Spatio-temporal distribution modeling and abundance index of dolphinfish (*Coryphaena hippurus*) in the Pacific Ocean off Peru

Edgar Josymar Torrejón – Magallanes[1]; Wencheng Lau – Medrano[1]; Daniel Grados[1]; Gladys Castillo[1] & Ana Medina[1]

[1]Instituto del Mar del Perú

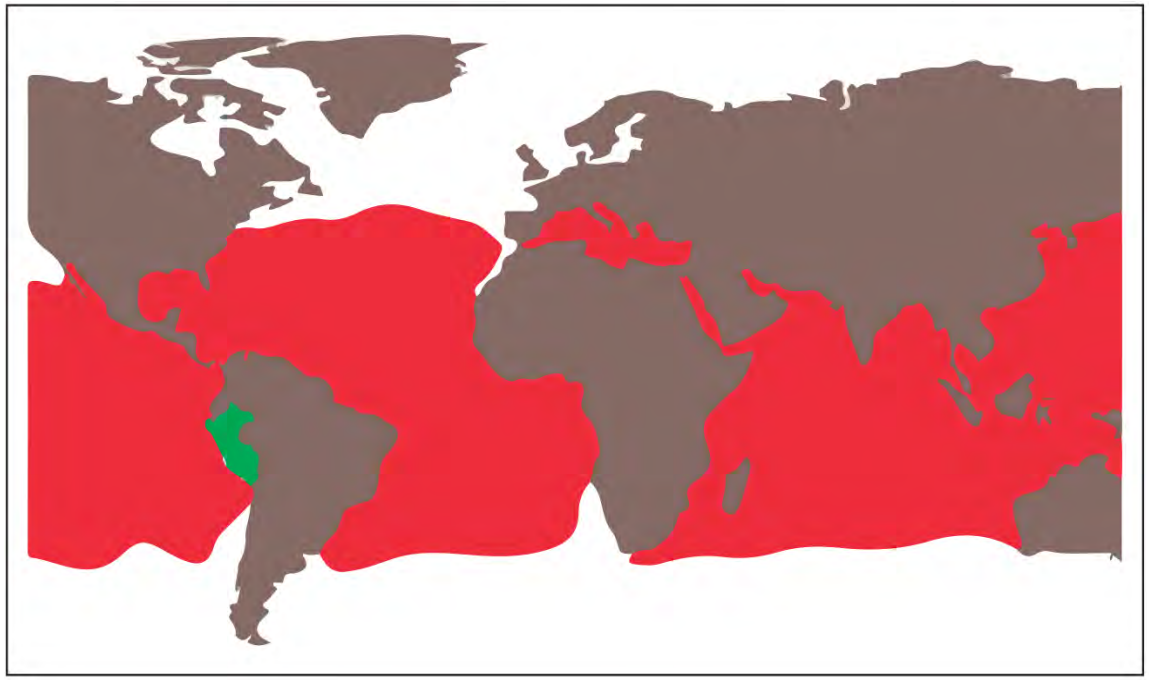
Understanding Changes in Transitional Areas of the Pacific

Introduction

- **Epipelagic species.**
- **Tropical and subtropical waters**

- **Mid-trophic level**
- **Fast growing**

IMARPE (2015)



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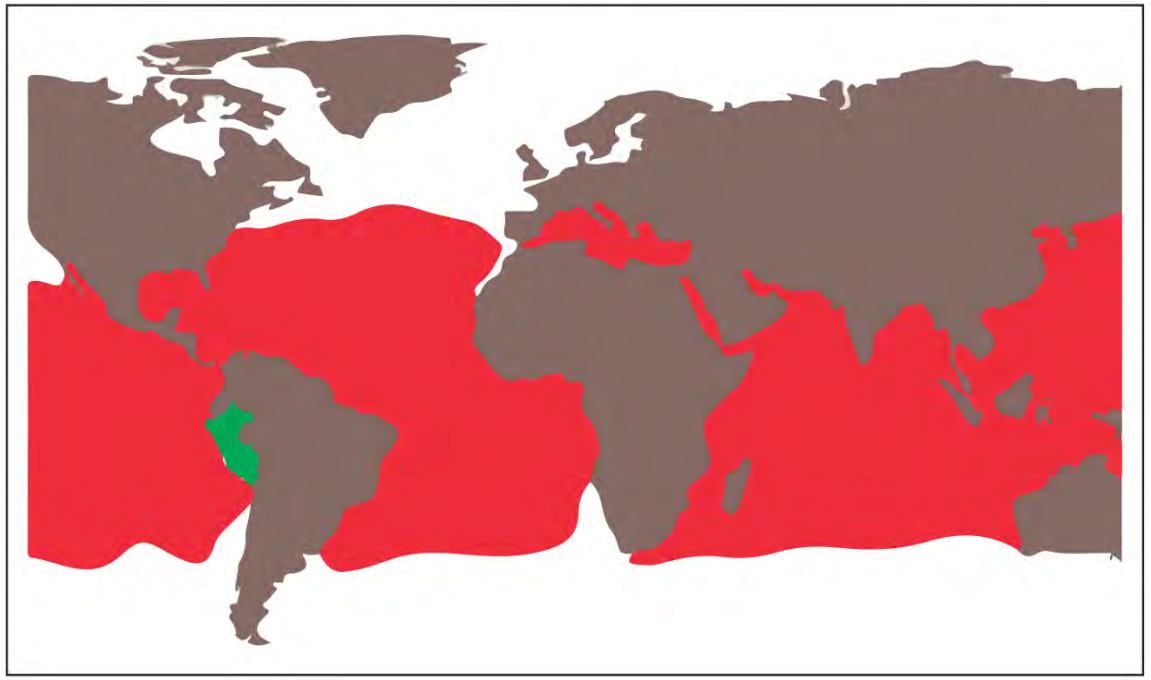

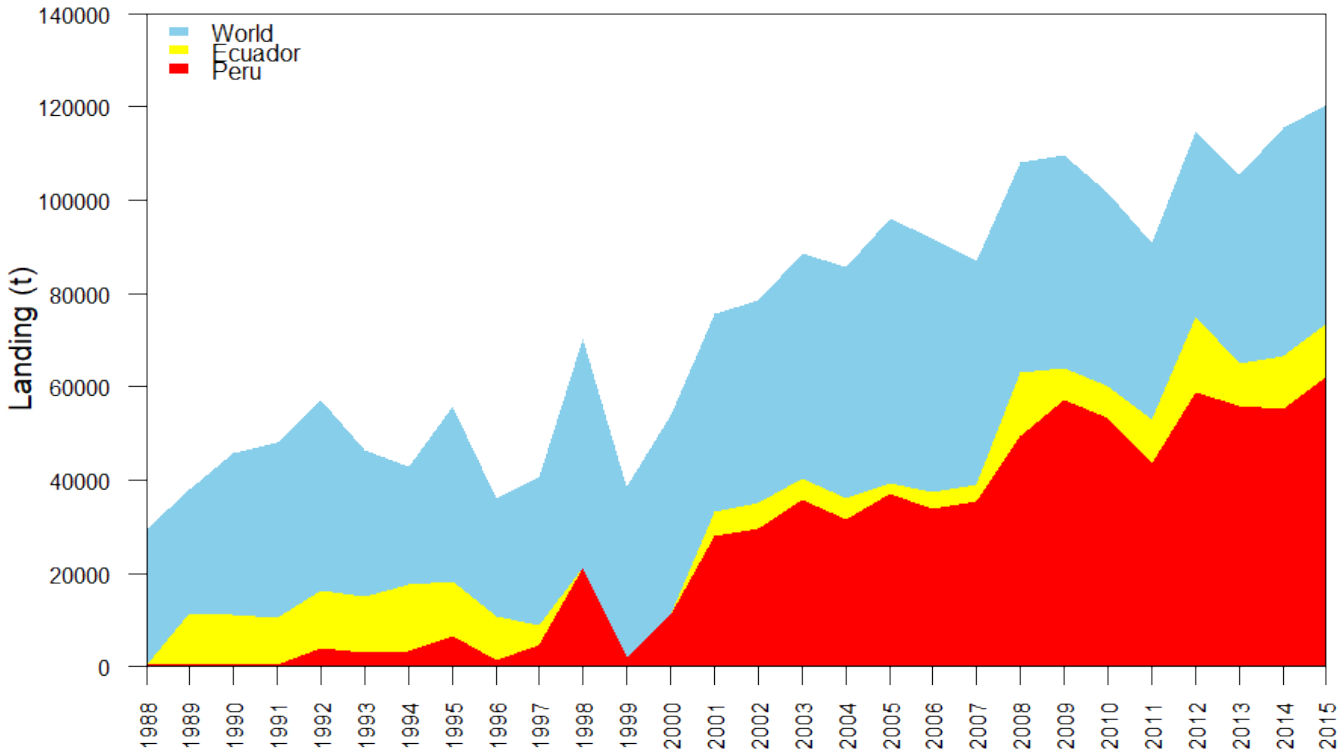

Fishstats: FAO (2017)

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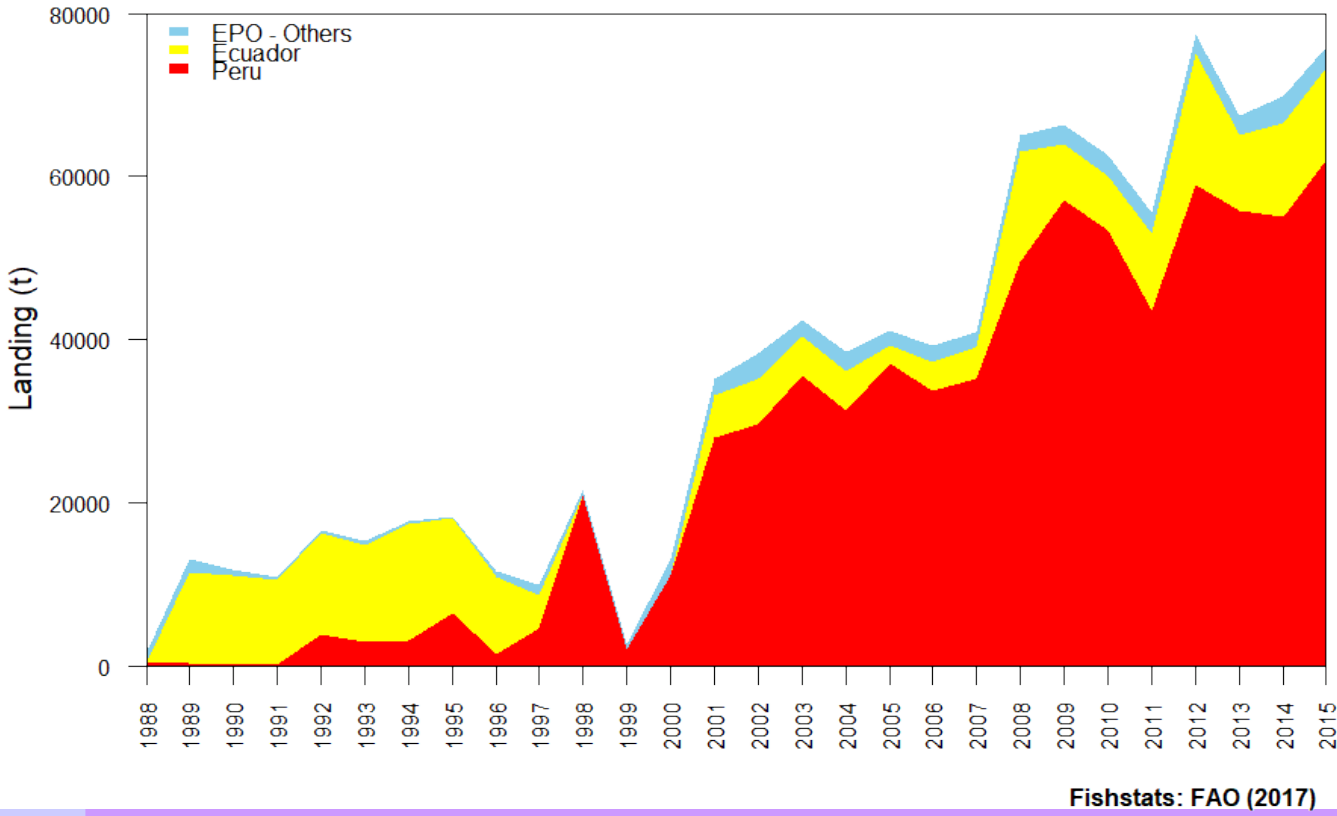

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INTER-AMERICAN TROPICAL TUNA COMMISSION

