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Distribution of Jumbo flying squid (*Dosidicus gigas*) and the environmental conditions in Peruvian waters

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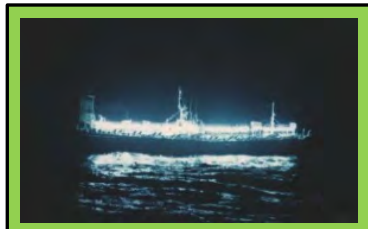
Jumbo flying squid research
Data analysis


Research surveys

- Biological data
  - Ecoabundance
  - Diversity
  - Distribution
  - Concentration
- Oceanographic data
  - Temperature
  - Salinity
  - Disolved Oxygen



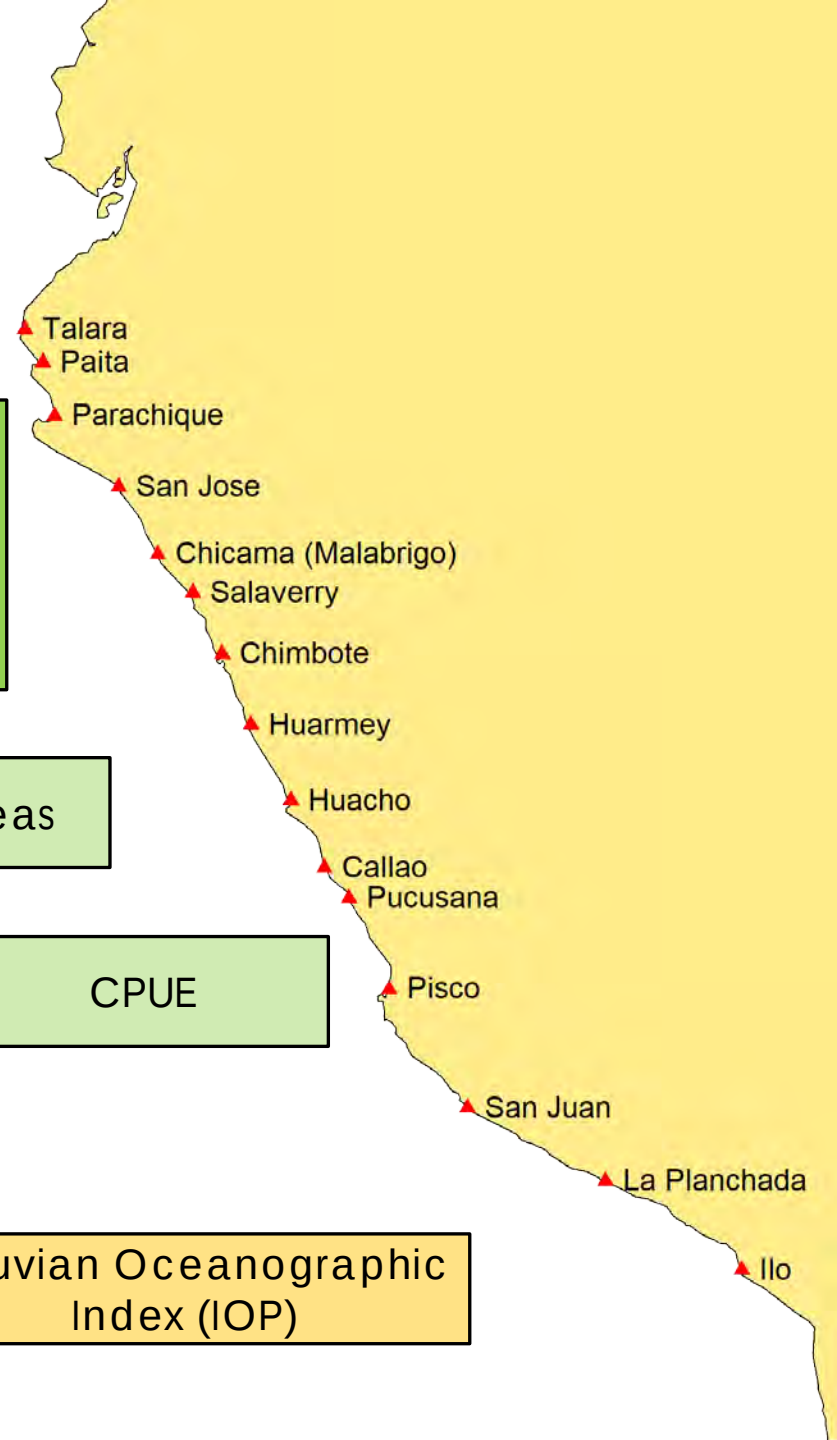

Fishery monitoring

- Biological data
- Fishing areas
  - Catch and fishing effort → CPUE

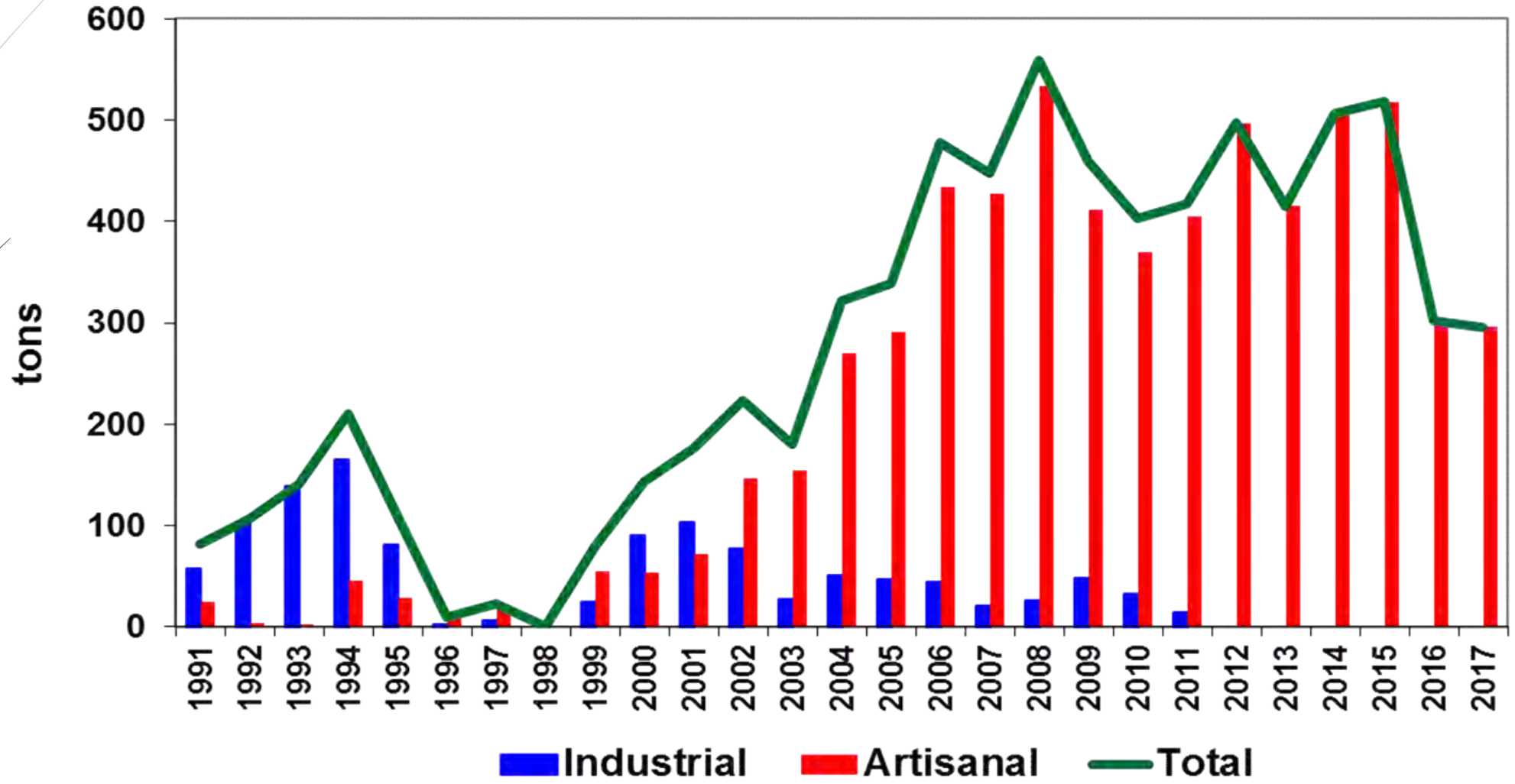
NOAA

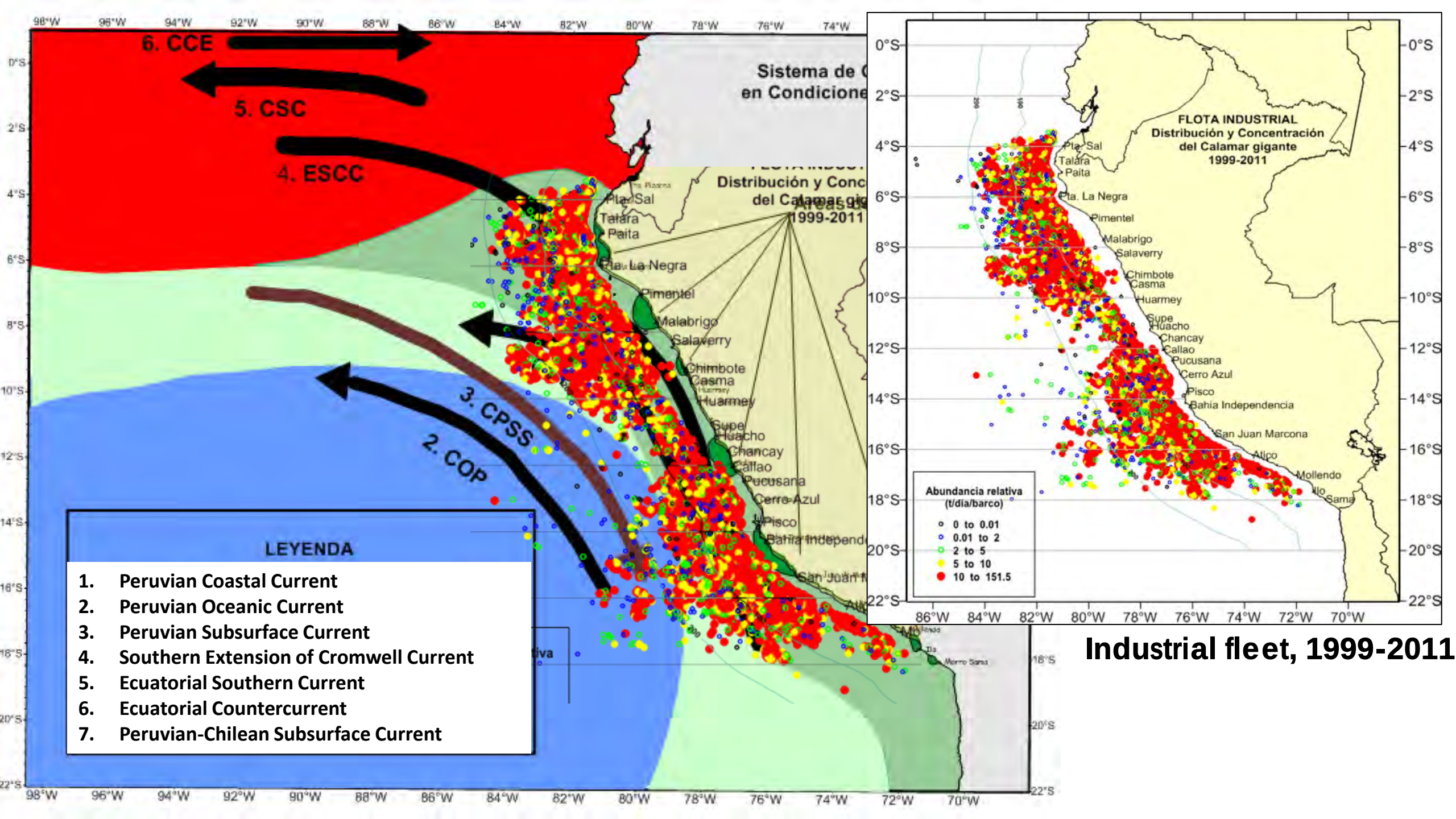
- El Niño 1+2 Anomalies
- PDO
- SOI
- MUR (SST) → Thermal gradients

Purca S., 2017 (IMARPE) → Peruvian Oceanographic Index (IOP)

