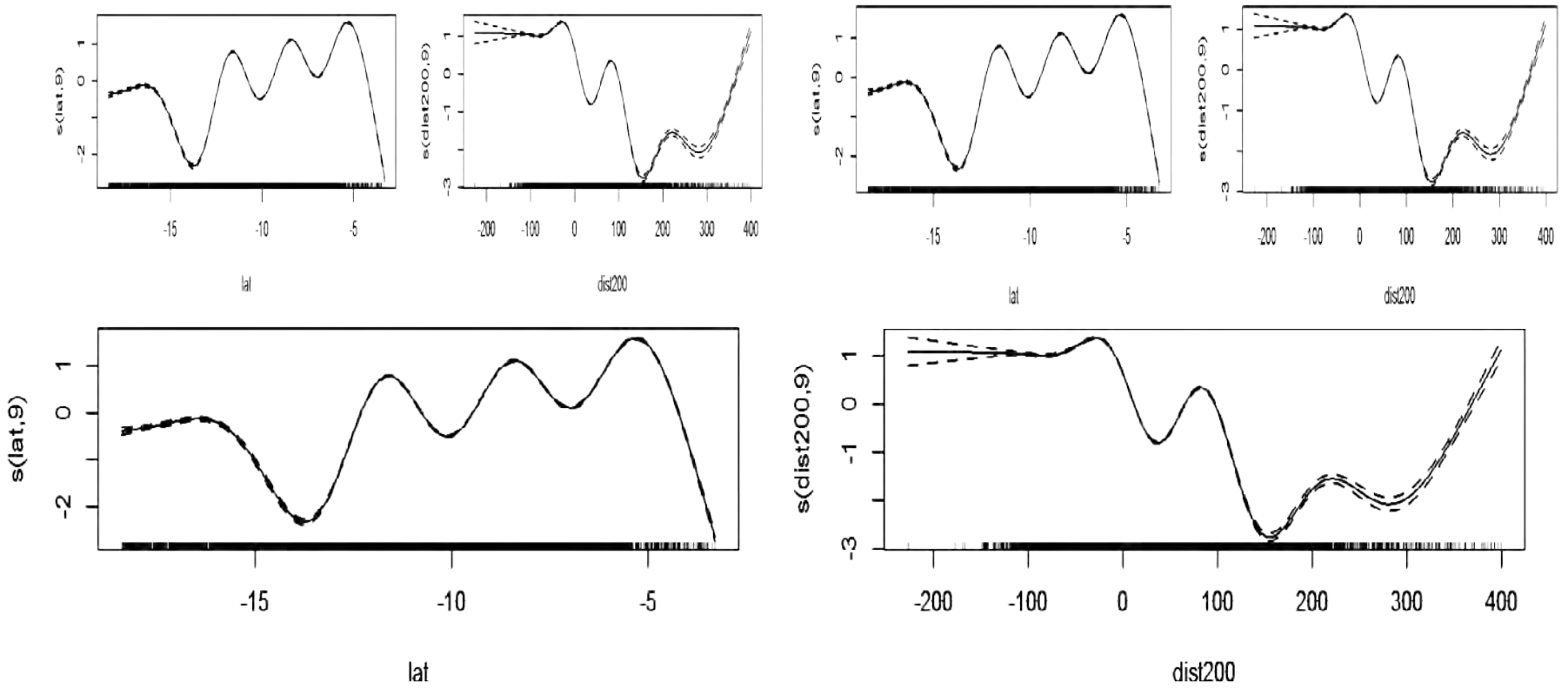


RESULTS: GAM anchovy larvae





RESULTS: GAM sardine eggs



SEW= Surface Equatorial Waters
MESC=Mix Equat Subtropical Coastal Waters
SSW= Oceanc Waters
MCS= Mix Coastal and Oceanic waters
CCW= Cold Coastal Waters
CAW=Cold Antarctic Waters
STW= Surface Tropical Waters

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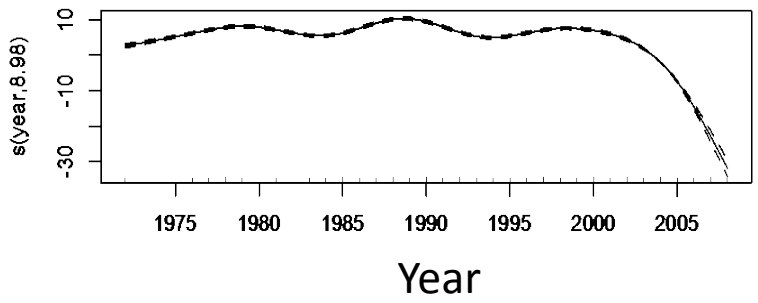

