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Drivers of dynamics of small pelagic fish resources

Ontogenic variability of the ecological niche of Peruvian anchoveta (*Engraulis ringens*)

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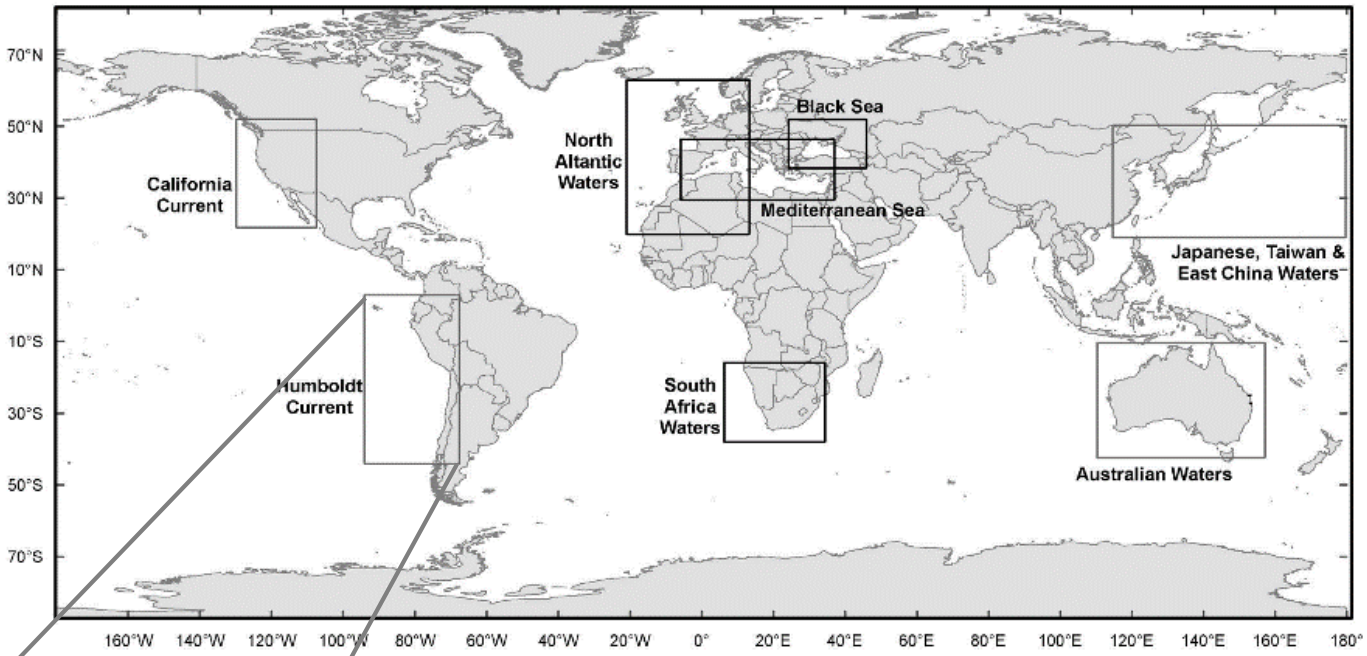
CIENCIACTIVA
Becas y Co-financiamiento de Concytec

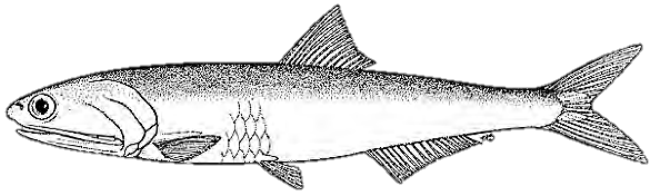
Outline

- Introduction: The anchovy (*Engraulis ringens*) on the HCS.
- Research problem
- Species distribution models (SDM)
- Ecological niche
- Methods
- Results
- Conclusions
- Perspectives

Introduction

(Giannoulaki et al., 2014)