1ST TECHNICAL MEETING ON DORADO

Manta (Ecuador)
14-16 October 2014

INTER-AMERICAN TROPICAL TUNA COMMISSION

2ND TECHNICAL MEETING ON DORADO

Lima, Peru
27-29 October 2015

A step-by-step illustration of the basis for the monthly depletion estimator in a Stock Synthesis model for dorado

Mark N. Maunder, Alexandre Aires-da-Silva, Carolina Minte-Vera, Cleridy Lennert-Cody, Juan L. Valero, and Jimmy Martínez-Ortiz

INTER-AMERICAN TROPICAL TUNA COMMISSION

3RD TECHNICAL MEETING ON DORADO

Panama City, Panama
25-27 October 2016

Evaluating data needs and assessment methods for data-limited dorado fisheries in the eastern Pacific Ocean

INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

SEVENTH MEETING

La Jolla, California (USA)
09-13 May 2016

DOCUMENT SAC-07-06a(i)

EXPLORATORY STOCK ASSESSMENT OF DORADO (*CORYPHAENA HIPPURUS*) IN THE SOUTHEASTERN PACIFIC OCEAN

Alexandre Aires-da-Silva, Juan L. Valero, Mark. N. Maunder, Carolina V. Minte-Vera, Cleridy Lennert-Cody, Marlon H. Román, Jimmy Martínez-Ortiz, Edgar J. Torrejón-Magallanes, and Miguel N. Carranza

INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

SEVENTH MEETING

La Jolla, California (USA)
09-13 May 2016

DOCUMENT SAC-07-06a(ii)

EXPLORATORY MANAGEMENT STRATEGY EVALUATION (MSE) OF DORADO (*CORYPHAENA HIPPURUS*) IN THE SOUTHEASTERN PACIFIC OCEAN

Juan L. Valero, Alexandre Aires-da-Silva, Mark N. Maunder, Carolina Minte-Vera, Jimmy Martínez-Ortiz, Edgar J. Torrejón-Magallanes and Miguel N. Carranza

Introduction

What is the population structure?

What is the dynamics?

Has a migration pattern?

Relation with regional oceanography?

Seasonal availability?

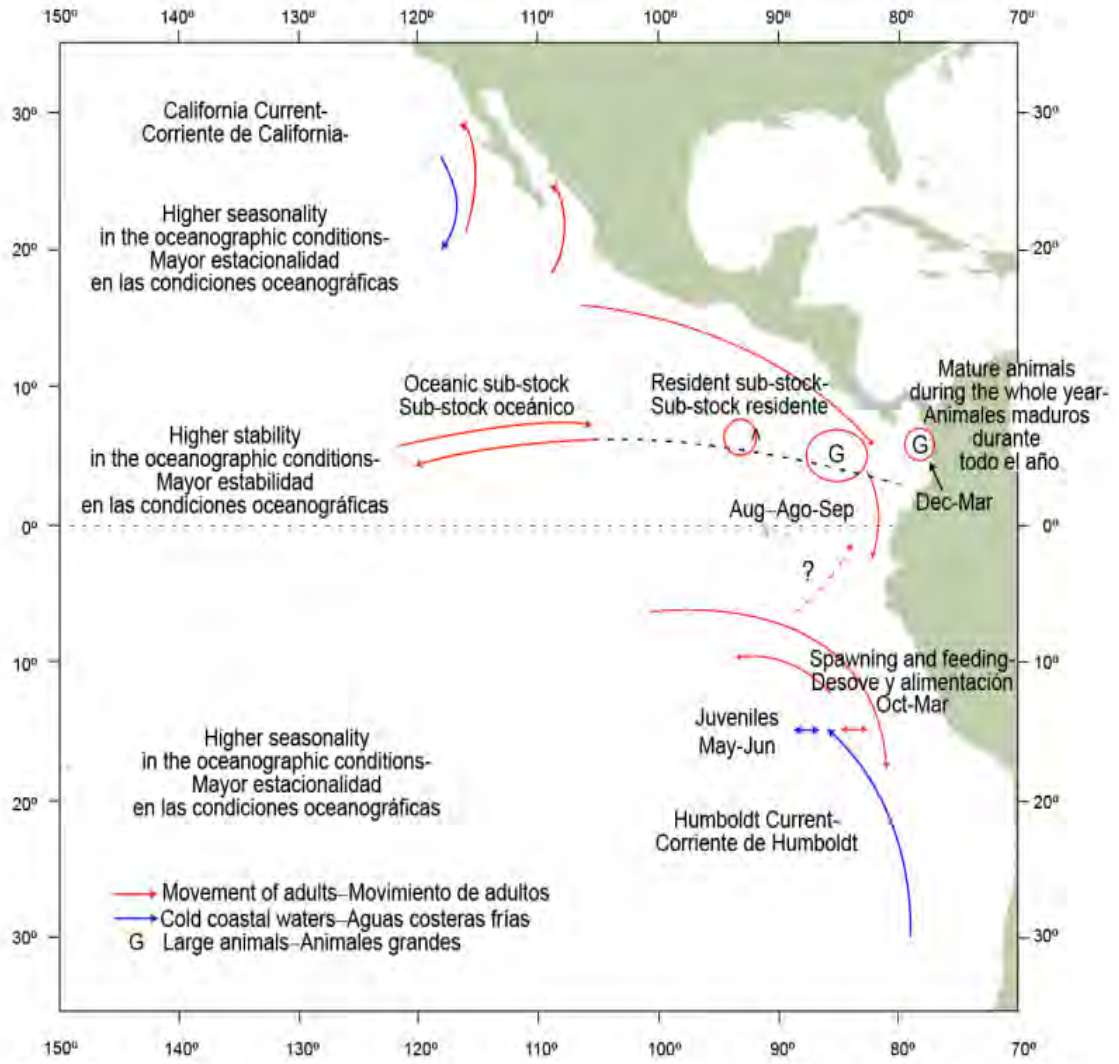

FIGURE 2a. Conceptual model of the movements and spatial distribution of dorado (2nd Technical Meeting on Dorado, 2015).

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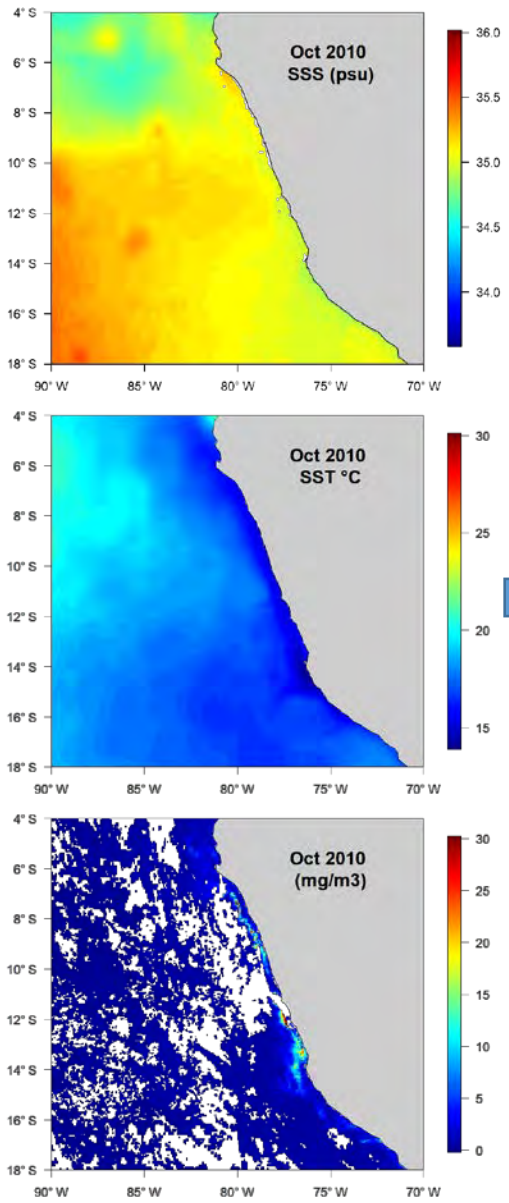
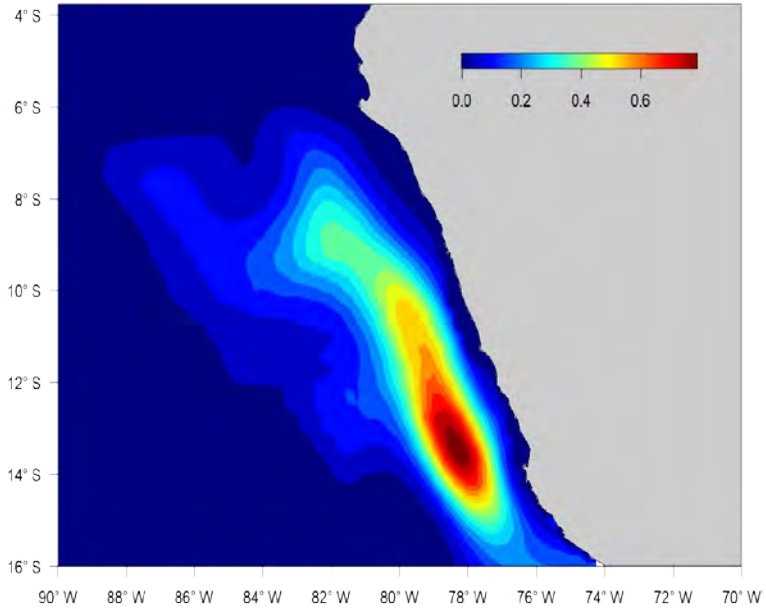
Research problem

- ✓ **What is the impact of climate variability on the distribution and the abundance of dolphinfish in the Pacific Ocean off Peru?**