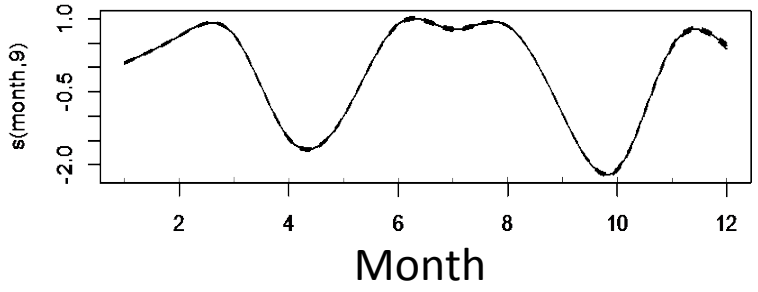

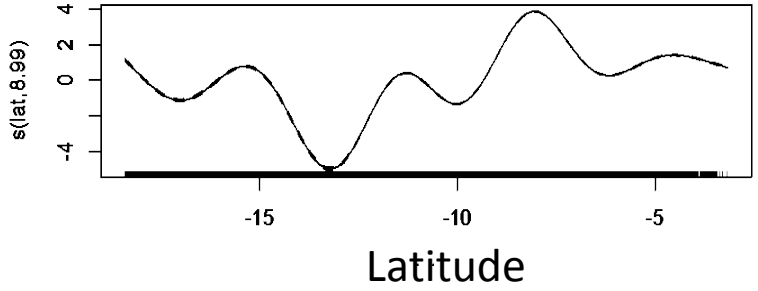

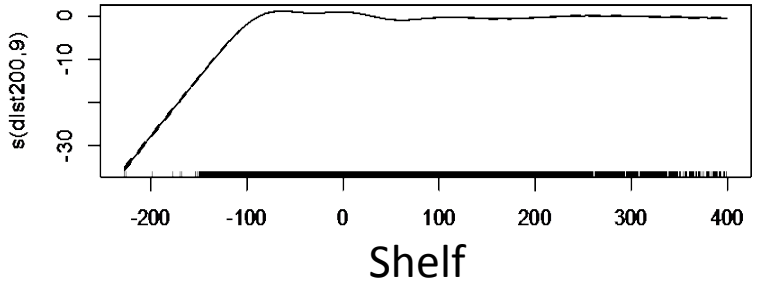

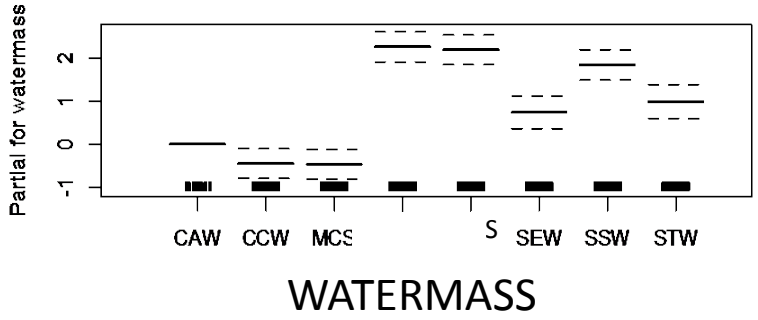