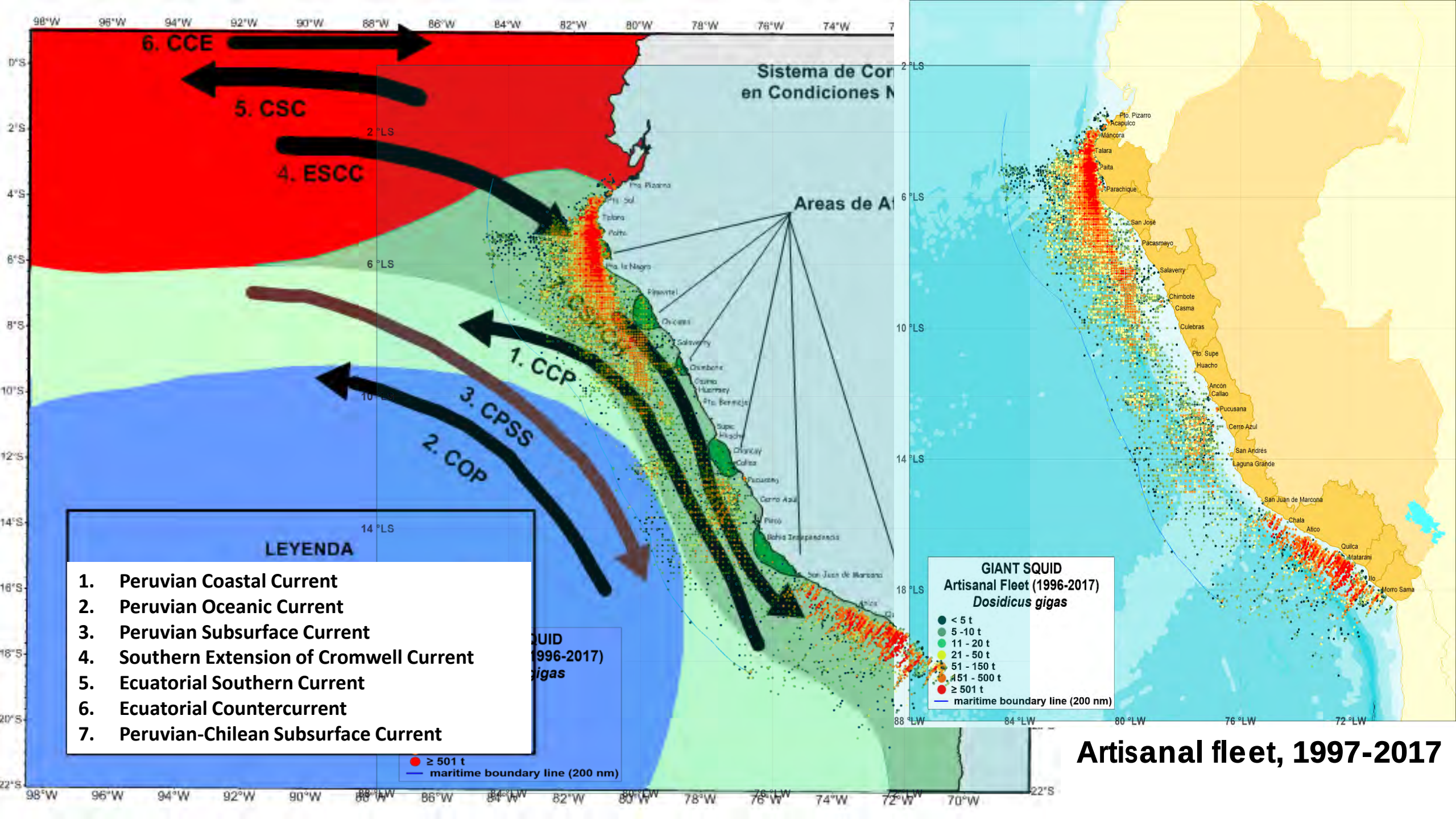


Landings of *Dosidicus gigas* in Peru



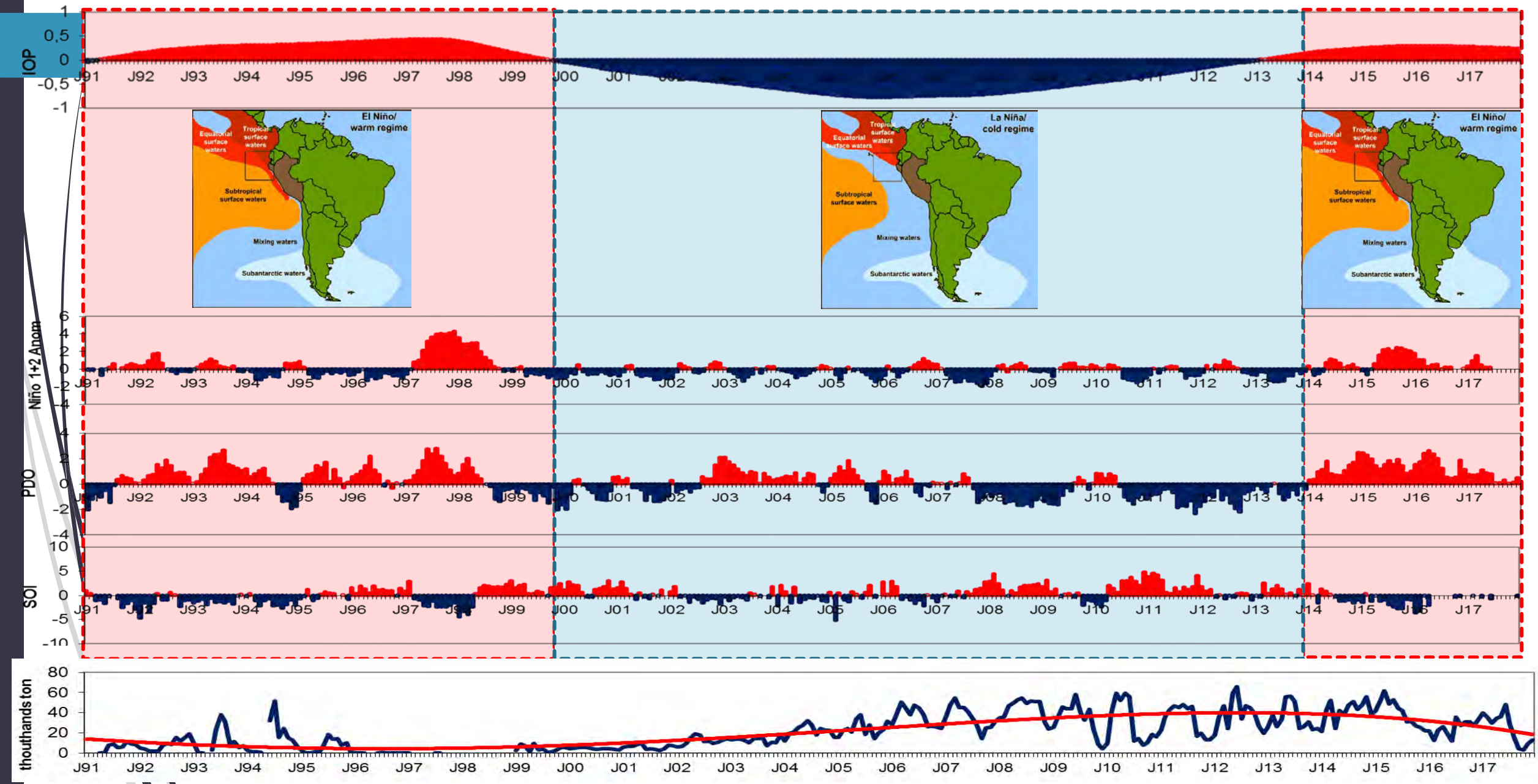


Industrial fleet, 1999-2011



Artisanal fleet, 1997-2017