Spatial Abundance index

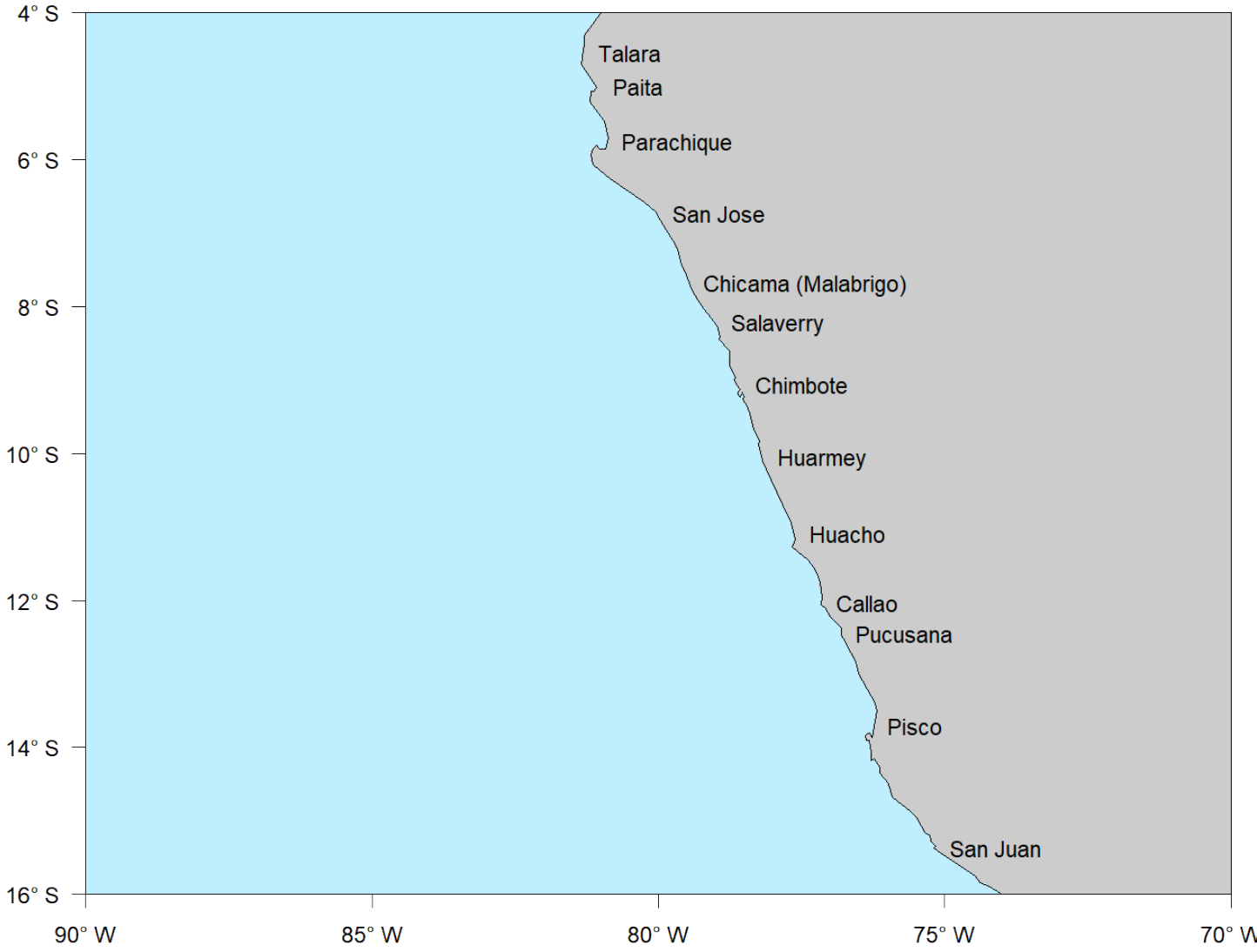


Data description

A) Study area:
- 4°S – 16°S | 75°W – 90°W

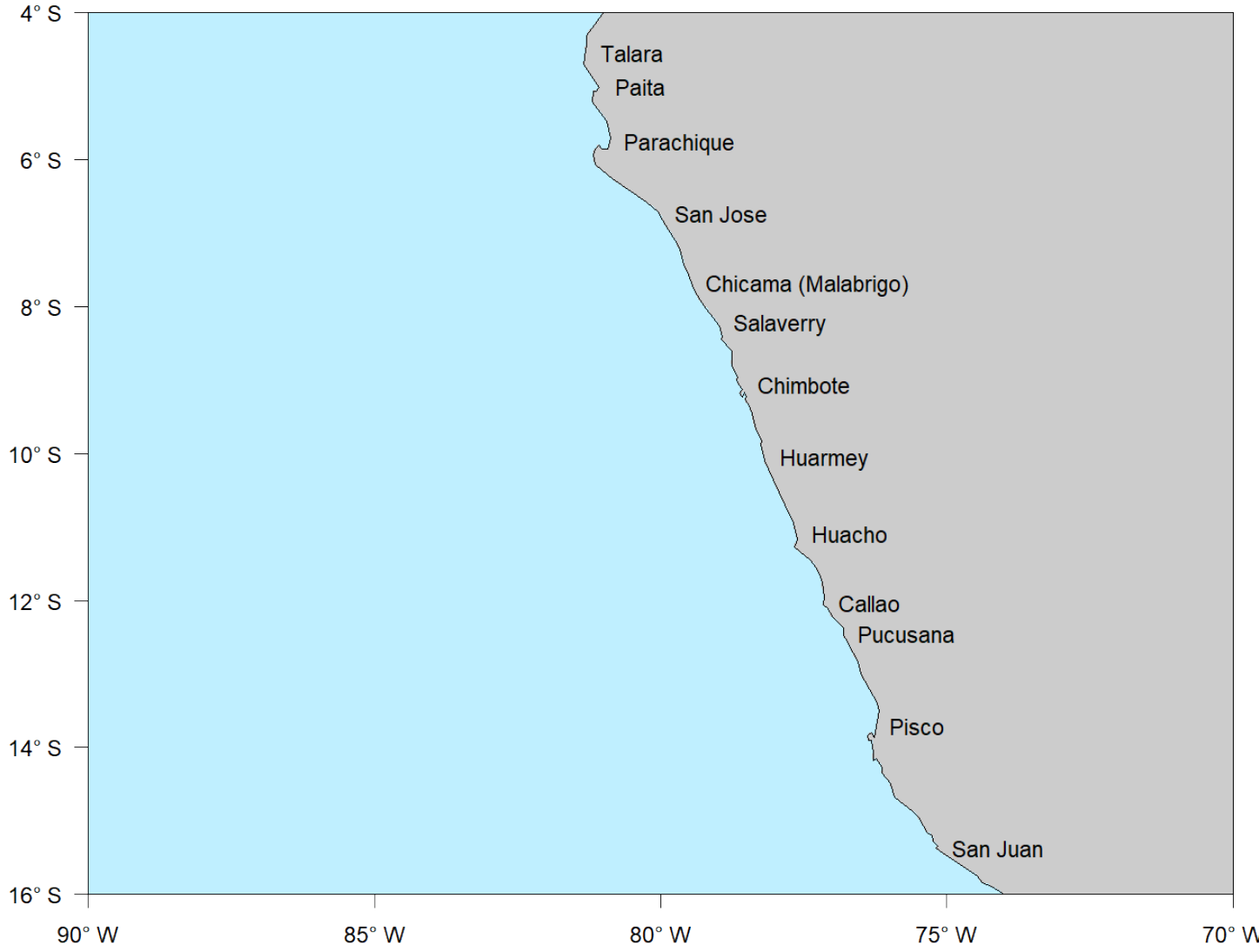
B) Fishery data from artisanal fleet:
- Period: October 2010 – March 2017
- Date
- Catch per trip (ton)
- Number of hooks
- Hold capacity (ton)
- **Longitude, Latitude**

C) Oceanography:
- *SST* from MUR (monthly)
- *SSS* from HYCOM (dayly)
- *Chl-a* from NOAA/MODIS (monthly)



Data processing

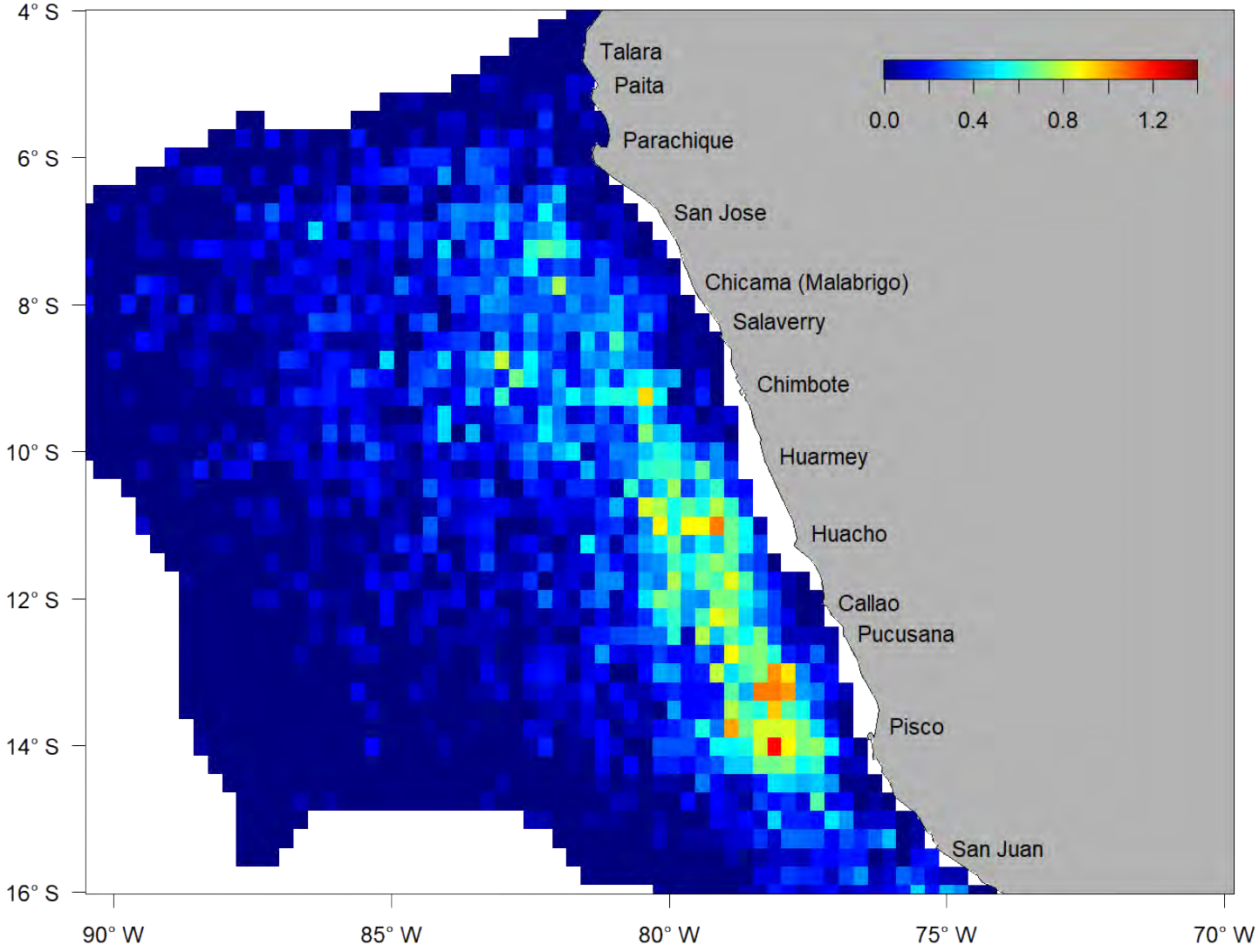
$$CPUE_{ijkl} = \frac{C_{ijkl}\ (ton)}{f_{ijkl}(N°hooks) * 1000}$$



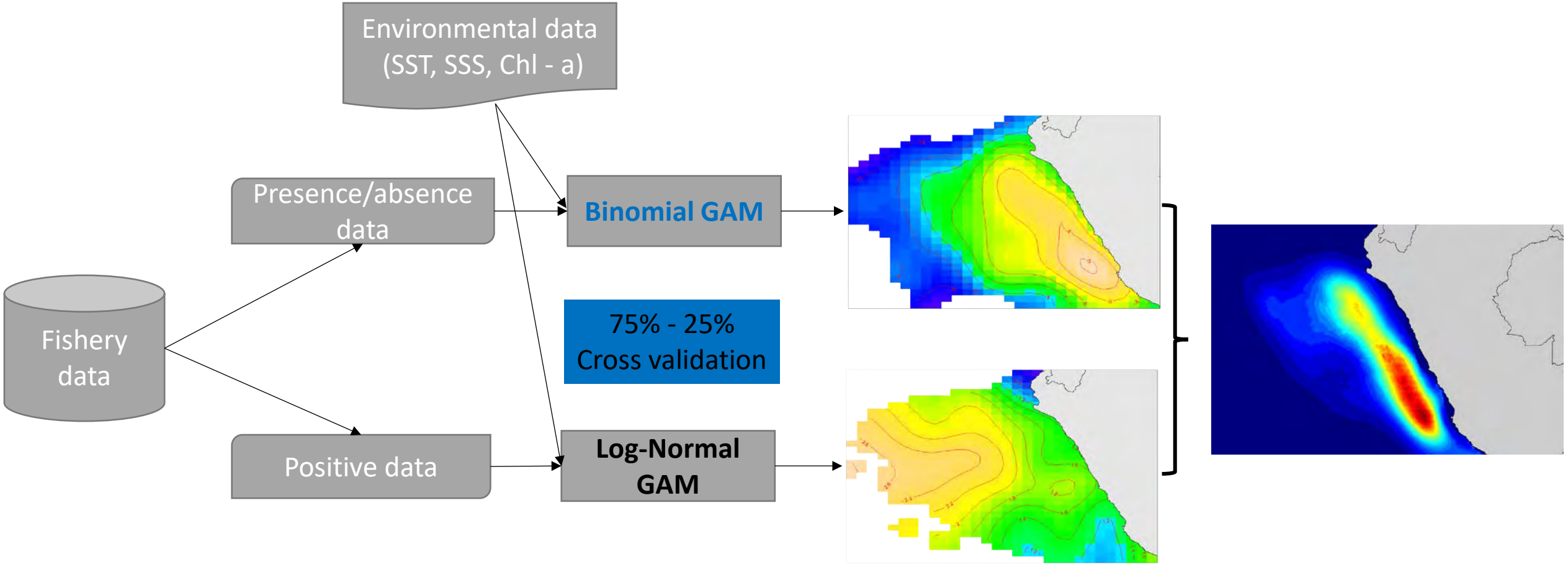
Data processing

$$CPUE_{ijkl} = \frac{C_{ijkl}\ (ton)}{f_{ijkl}(N°hooks) * 1000}$$

- The dataset included a total of 7 108 trips, aggregated in a total of 4 127 x 0.25° grid.
- Satellite remote sensing oceanographic data were averaged to 0.25° grid for each month to match the spatial-temporal resolution of fishery data.