MESC=Mix Equatorial, Subtropical, Coastal Waters
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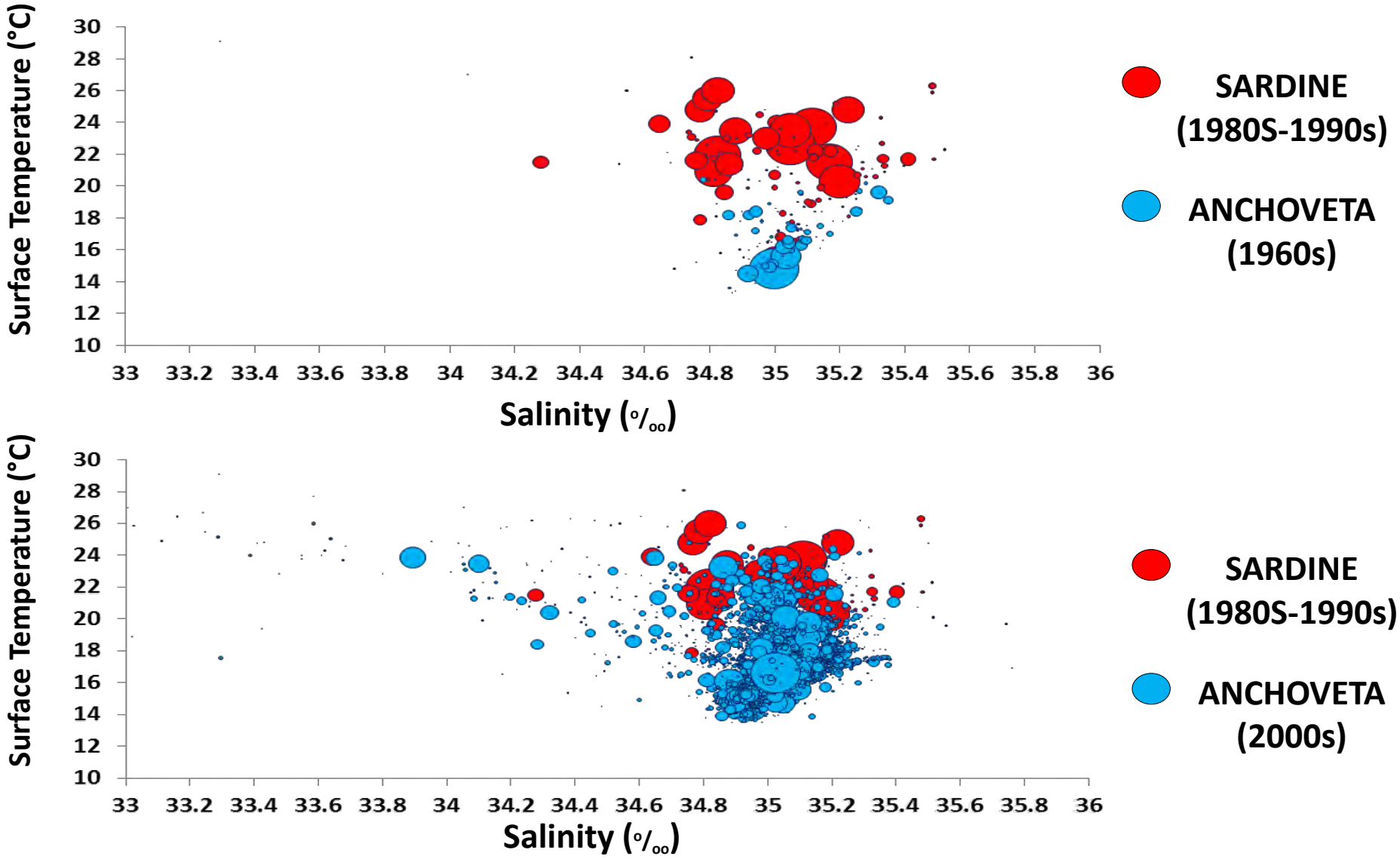
RESULTS: Index of abundance of sardine and anchoveta eggs