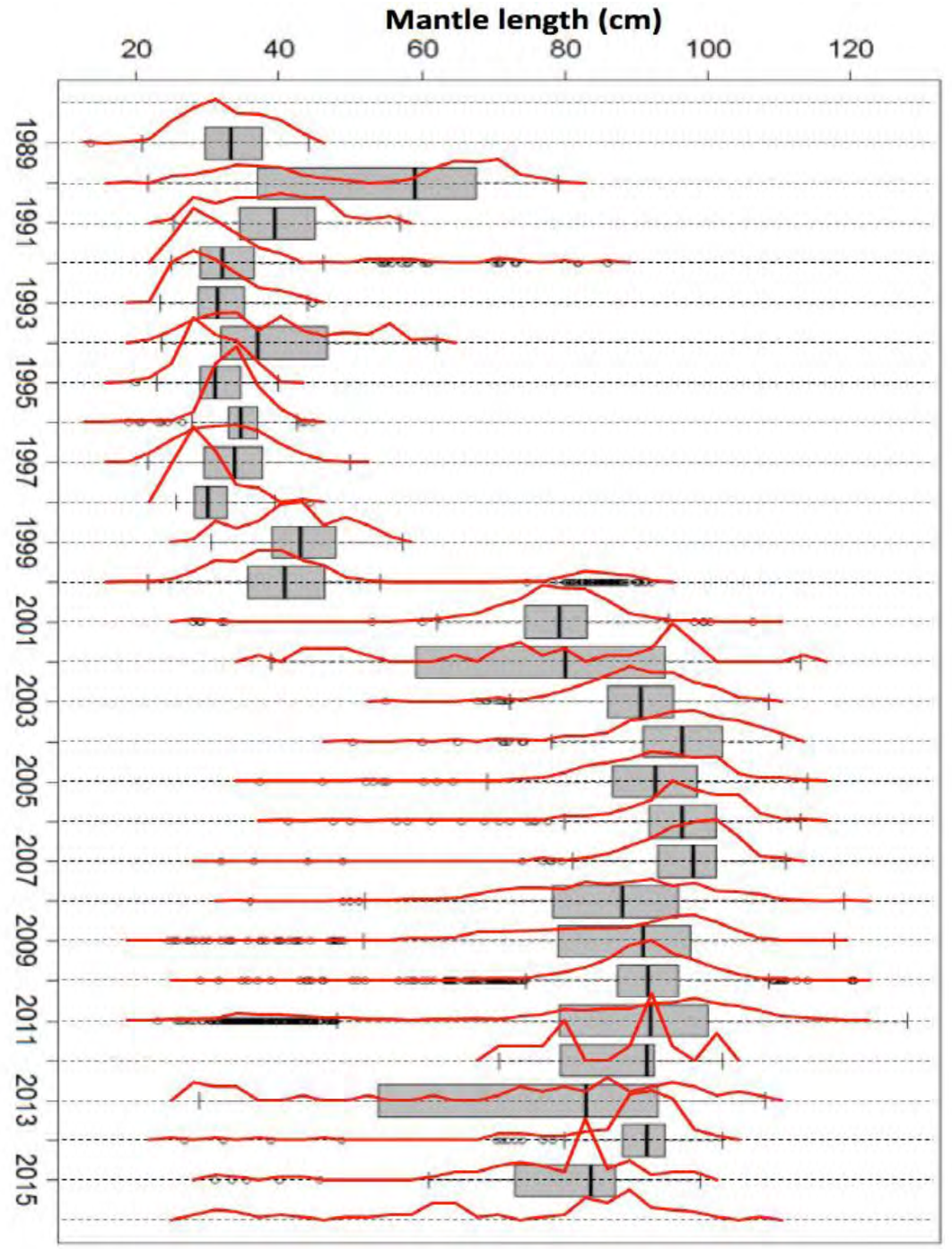
Time series analysis



High phenotipic variation in the size composition and mean size at maturity

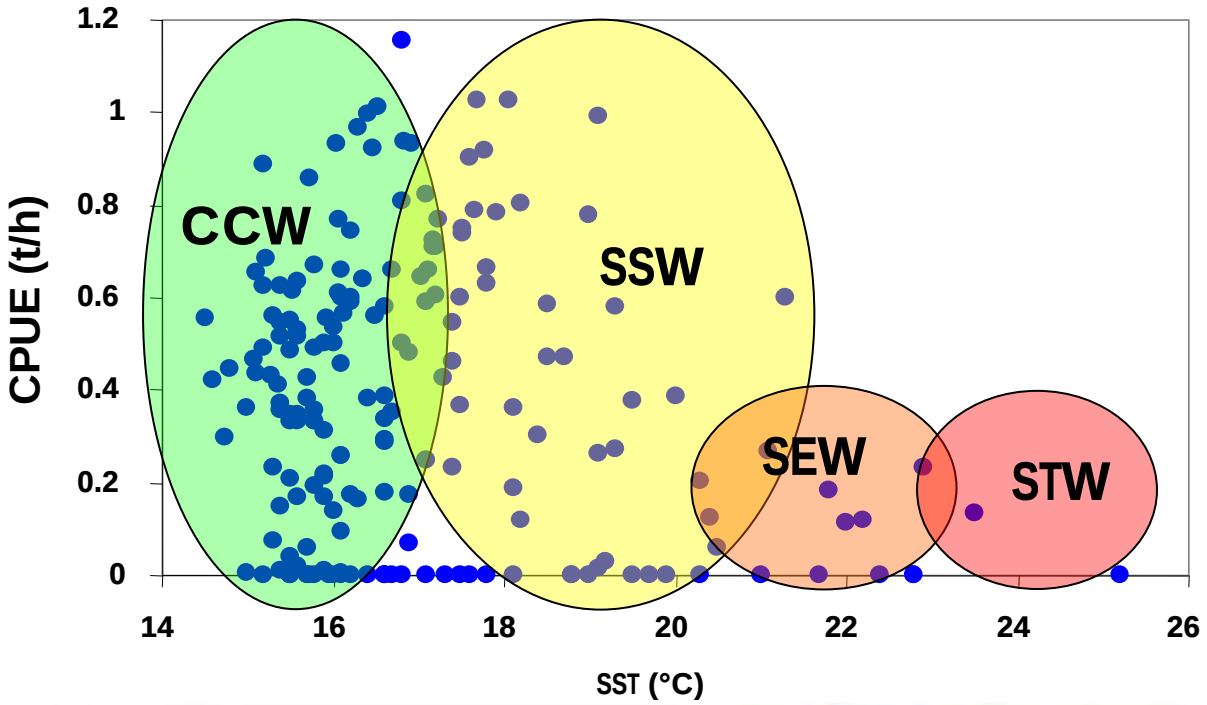
Arguelles et al. (2017)