Spatial distribution & Abundance index

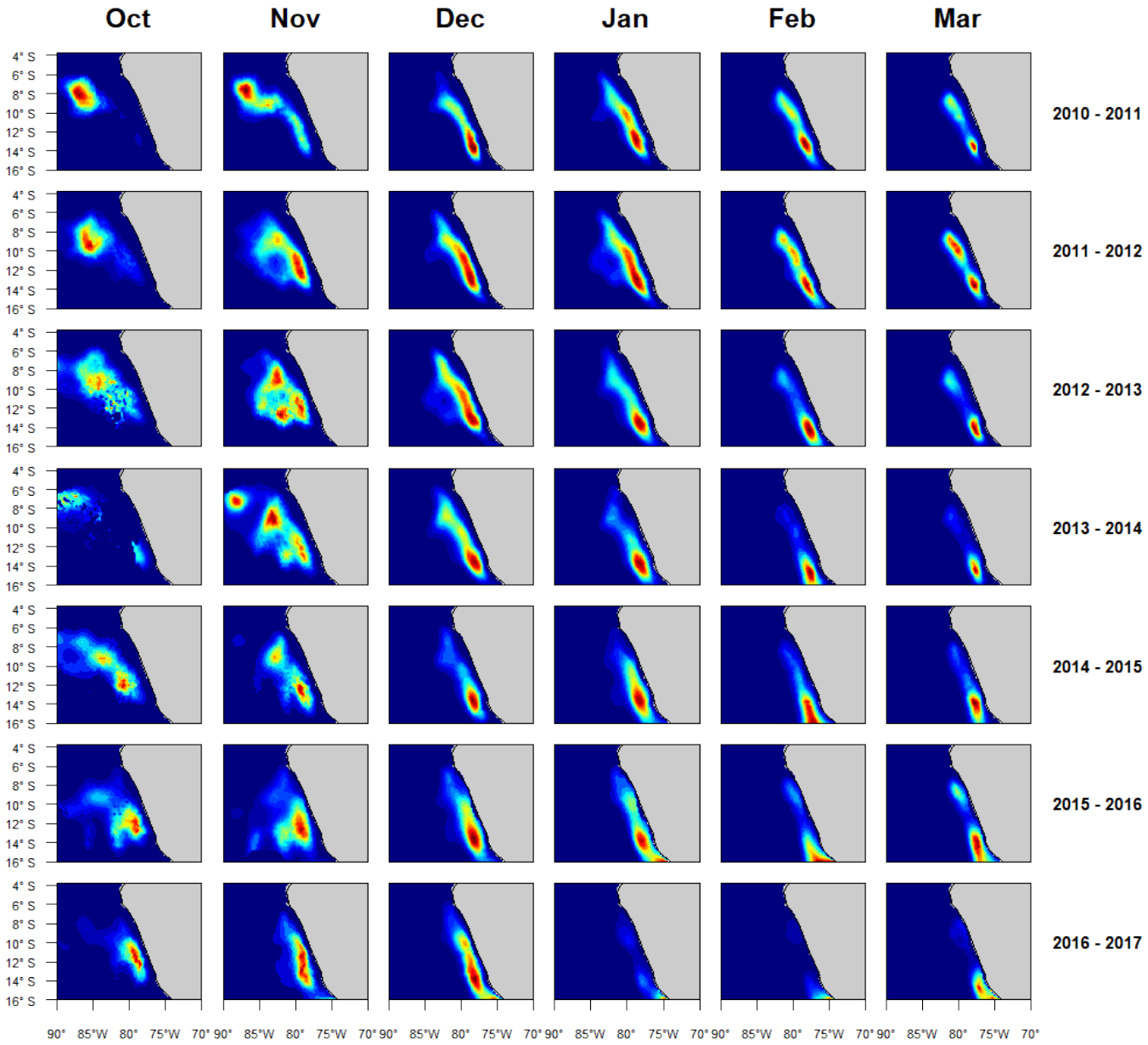


mgcv - R

$$log\left(\frac{p}{[1-p]}\right) \sim year + month + s(SST) + s(SSS) + te(lon, lat, month) + te(lon, lat, year)$$

$$log(CPUE^{+}) \sim year + month + s(SST) + s(SSS) + te(lon, lat, month) + te(lon, lat, year)$$

Spatial distribution



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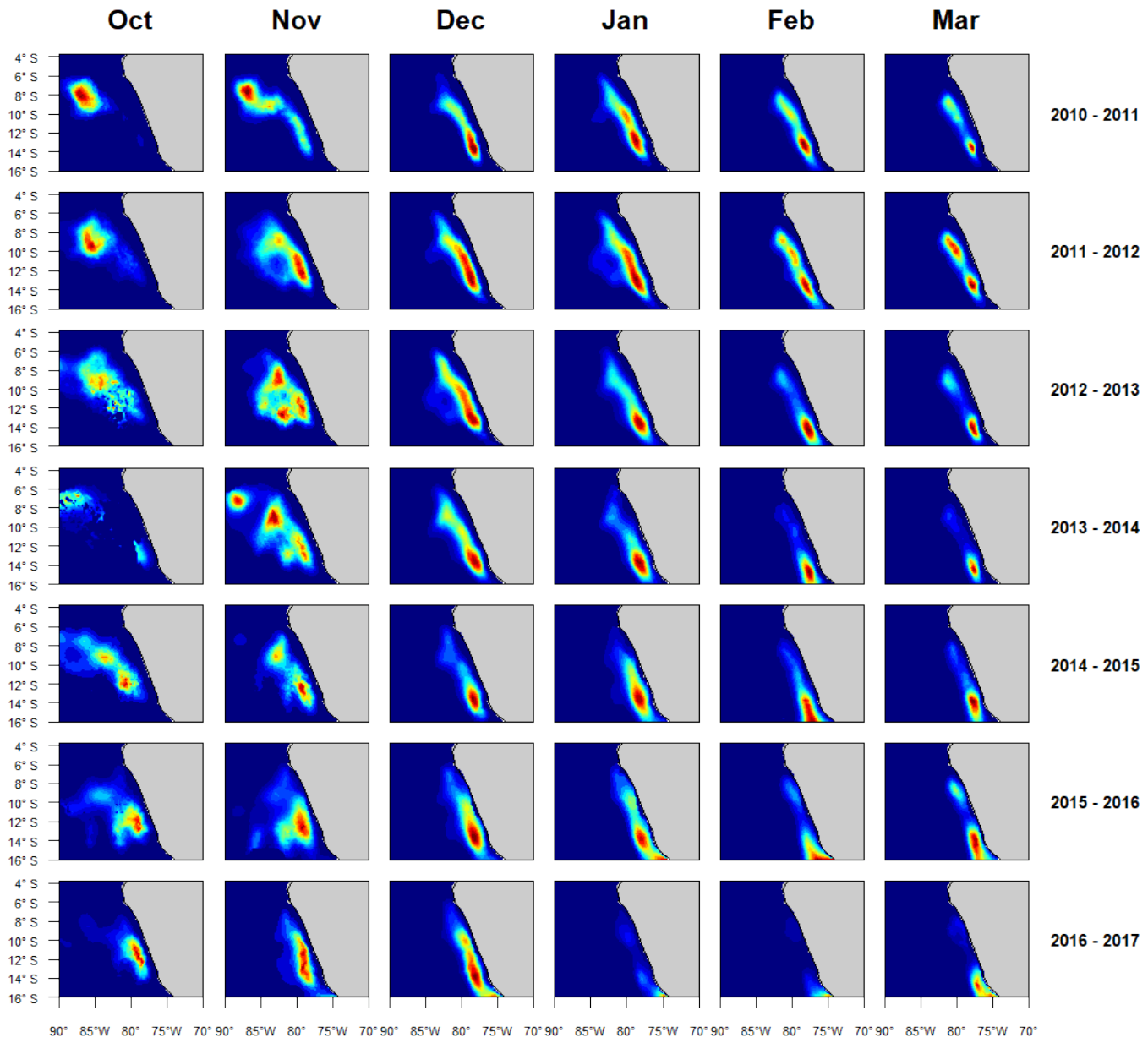
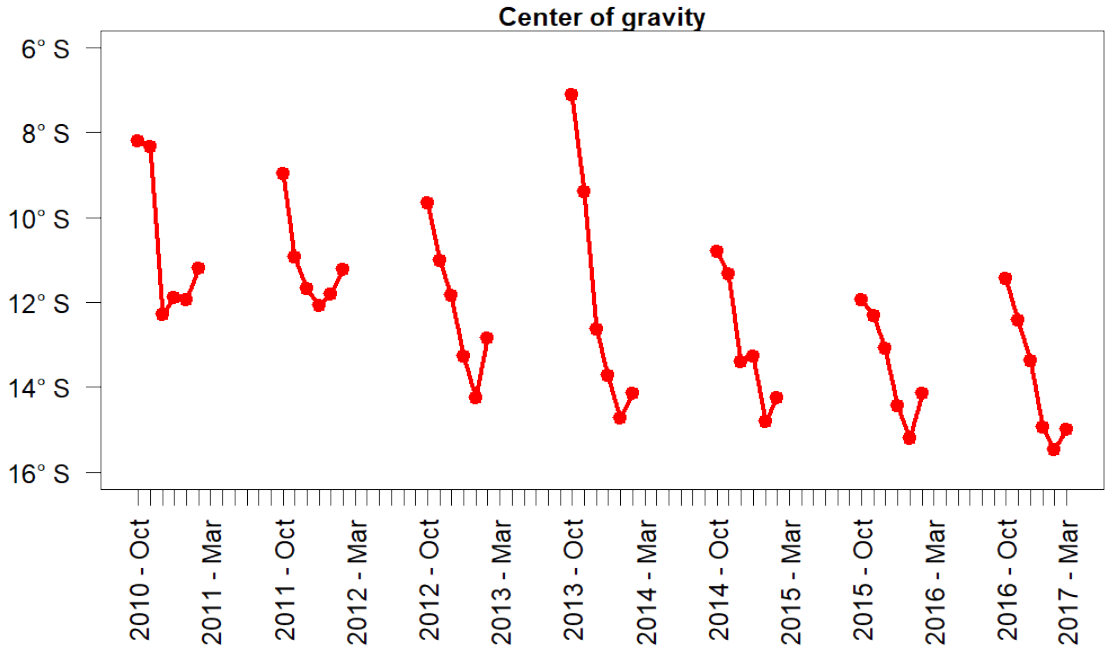
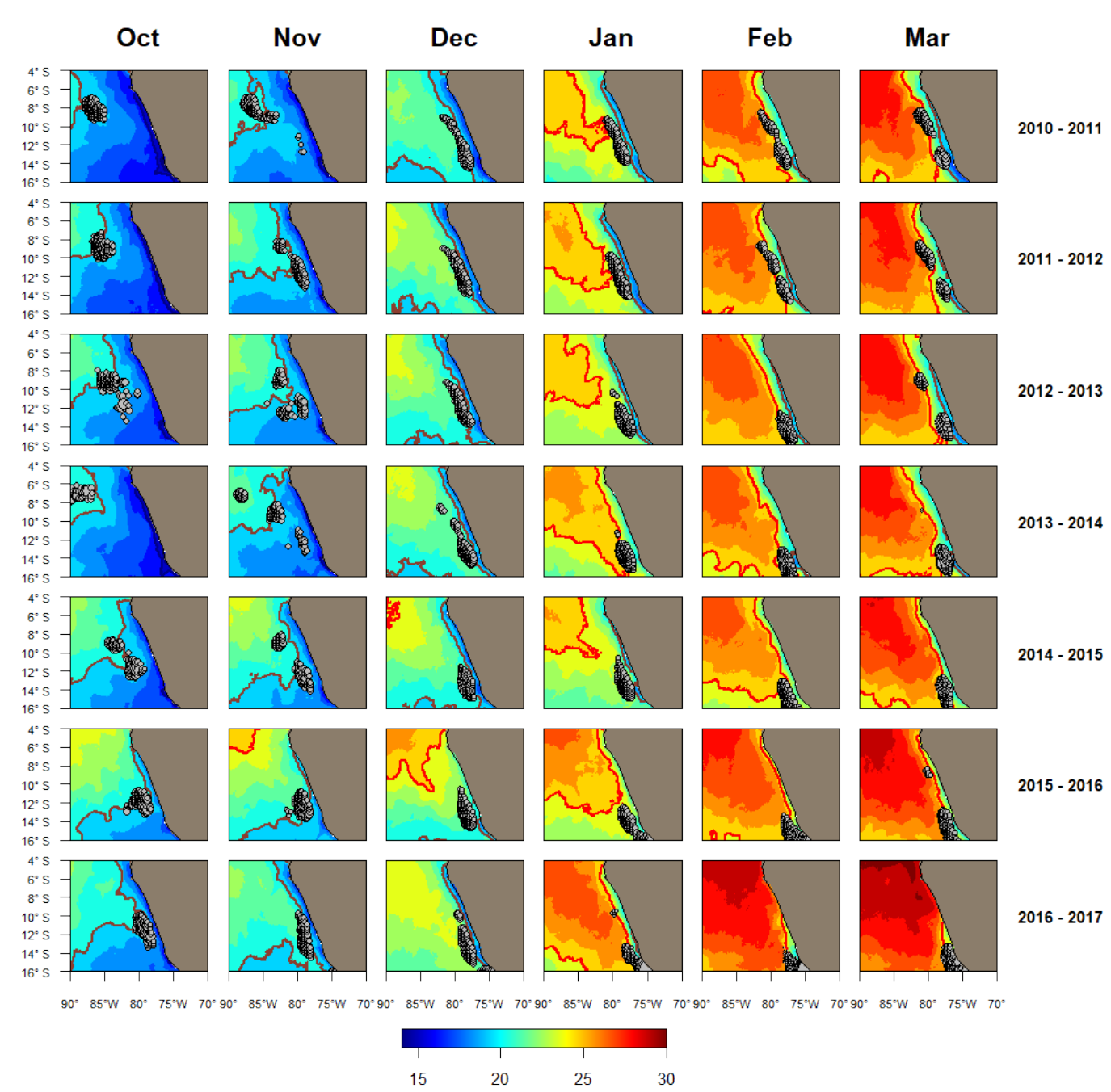
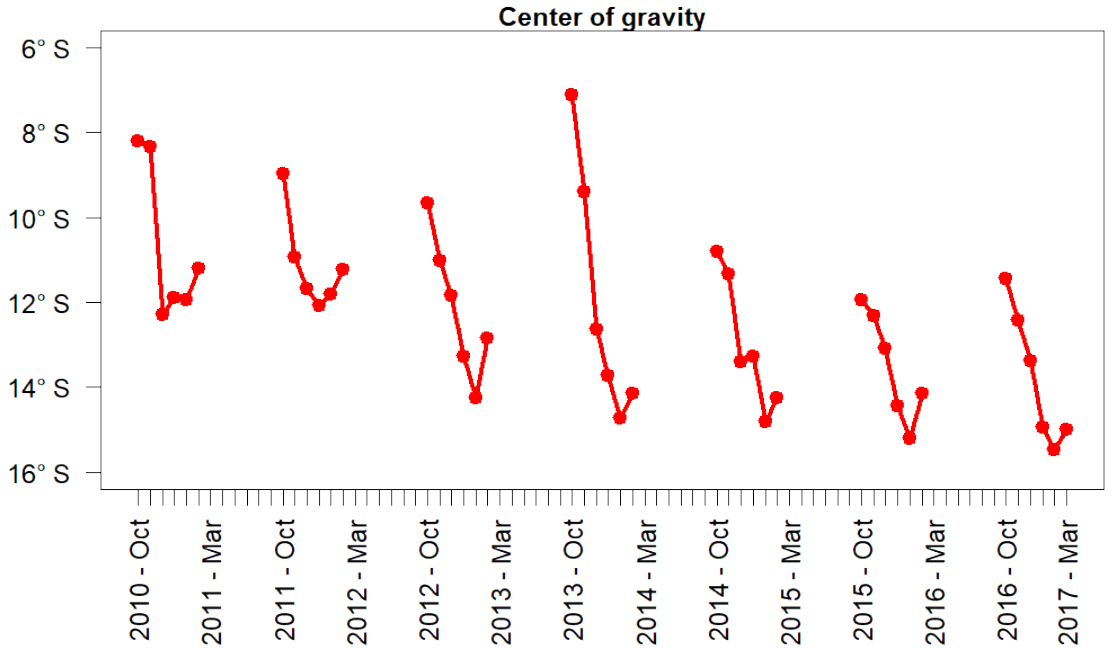