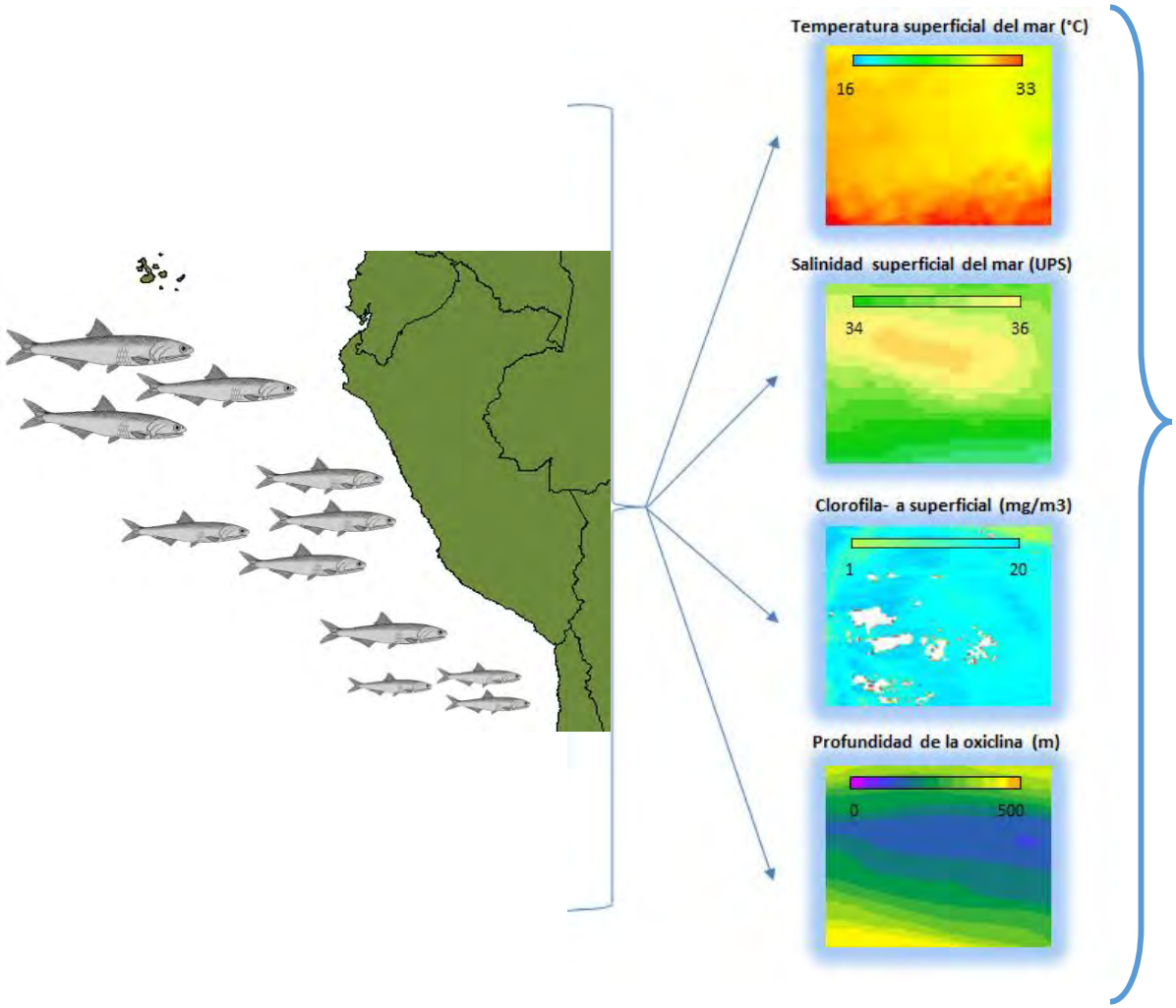




Peruvian anchovy (*Engraulis ringens*)

(FAO, 2014)