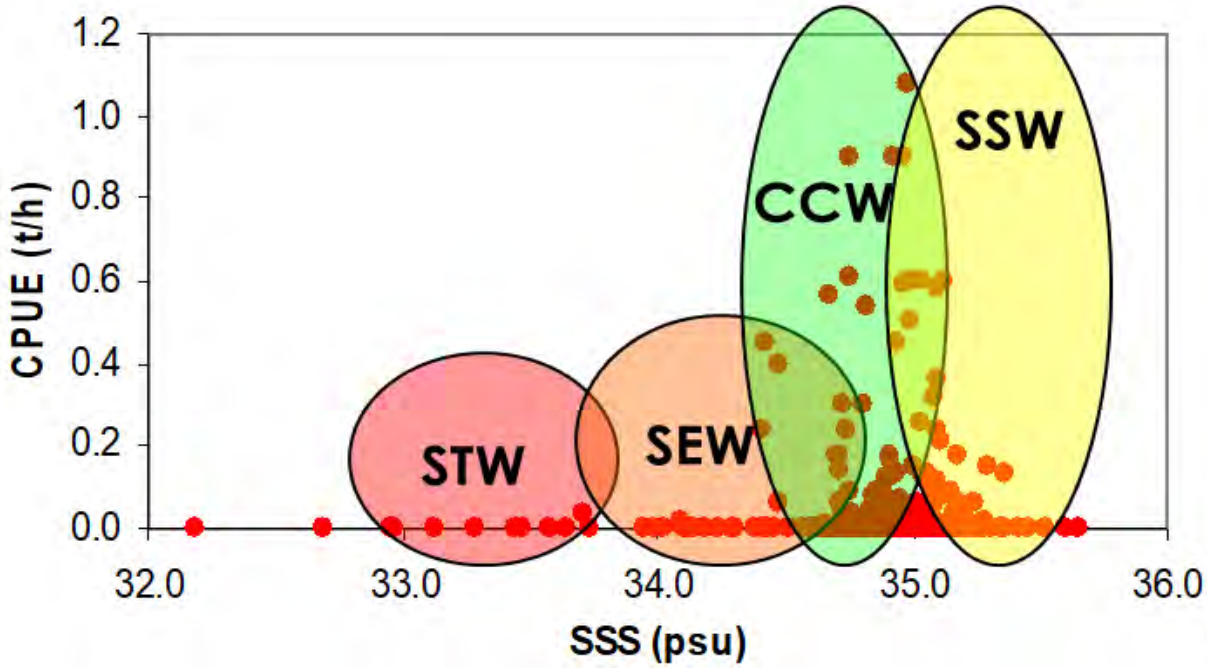
Size composition of mature females in red solid line
Median size at maturity in grey bars



Variations of CPUE in relation to water masses

Watermass	SST range (°C)	SSS range (psu)
STW (Surface Tropical Waters)	>25,0	<34,0
SEW (Surface Equatorial Waters)	19,0 – 25,0	34,0 – 34,8
CCW (Cold Coastal Waters)	14,0 – 18,0	34,9 – 35,0
SSW (Surface Subtropical Waters)	>17,0	>35,1



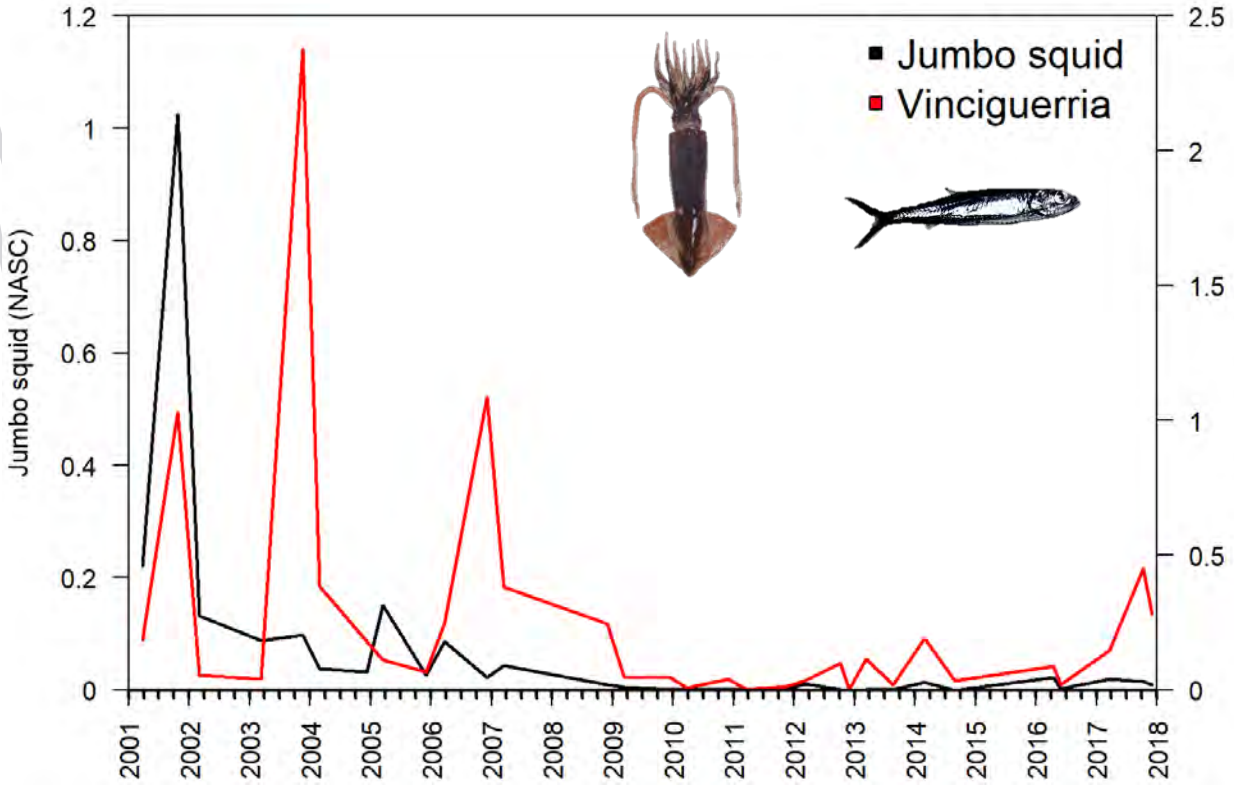


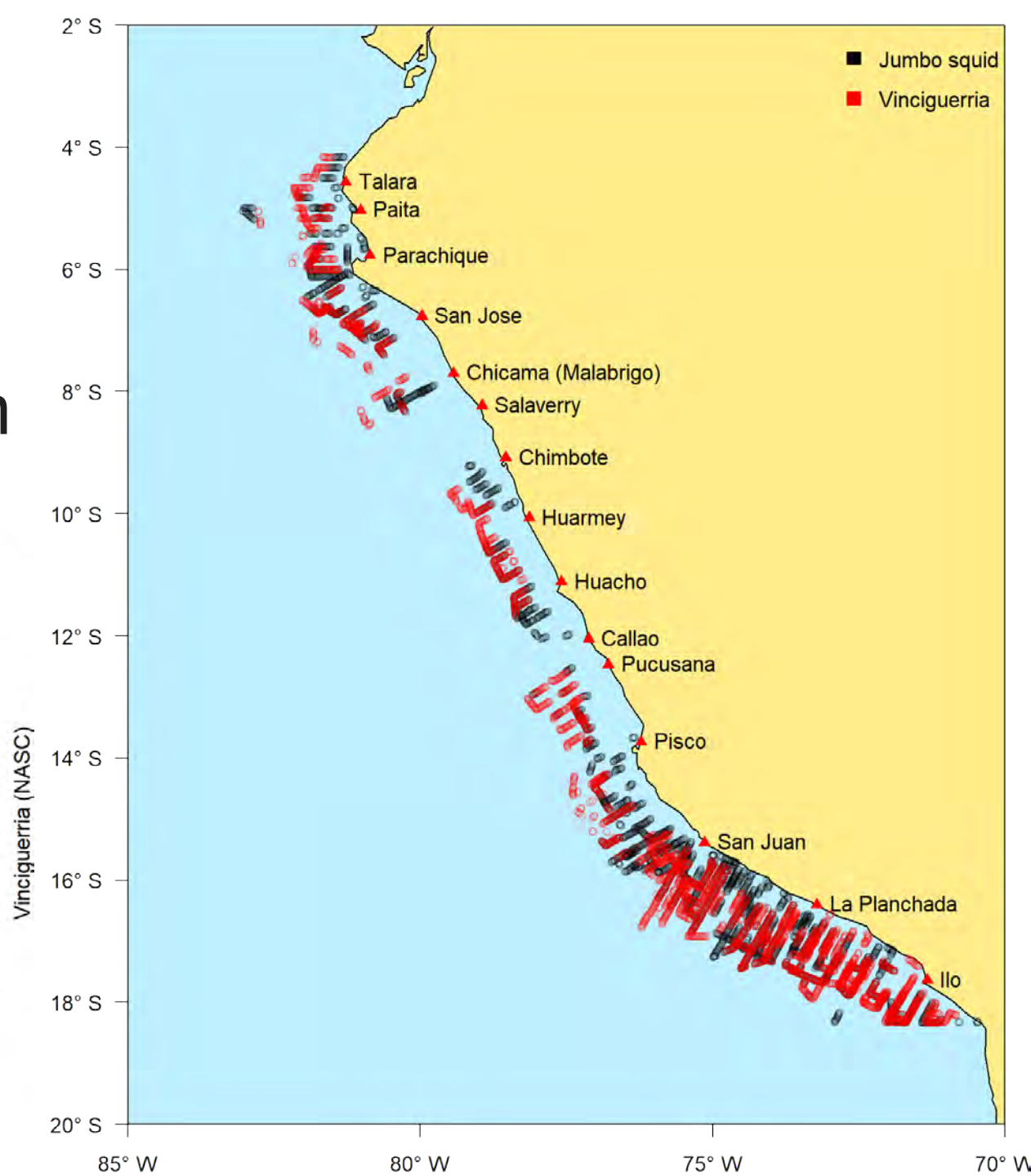
Relationship between Jumbo flying squid and Lantern fish