Spatial distribution - SST





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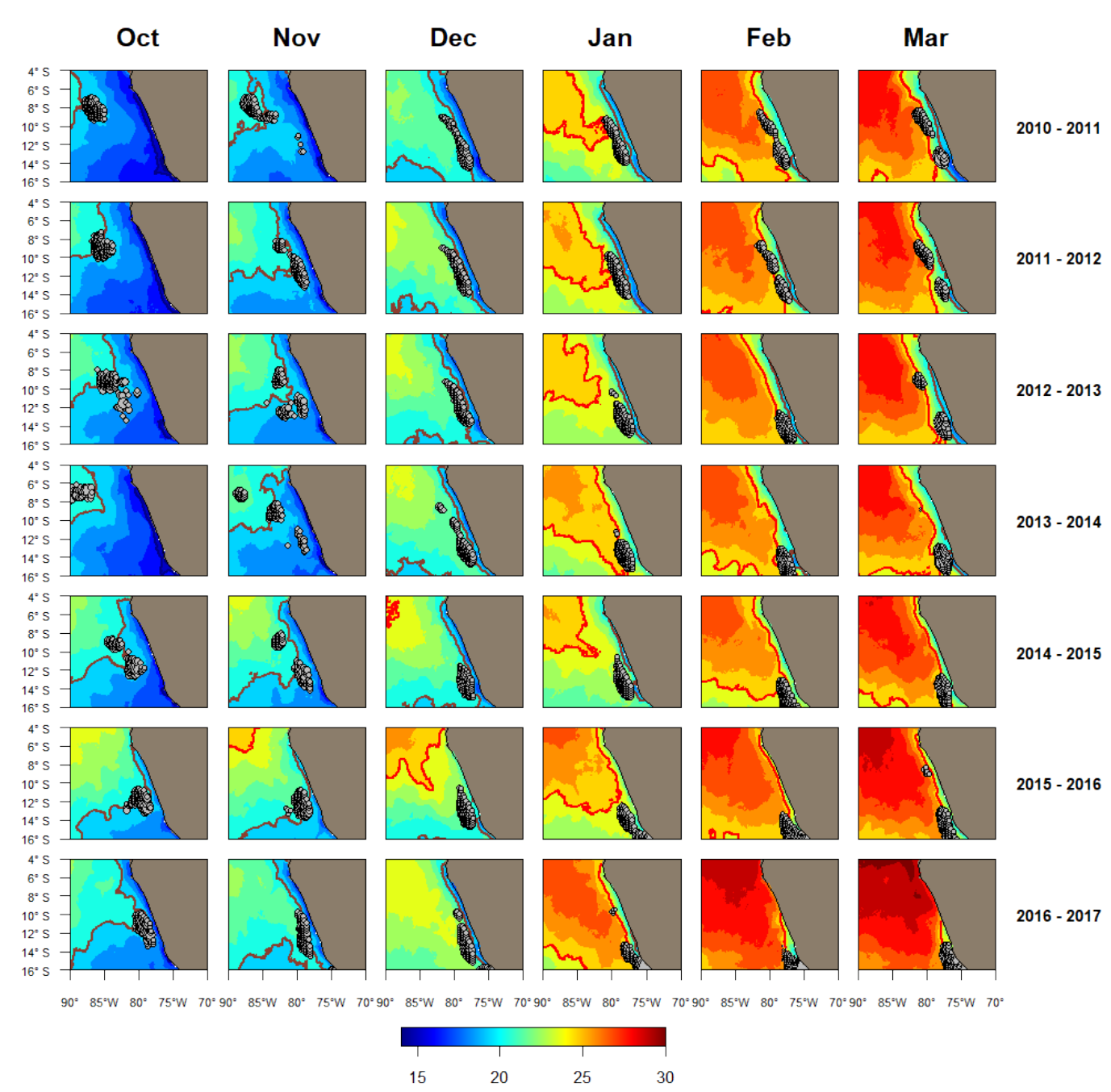
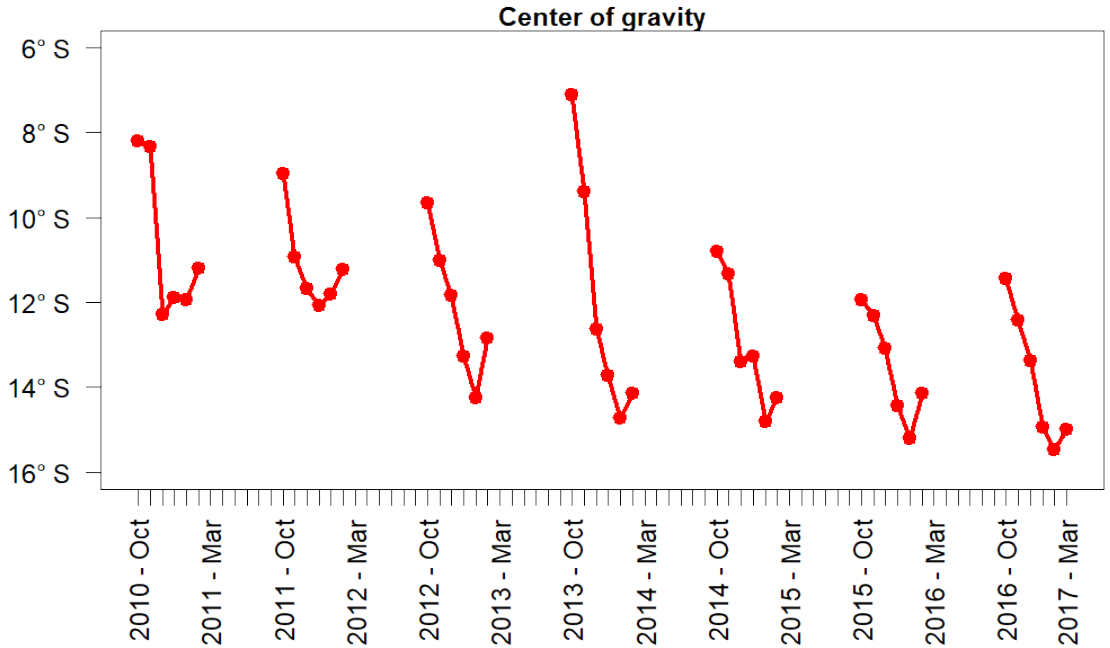
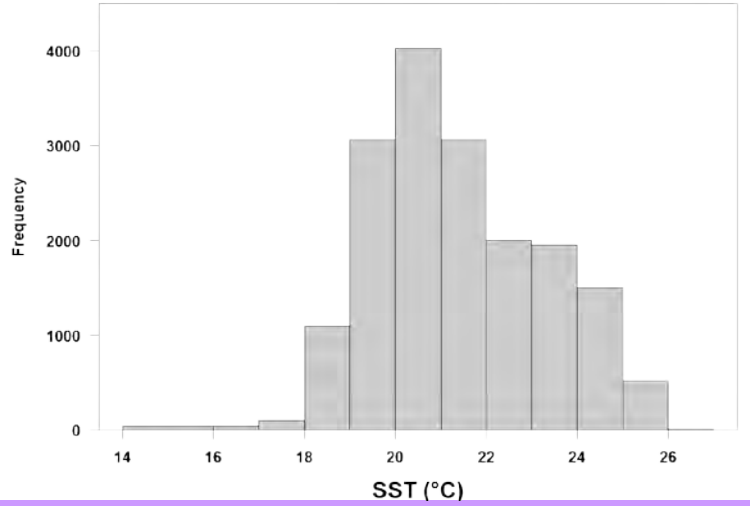
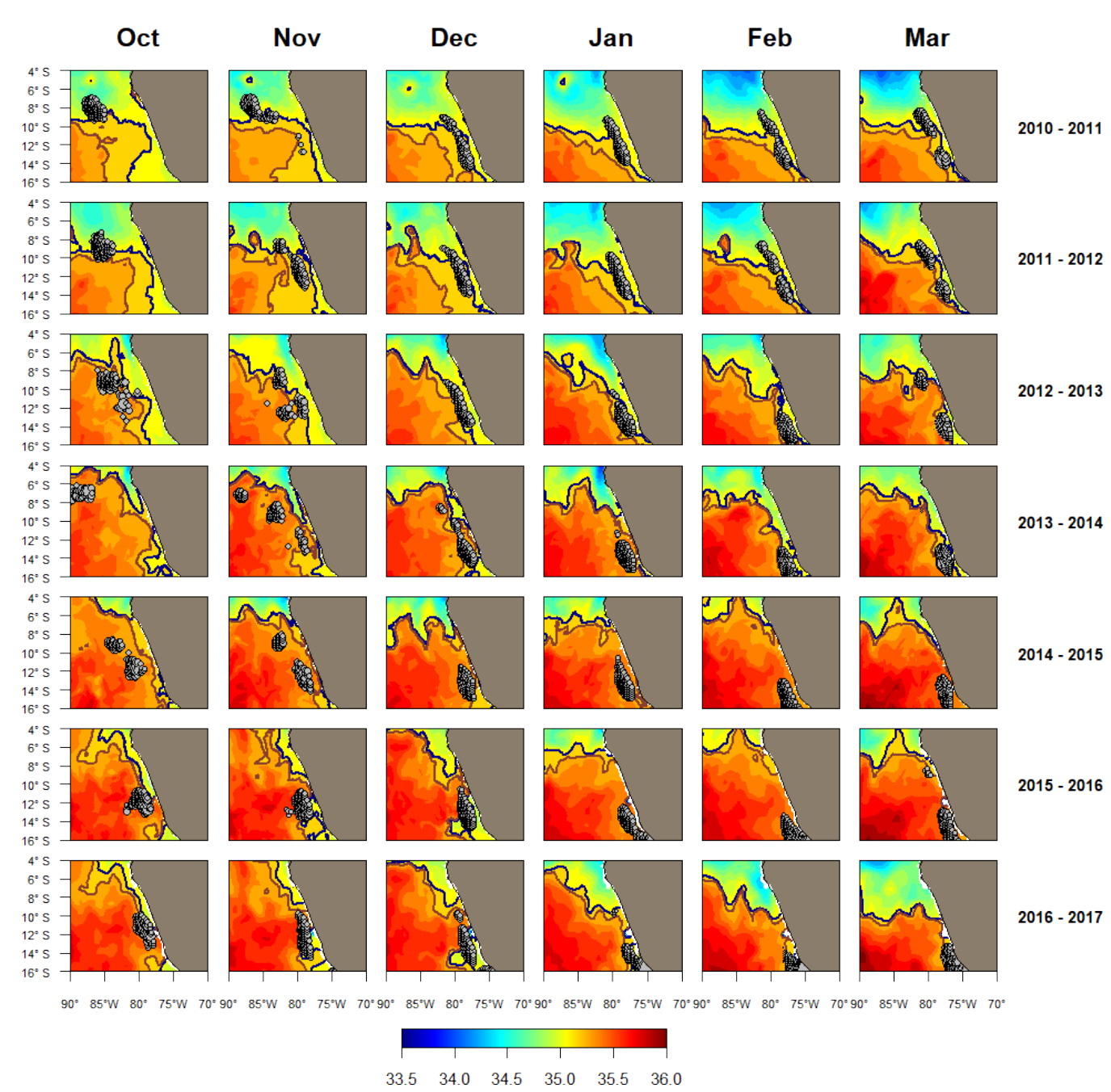
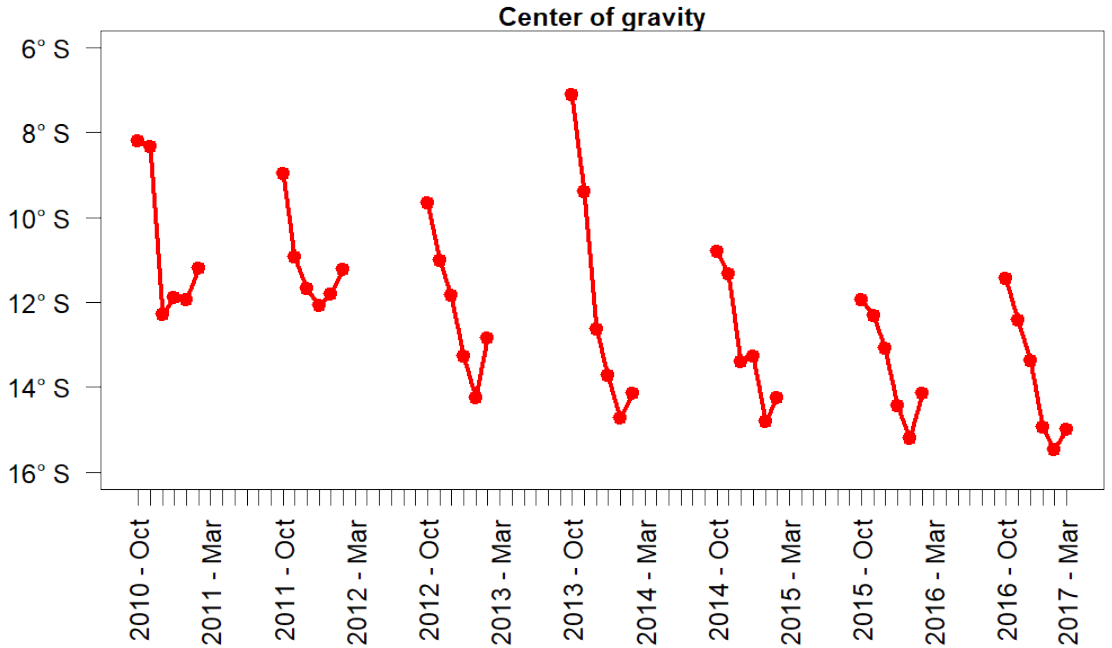