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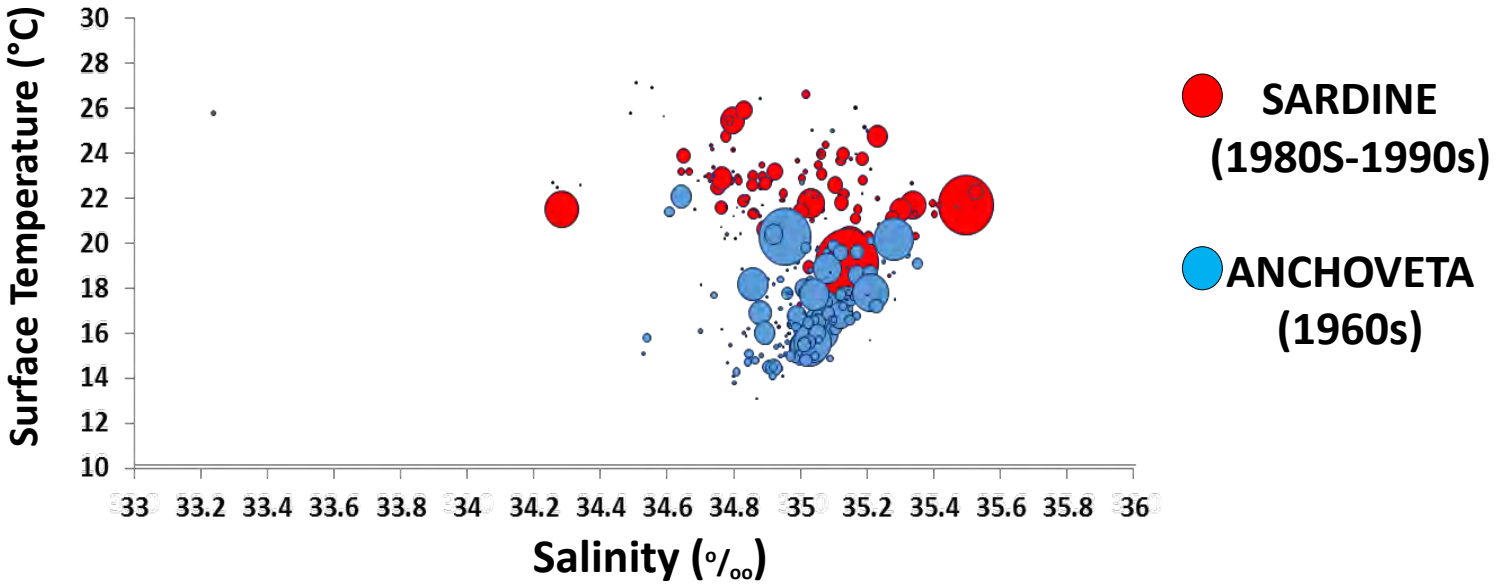
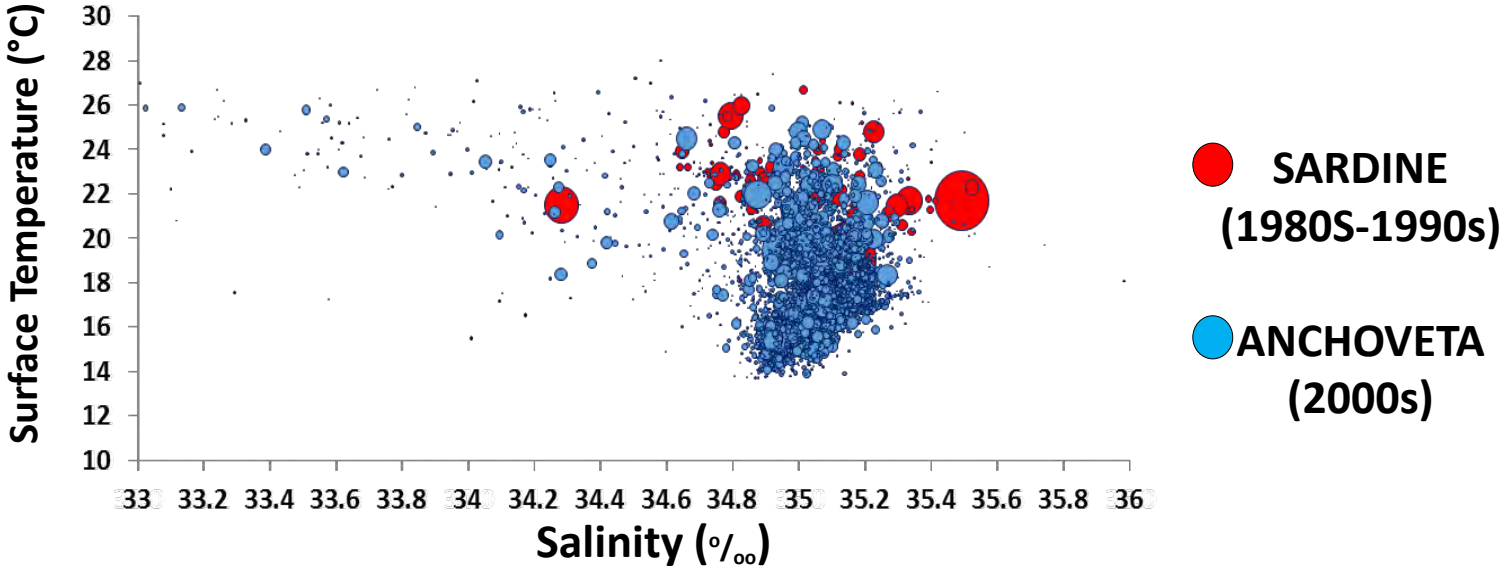


SARDINE (1980S-1990s)