Jumbo flying squid
Dosidicus gigas

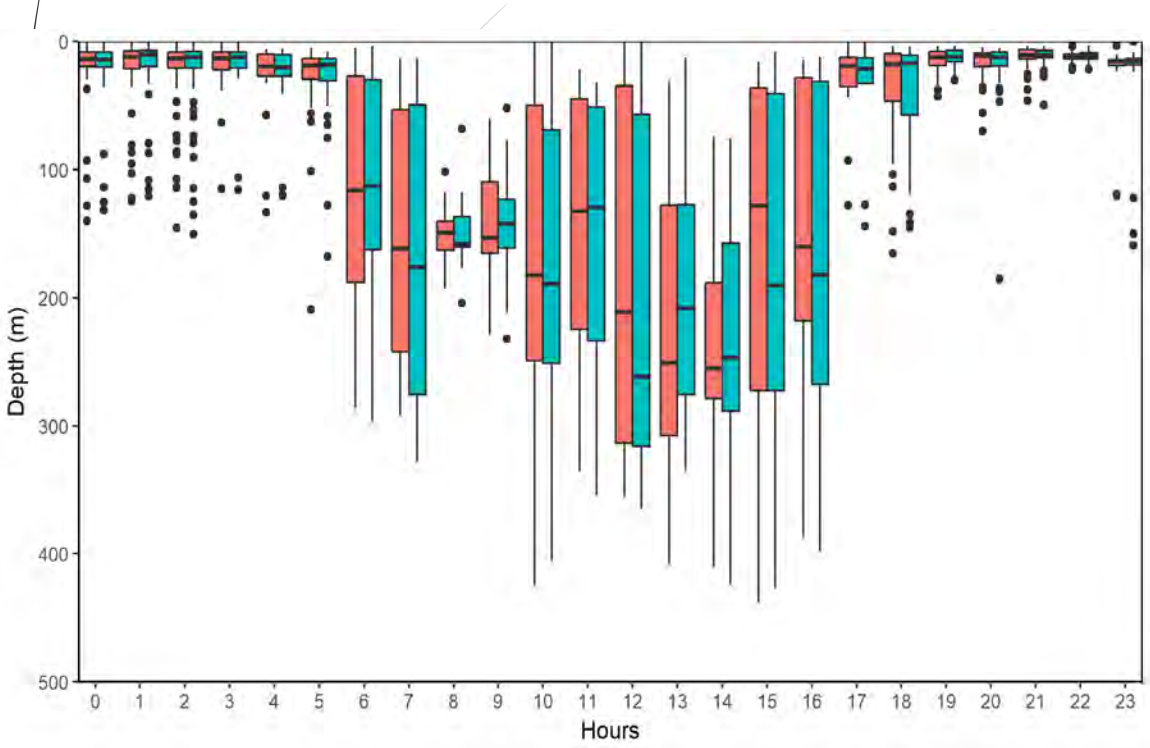
Lantern fish
Vinciguerria lucetia

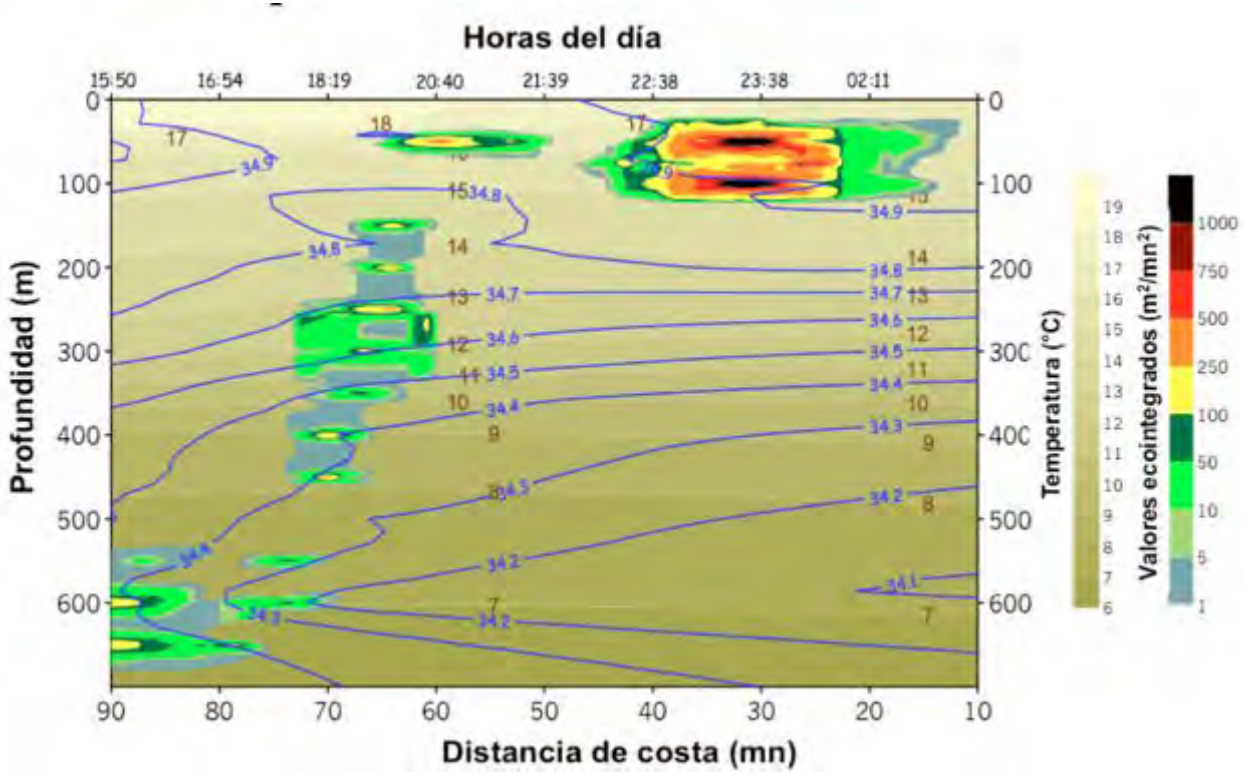
Acoustic biomass and distribution area of Jumbo flying squid and Lantern fish