Research problem



Habitat use
Spatial distribution of species
Patterns of migration of species

Dynamic features

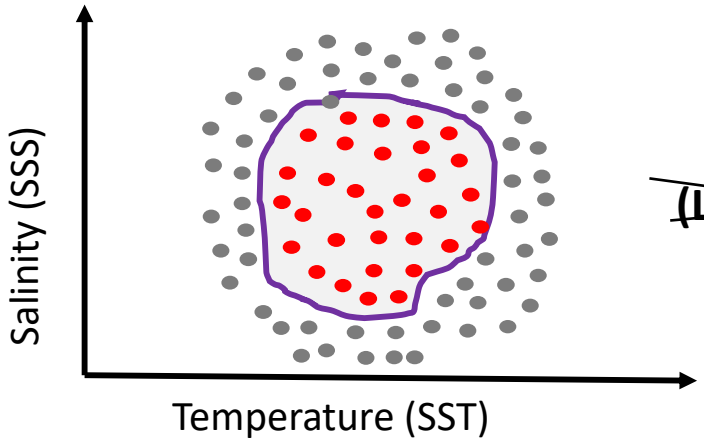
Species

Environment

Spatial distribution models

Ecological space

Ecological niche model

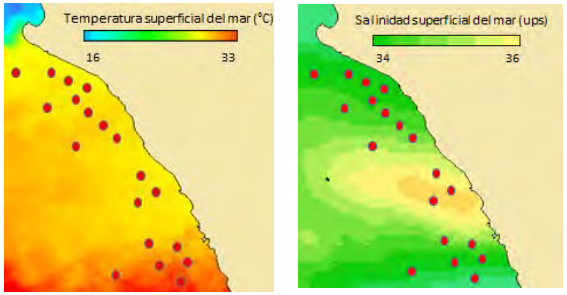


~~(Latitude, Longitude)~~

(SST, SSS)