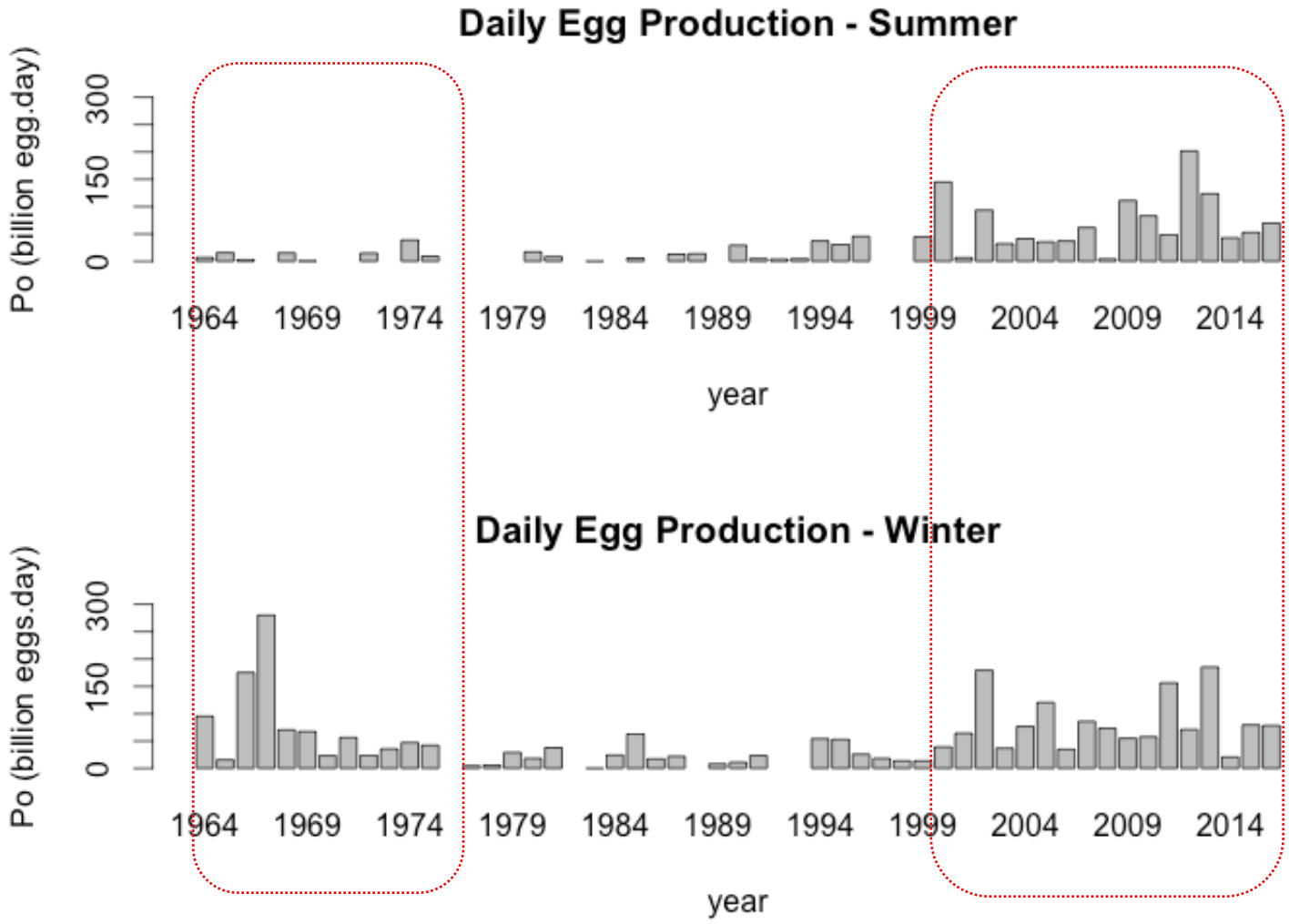
ANCHOVETA (1960s)



SARDINE (1980S-1990s)