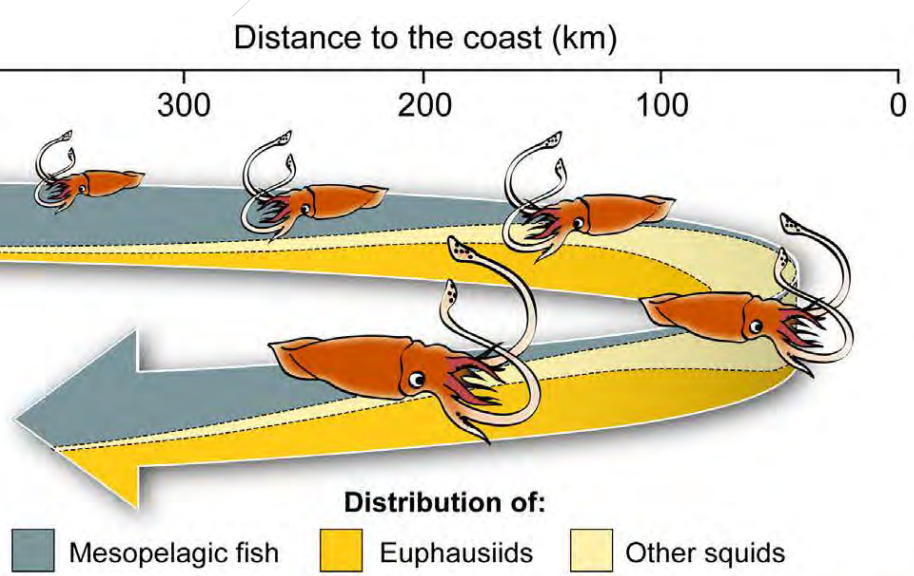
Vertical migration of **Jumbo flying squid** and ***Lantern fish***





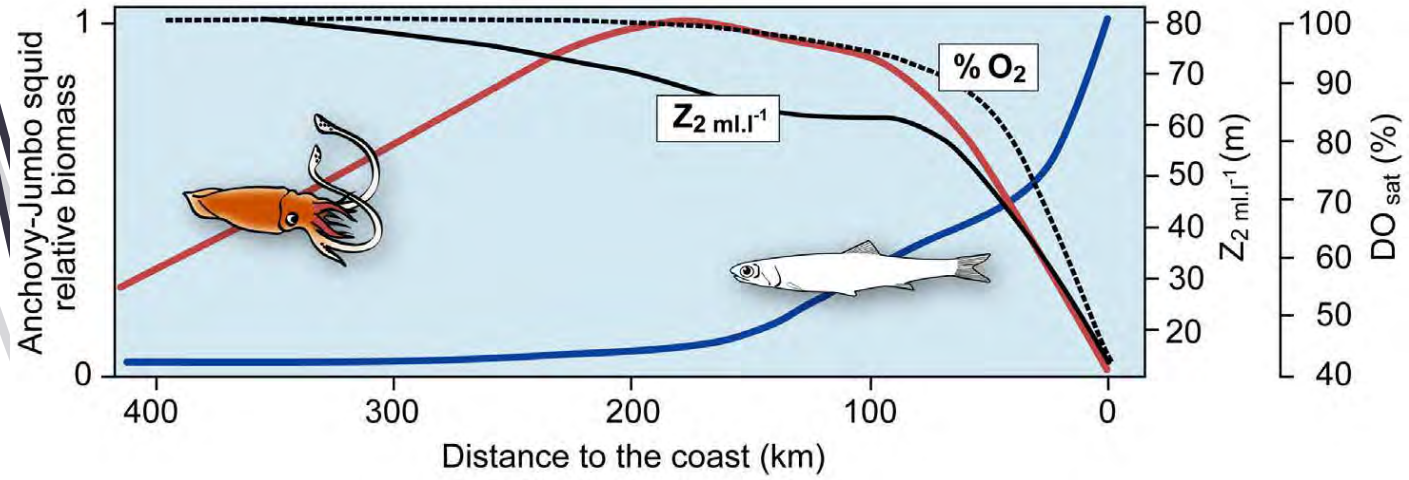
Is the oxygen the key for the distribution of Jumbo flying squid?

An conceptual model about the opportunistic foraging behaviour of jumbo flying squid impacted by ontogenetic migration and potentially constrained by oxygen saturation in surface waters (Alegre et al., (2014)



Cross-shore distribution of jumbo squid along its ontogenetic cycle

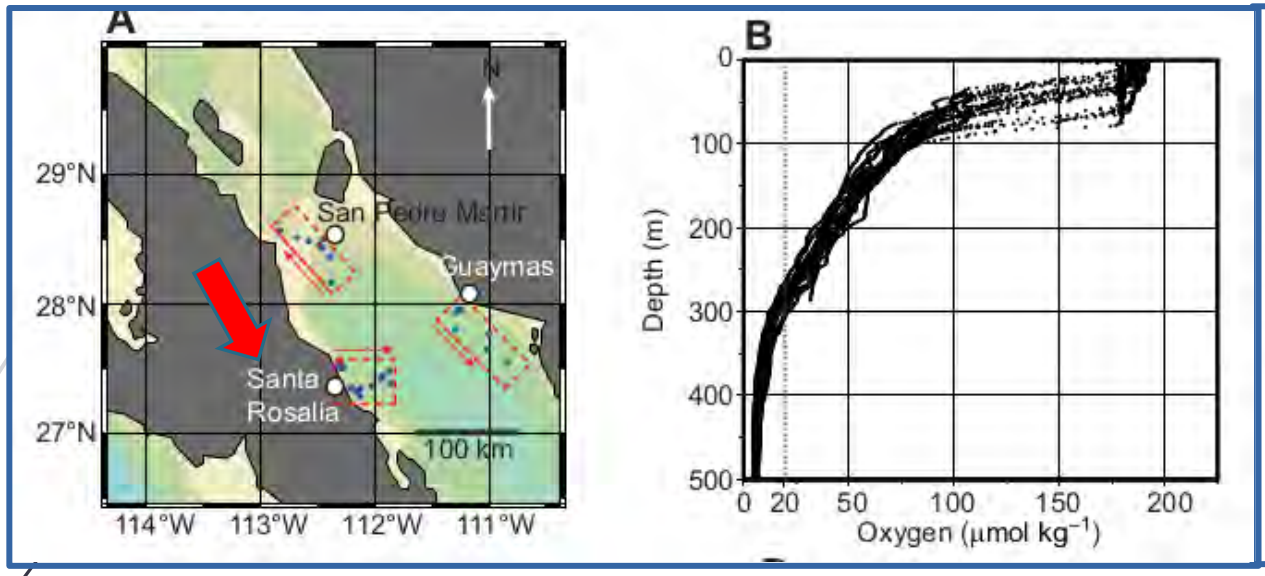
Schematic range of distribution and proportional abundance of the **three main prey groups: Mesopelagic fish, Euphausiids and Other squids**