Geographical space

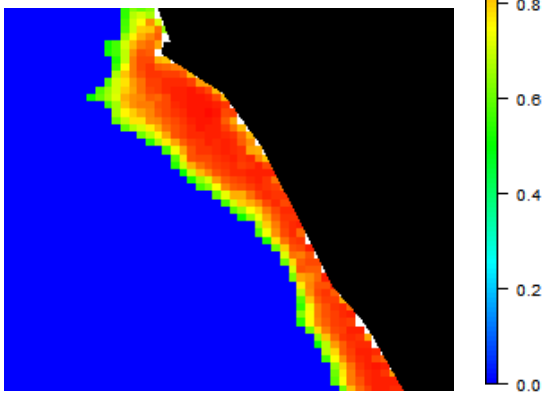
Environmental data



Presence records

INPUT

Spatial Distribution

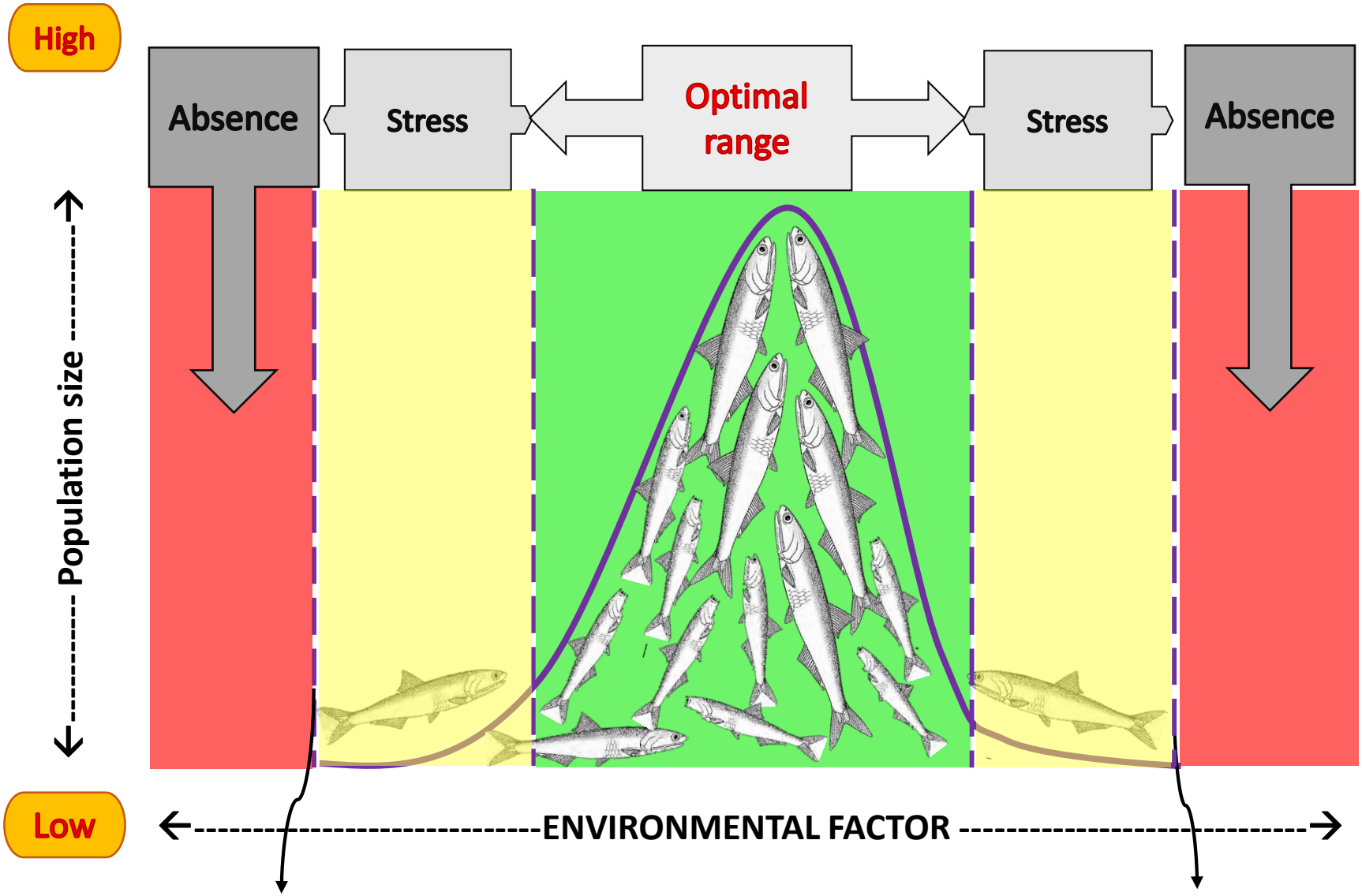


OUTPUT

Ecological niche

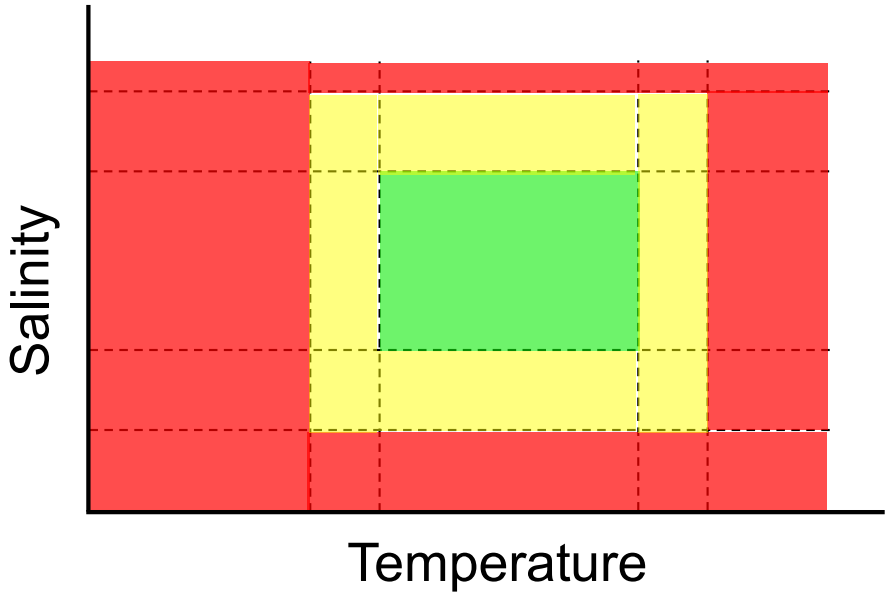
1 ENVIRONMENTAL FACTOR

Tolerance law (Shelford)