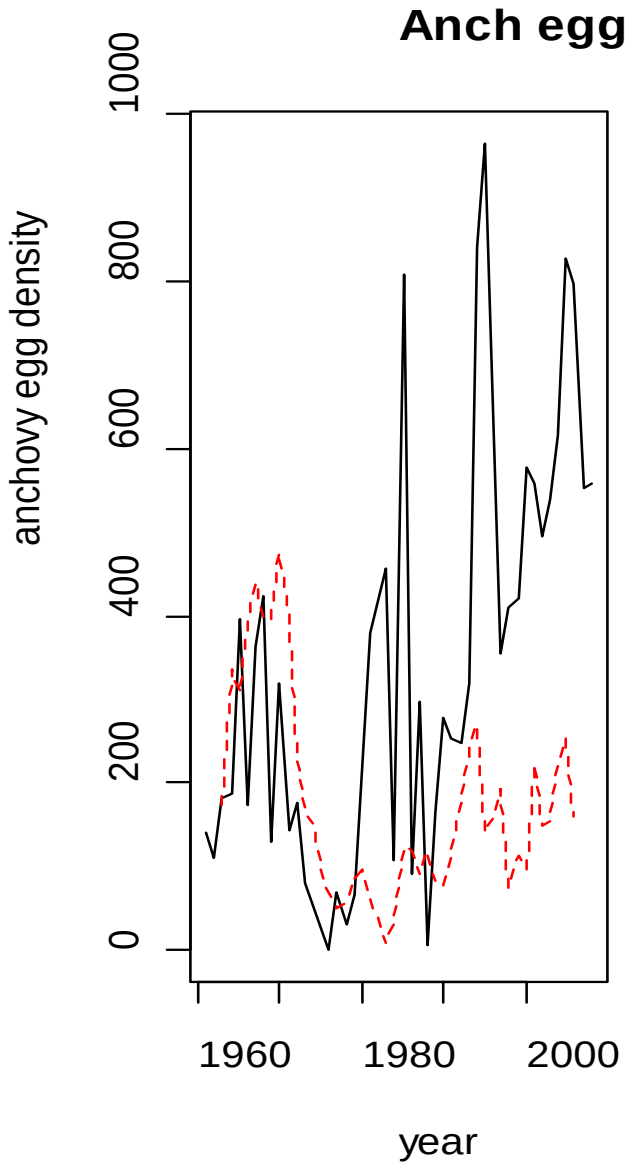
ANCHOVETA (2000s)

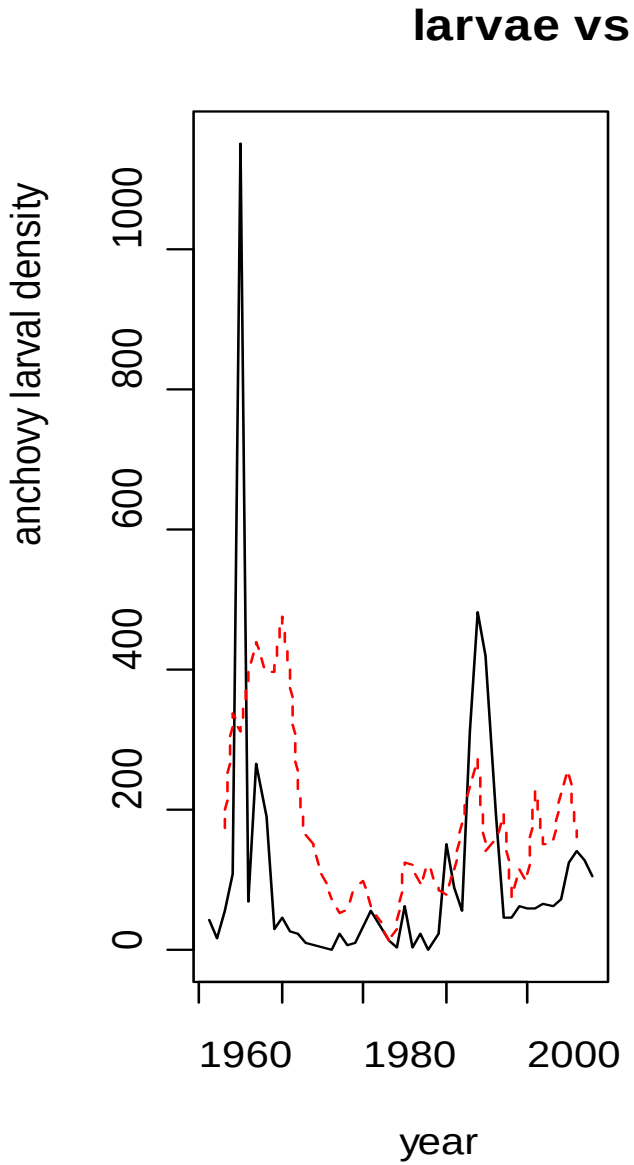
RESULTS: Anchoveta's Daily Egg Production (1964-2016)