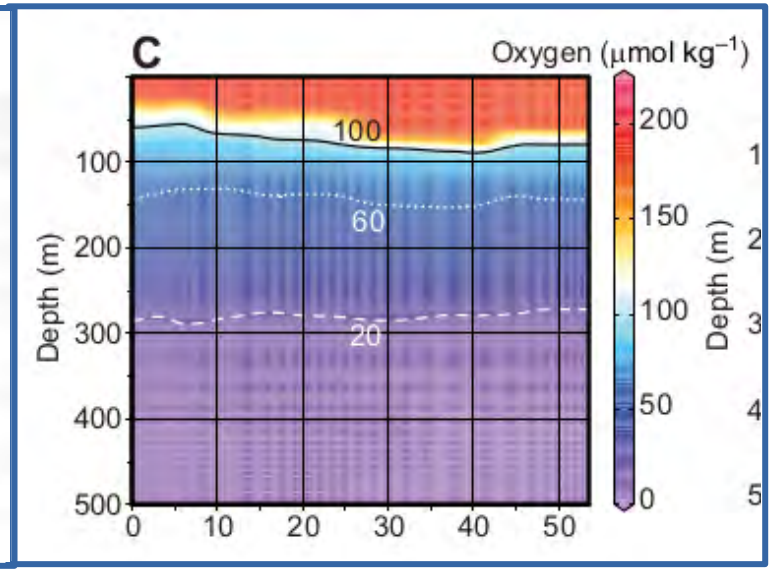


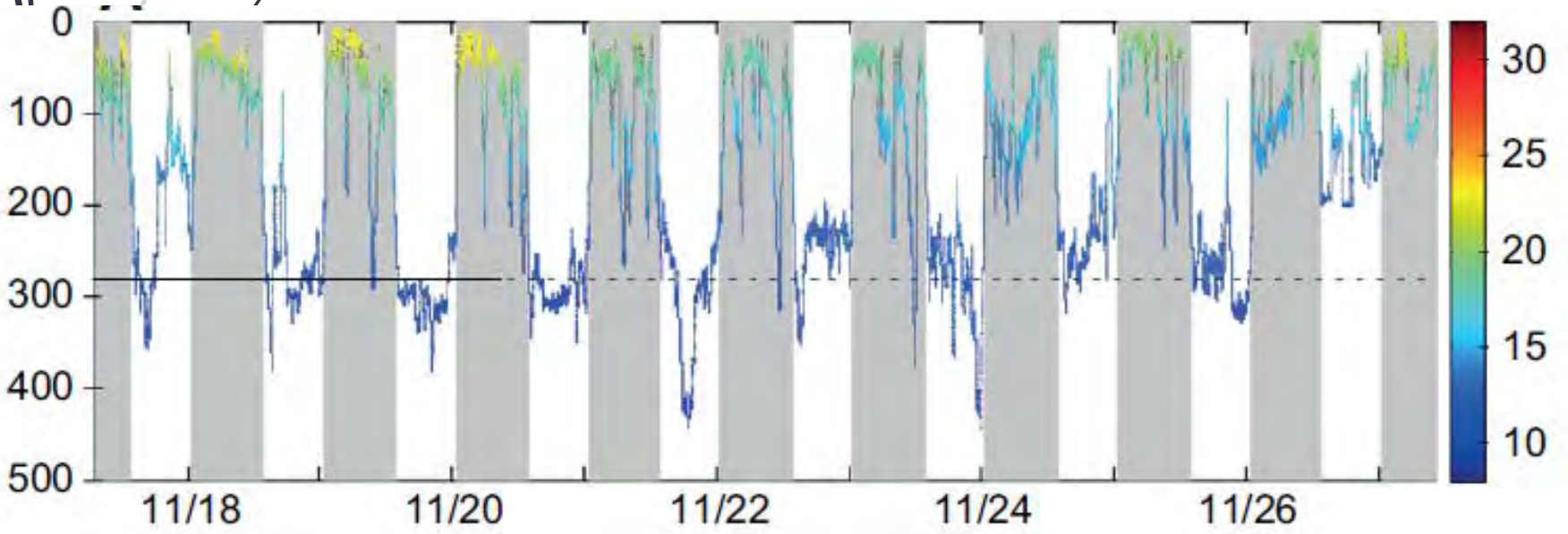
Abundance of Peruvian anchovy and jumbo squid related to the % saturation of dissolved oxygen and depth of the 2 ml.l^{-1} isoline

- **Biomass of jumbo squid** (**solid red line**)
- Biomass of Peruvian anchovy (*Engraulis ringens*) (**solid blue line**)
- **% saturation of dissolved oxygen** (**dotted line**)
- Depth of the 2ml.l^{-1} isoline (**black solid line**)

Oxygen at depth in the areas of pop-up archival transmitting (PAT) deployments on *Dosidicus gigas* (Gilly et al., 2012)



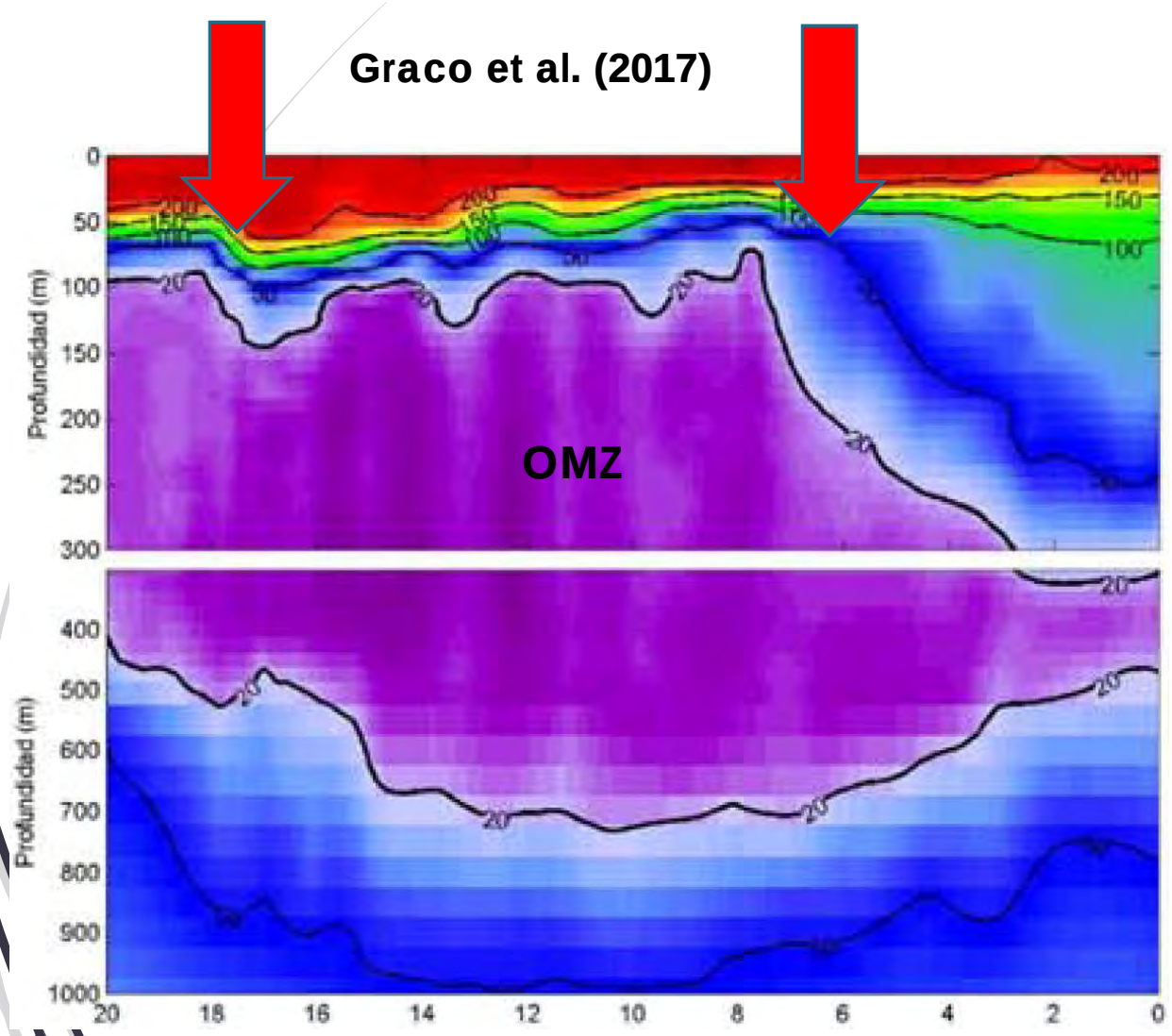


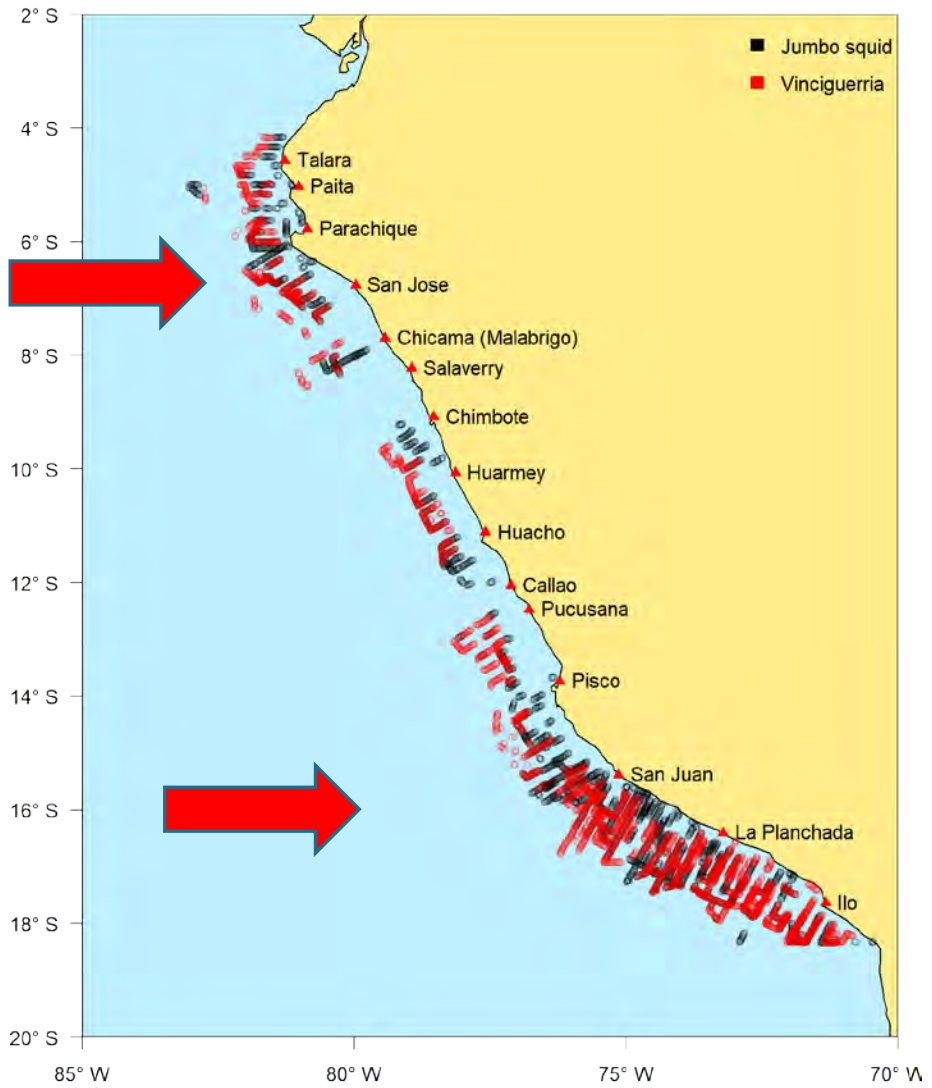


Time-series records of depth and color-coded temperature data for tags deployed on *Dosidicus gigas* in Santa Rosalía.