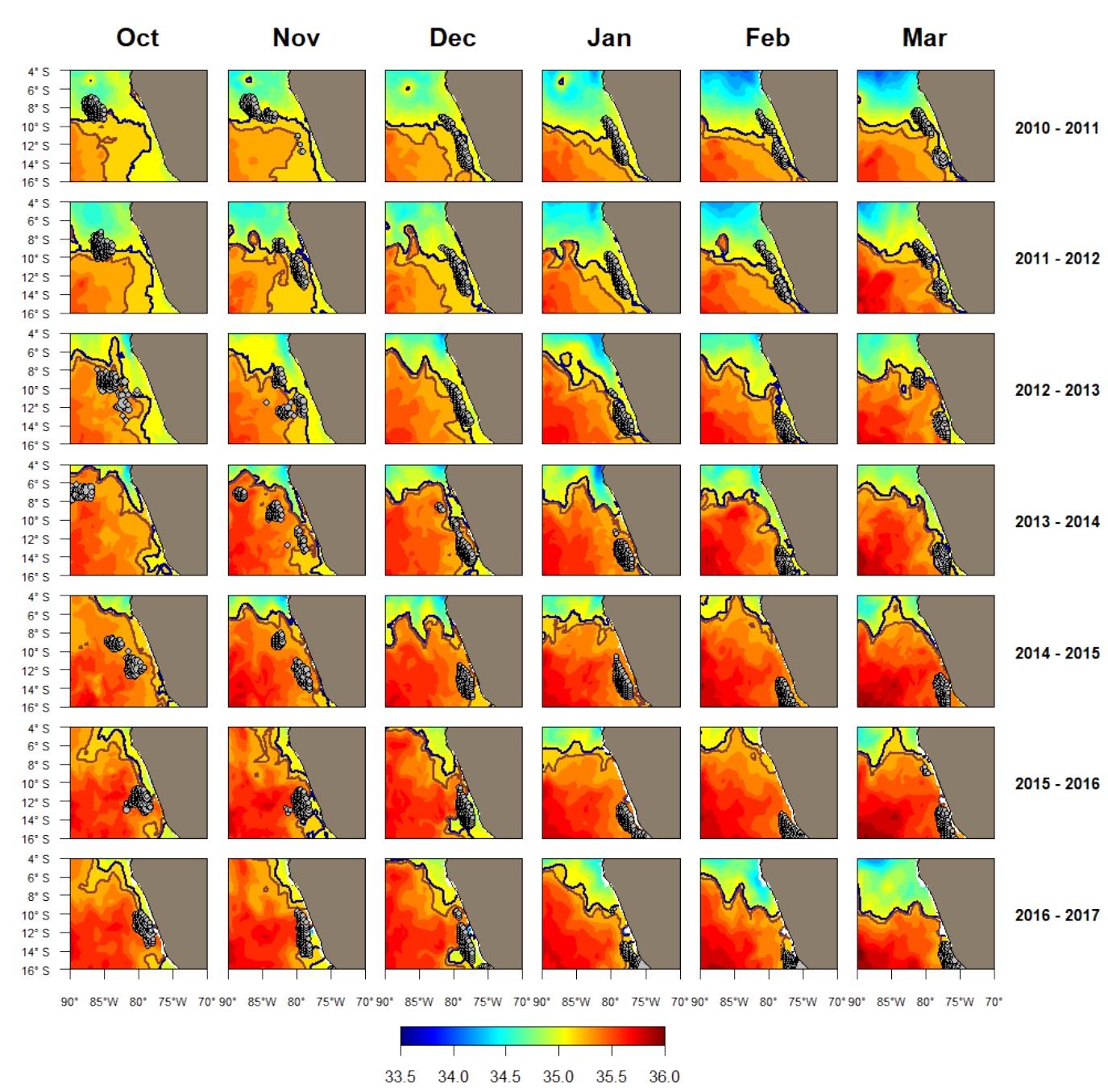


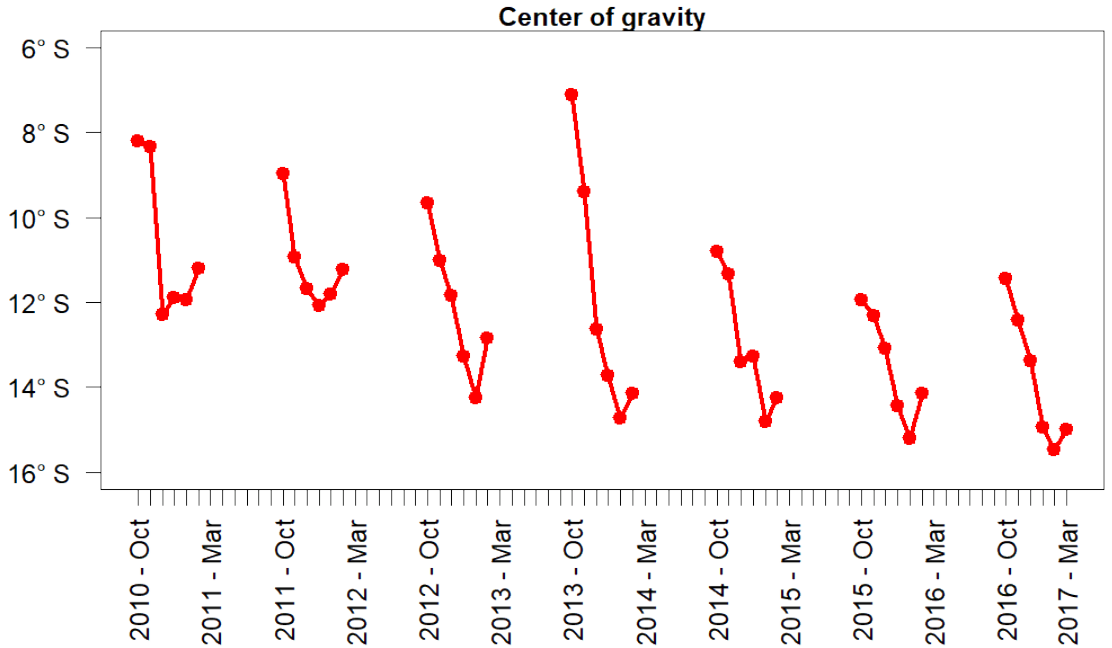
Spatial distribution - SSS

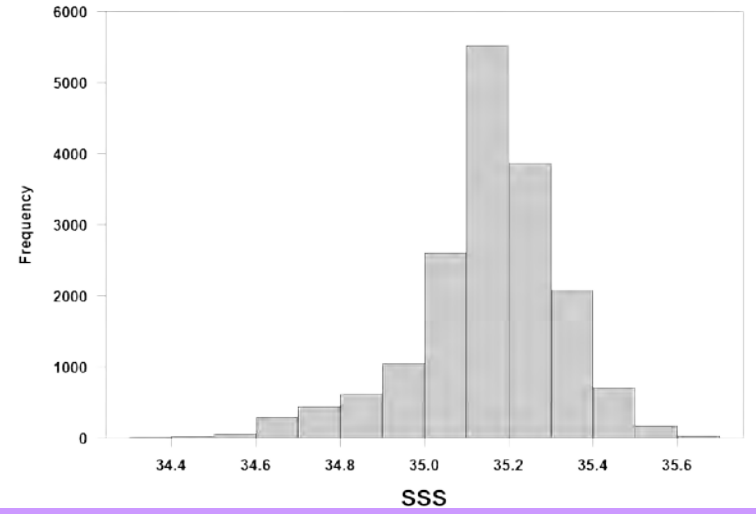




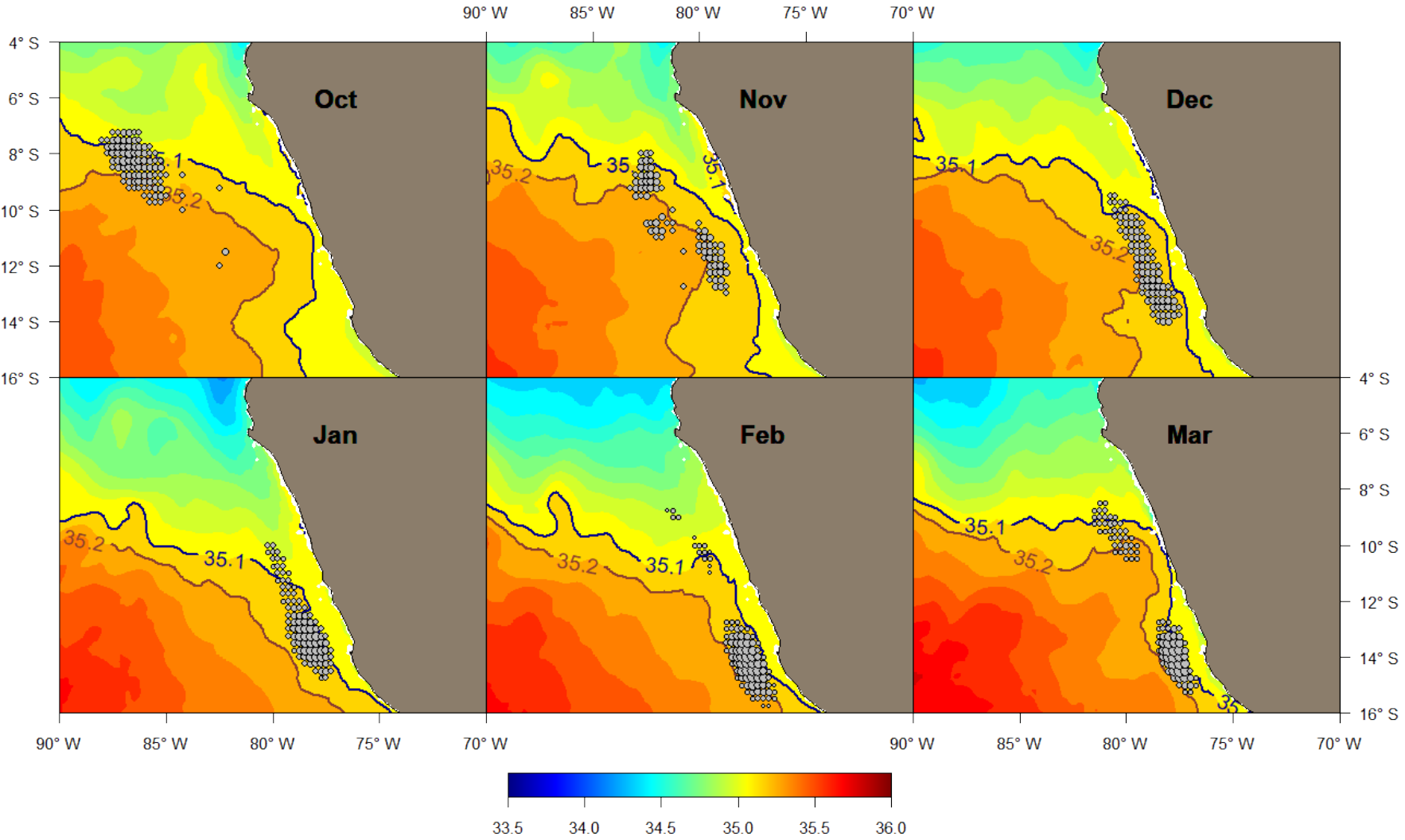
Spatial distribution - SSS

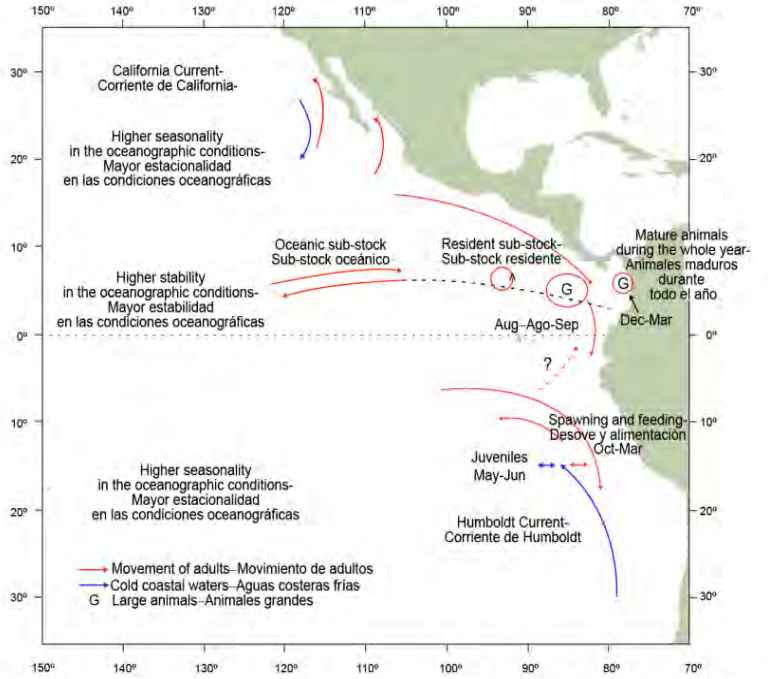