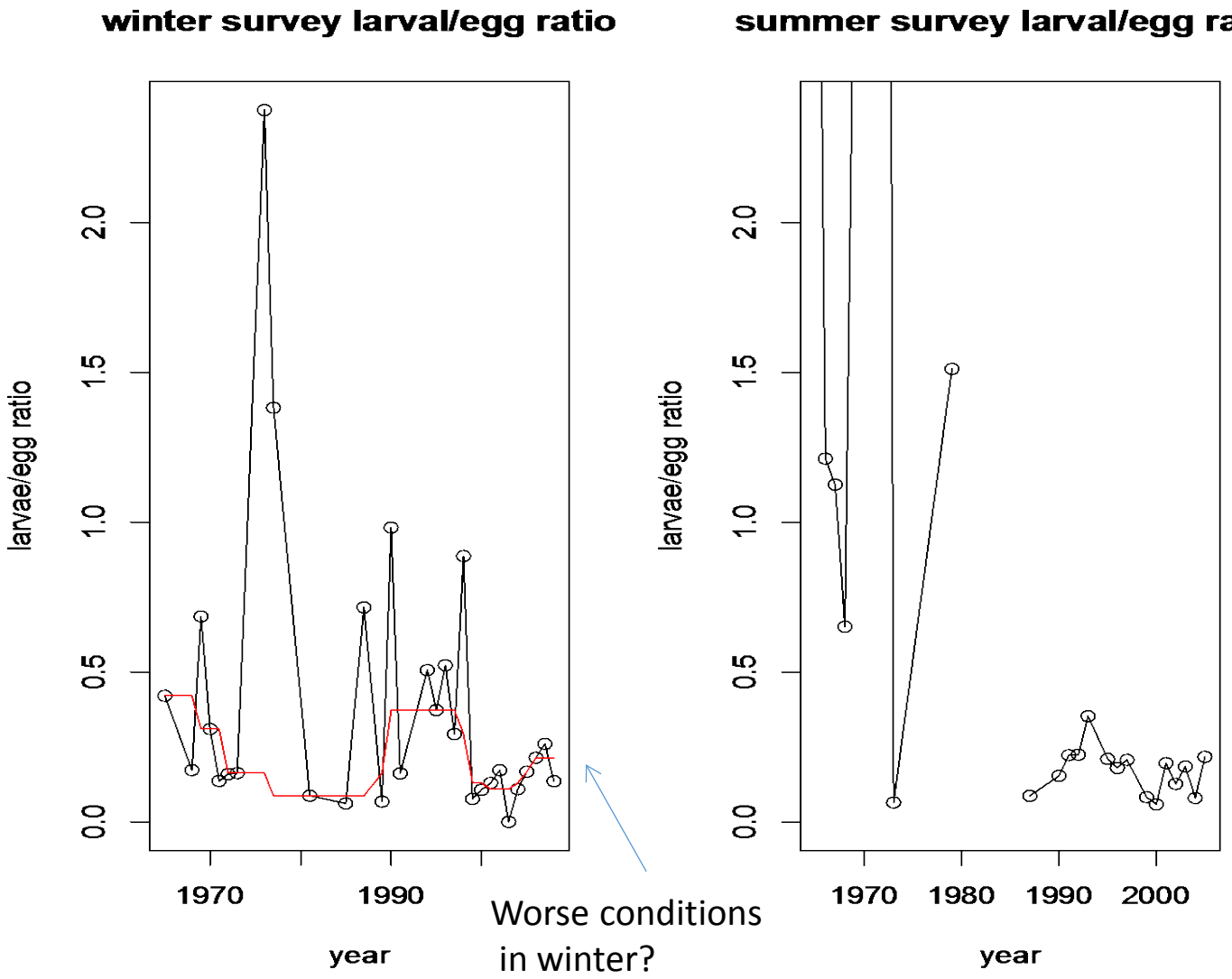
RESULTS: Anchovy egg & larvae Vs Anchovy Biomass

Annual VPA (red dotted lines) abundance estimate index and egg and larval density indexes for Peruvian anchovy.