The depth of the oxygen minimum zone (OMZ) is indicated by the solid and dashed line.

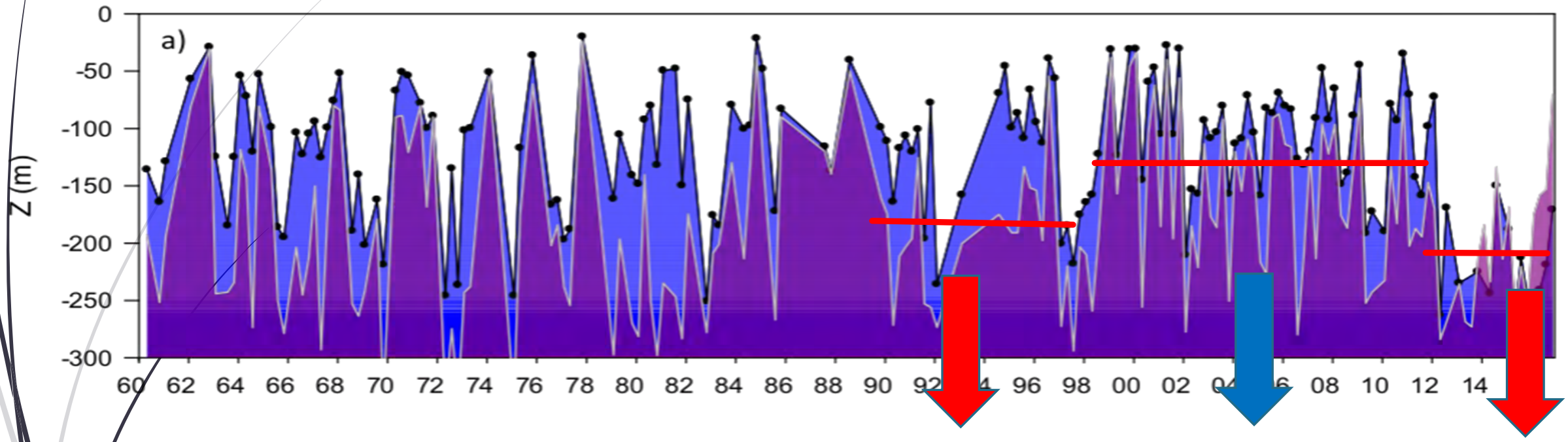
Average of vertical distribution of dissolved oxygen by latitud

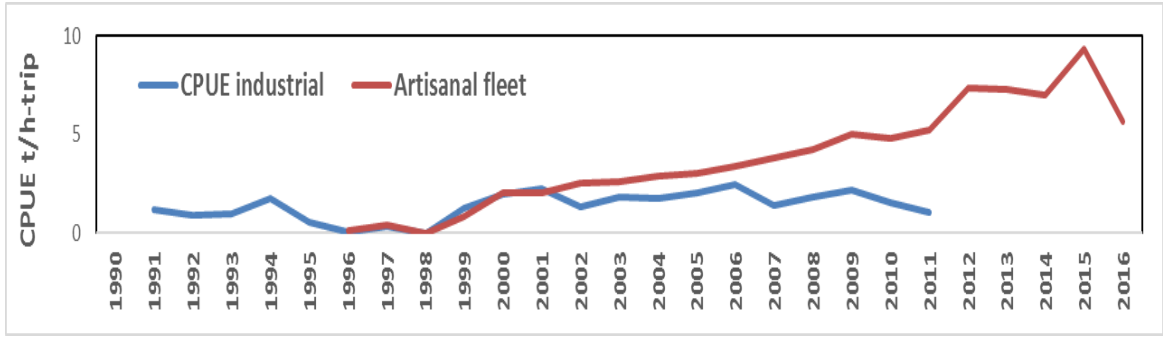




Time series 1960-2016 for oxycline depth (Blue) and OMZ (Purple)

Graco et al. (2017)





Conclusions

- The highest densities of *Dosidicus gigas* were associated with zones of mixed Subtropical Surface Waters and Cold Coastal Water masses.
- During moderate variations of the environmental conditions, D. gigas maintains high abundance indexes, while under extreme variations like strong ENSO events the abundance indexes are low.
- Likewise, in Cold Regimen years the OMZ is more shallow and this conditions favors the concentration and high growth of D. gigas, which reaches large sizes and greater size at maturity.
- There is a close correlation between D. gigas and Lantern fish. which biomass is high in the oceanic zone.
- The effect of some oceanographic variables like temperatures and salinities would not be limiting for the D. gigas concentration, but the depth and amplitude of the OMZ would represent a limiting factor for the availability and abundance of this resource.

Acknoledgements

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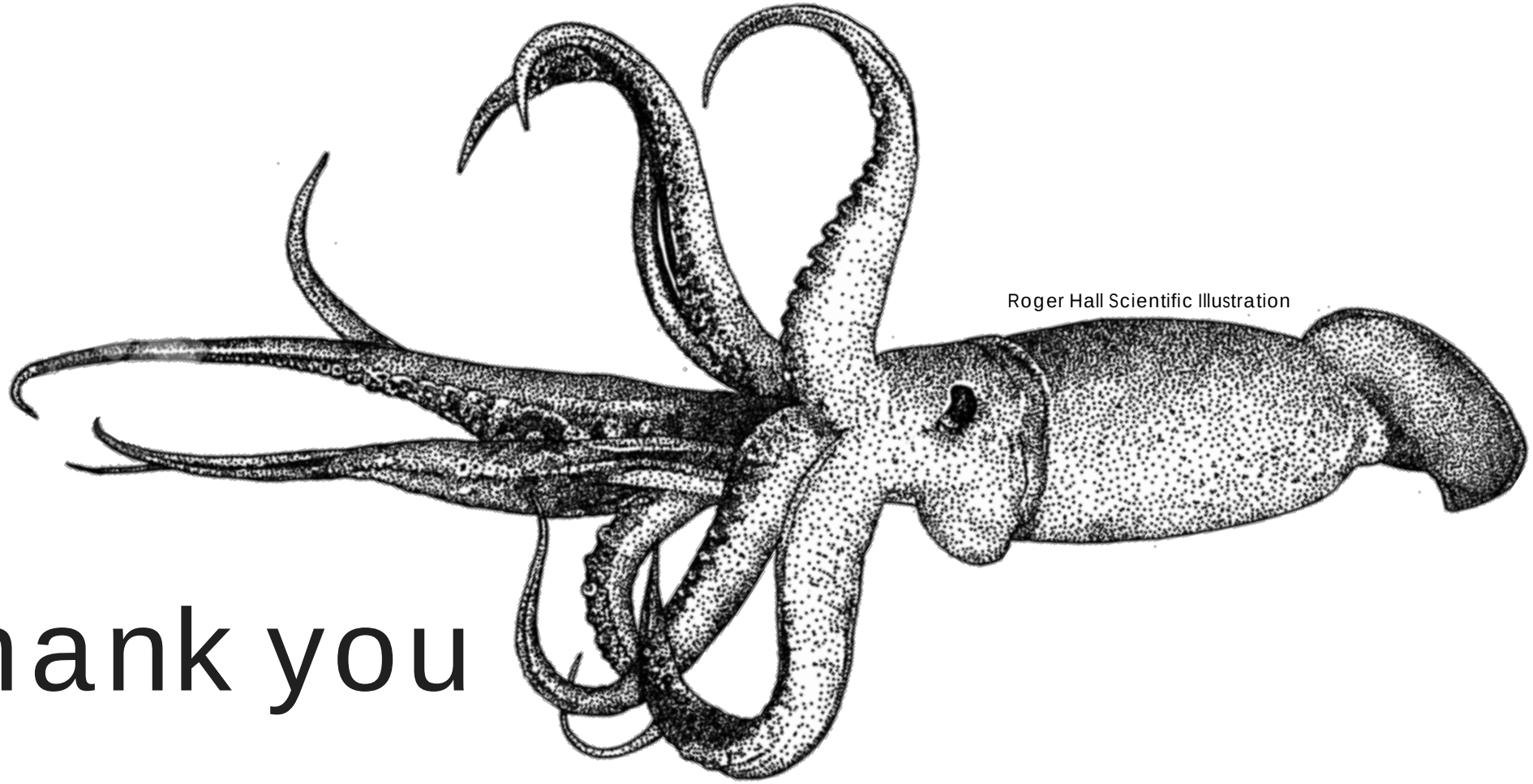
Thank you



Roger Hall Scientific Illustration