Hotspots – SSS





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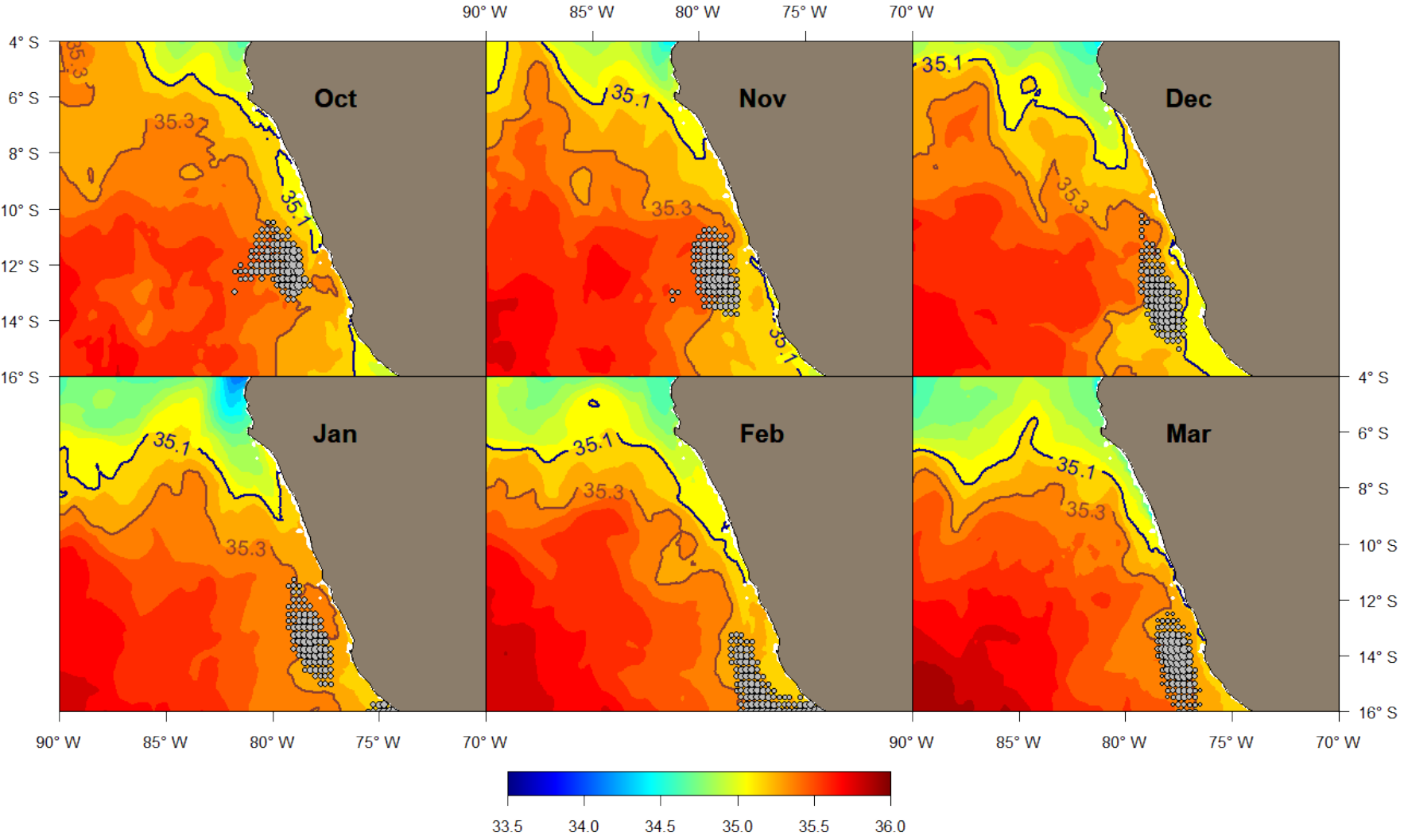
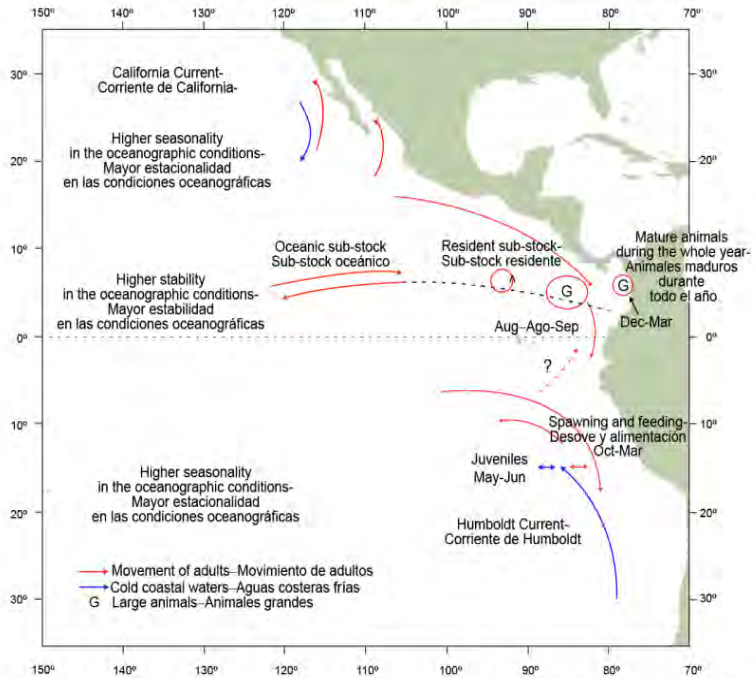
Hotspots – SSS – Warming events





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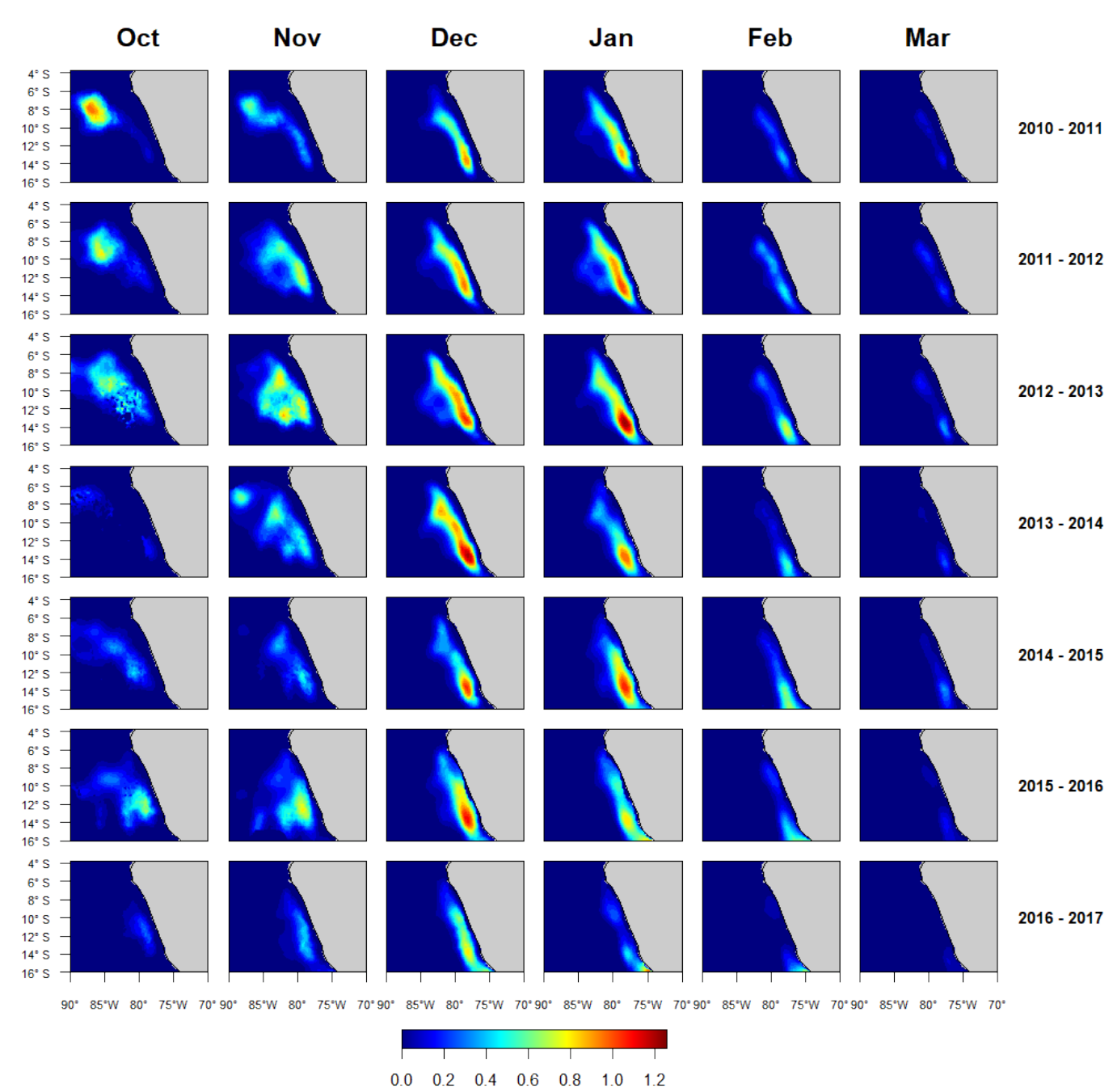