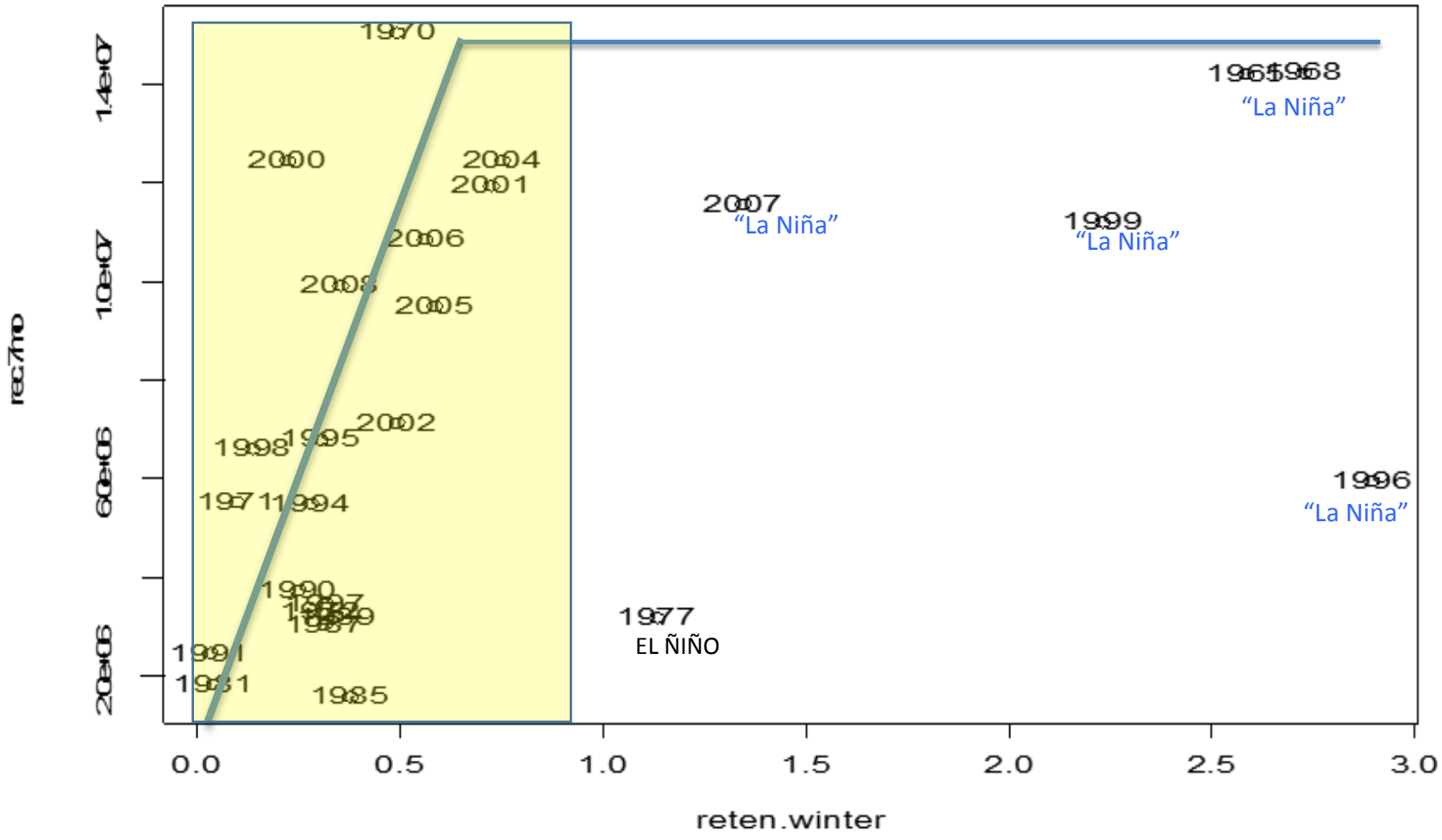


RESULTS: Larval/egg ratio (retention)



Worse conditions in winter?

RESULTS: Larval/egg ratio Vs Recruitment



CONCLUSIONS

- There is a divergent trend in the egg and anchovy larvae series since the mid-2000s. This is different from what was observed in previous decades, and seems to mean a less egg survival.
- Although the environmental conditions have been predominantly warm in the last years, a significant presence of sardine eggs and larvae is not observed. They have only been observed in certain places of the coast.
- The niche of anchovy eggs and larvae, described in terms of temperature and salinity, has expanded in the last two decades, compared to what was observed in the 1960s. Now it shows a greater overlap with that of the sardine.
- Egg production in the 2000s is generated both in summer and in winter. In the 1960s, the main egg production was basically generated in winter.

CONCLUSIONS

- In anchovy, the winter retention index has decreased between the 1990s and the present. This seems to indicate that the winters of the 2000s appear to be less favorable for egg survival than those of past decades. Perhaps because of this, now the production of anchovy eggs is generated both in summer and winter, to maximize annual survival and maintain their high biomass.
- Finally, the retention index seems to show a good correlation with the recruitment estimates, for the years with near-average environmental conditions. Not so for the years with extreme conditions.

ACKNOWLEDGMENTS