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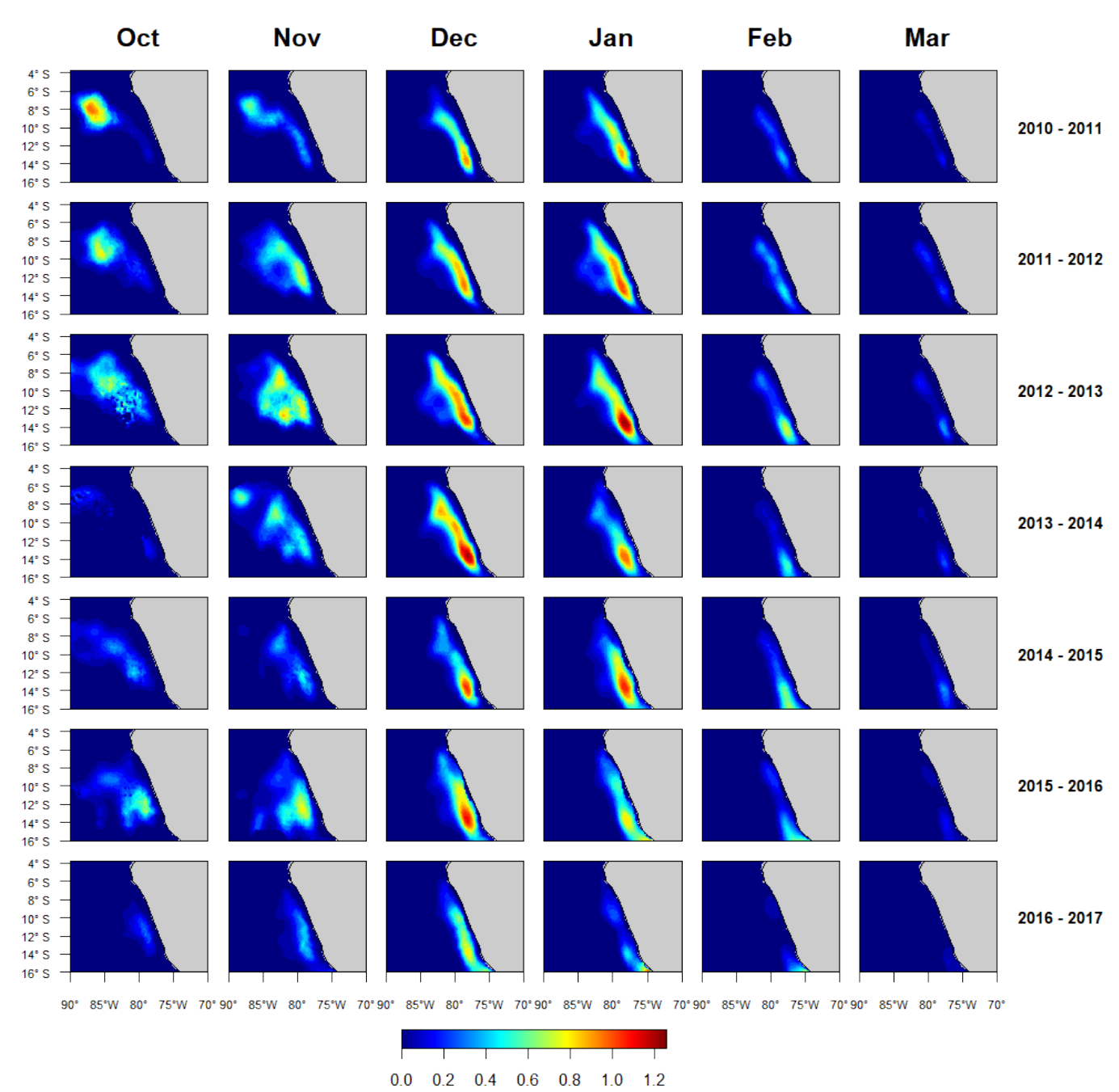
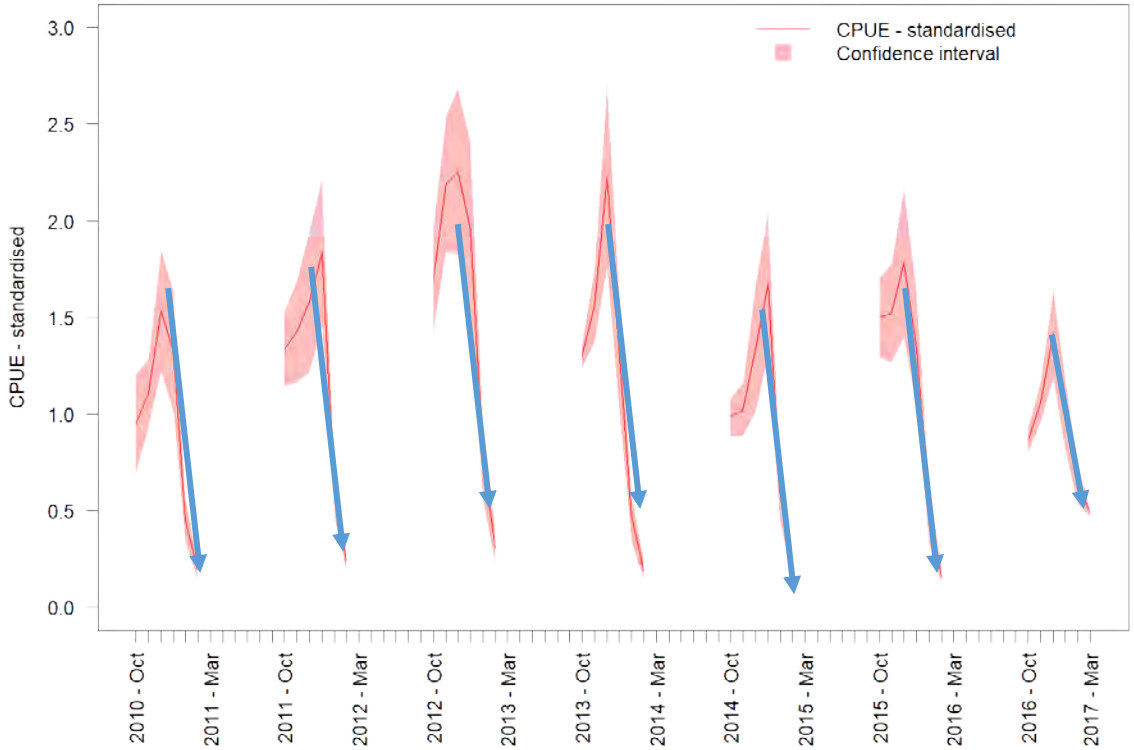


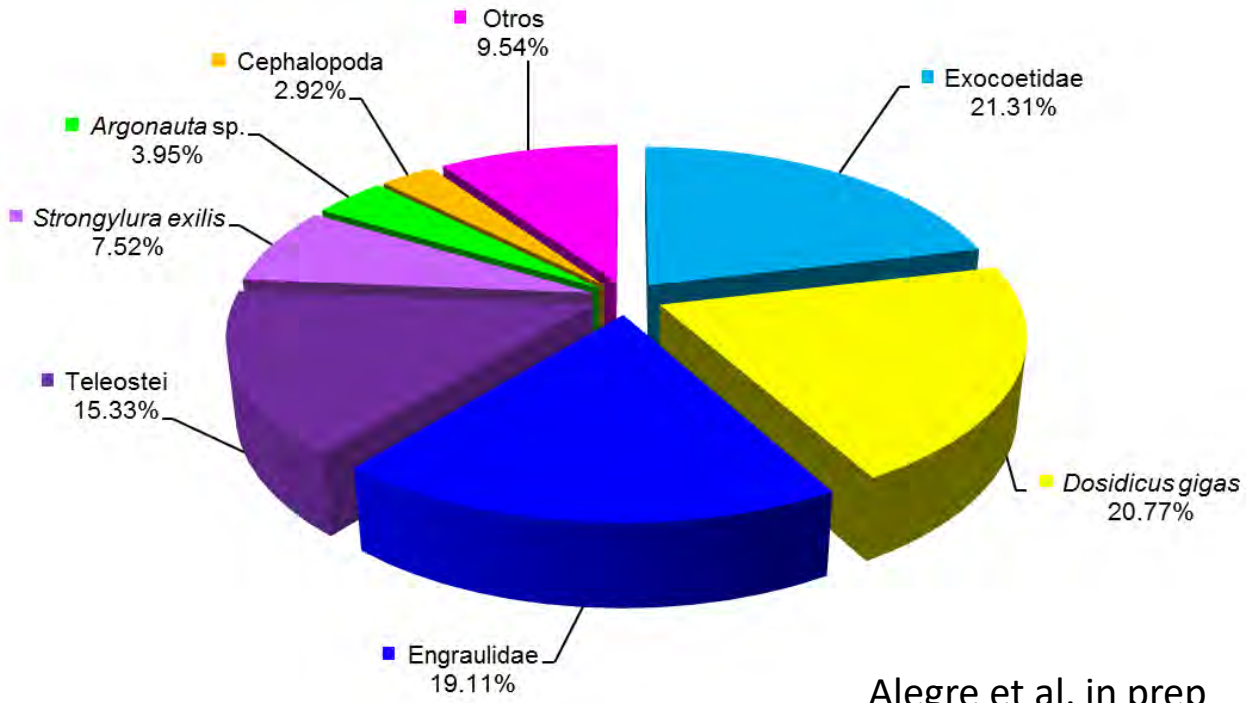


Conclusions

- Dolphinfish showed a strong seasonal changes in their distribution in response to the regional oceanography.
- Dolphinfish prefers to stay in slightly higher SST around 20 – 24°C and SSS around 35.1 – 35.3. Boundary between SSW and CCW.
- Dolphinfish fundamentally changed their monthly distribution latitudinal direction from north to the south and their longitudinally direction from west to the east.
- In warming events, during the fishing season, the hotspots of dolphinfish were in the central and coastal off Peru.
- The time series of CPUE would be reflecting the monthly decay (year after year) of a single cohort of dorado due to natural mortality and fishery. At the beginning (oct - nov) the cohorts is not fully recruited to the fishery (migration, availability).
- Results derived from this study could improve our understanding of how the spatial distribution of dorado is likely to vary with climate and form the basis to forecast fishing grounds in the future.
- Fisheries management arrangements could be developed based on preferred habitat ranges to account for the variation in oceanographic conditions driven by climate change.

Next steps

- To further improve accuracy and predictive capacity, future research could include other ecological descriptors, predator-prey interactions, diets, energetics and ontogenetic changes.



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- To further improve accuracy and predictive capacity, future research could include other ecological descriptors, predator-prey interactions, diets, energetics and ontogenetic changes.

- Including aspects of fishing behavior will be an important next step in conducting more comprehensive investigations into the influence of climate variability on dolphinfish fisheries.

- Tagging studies will be necessary to verify the accuracy of the estimation of the spatio-temporal modeling approach.

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