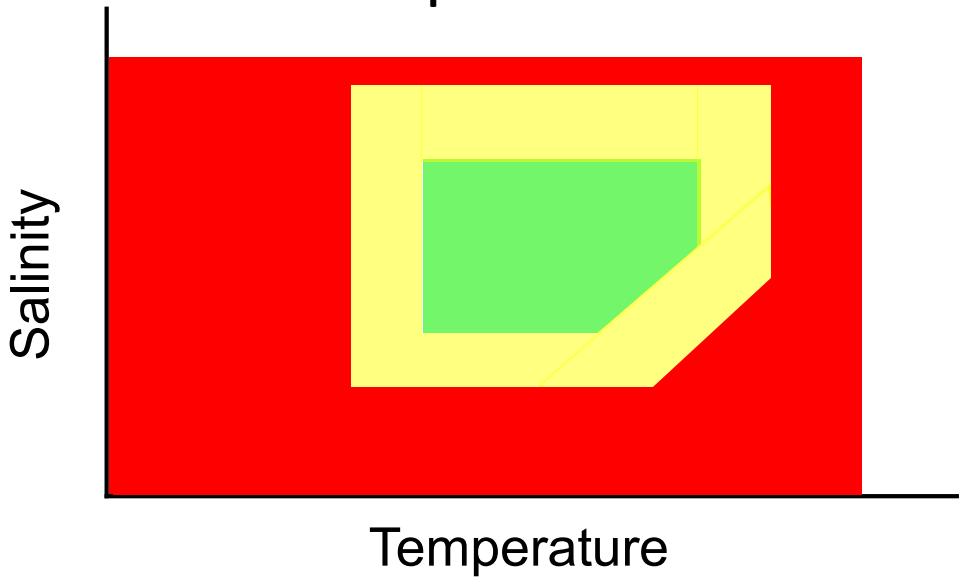


Ecological niche

2 ENVIRONMENTAL FACTORS



Interactions between environmental factors are possible!

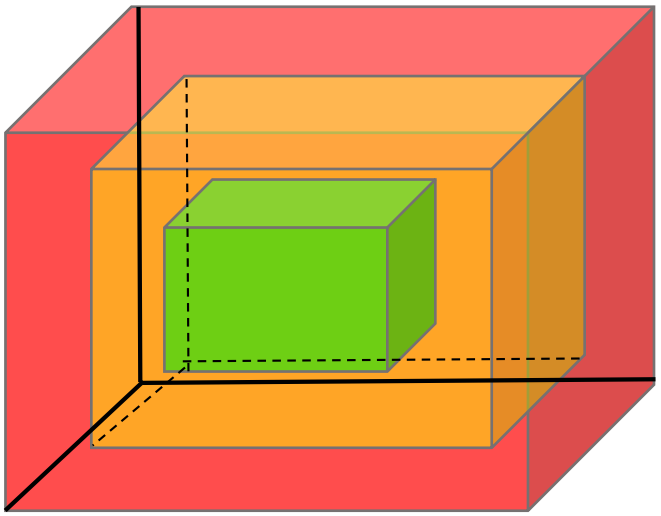


Ecological niche

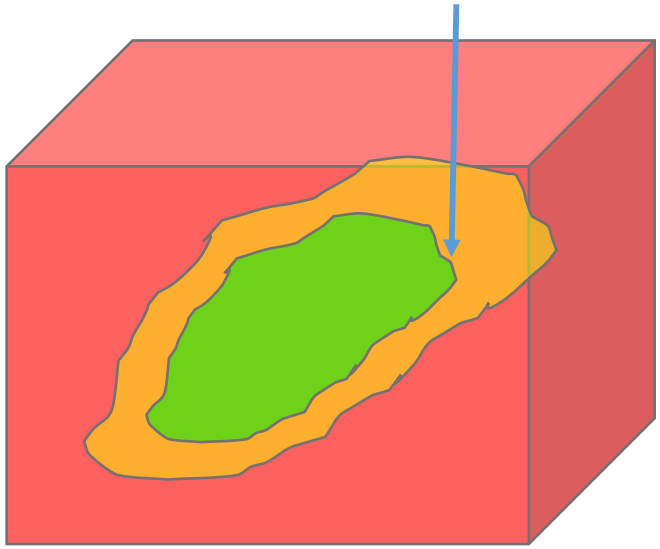
3 ENVIRONMENTAL FACTORS

… "*an n-dimentional hypervolume where every point in which corresponds to a state of the environment which would permit the species (S) to exist indefinitely …* "
(Hutchinson, 1957).

Identify the **niche** is equivalent to find its **boundary**.



Without interactions



With interactions

Methods

Data:

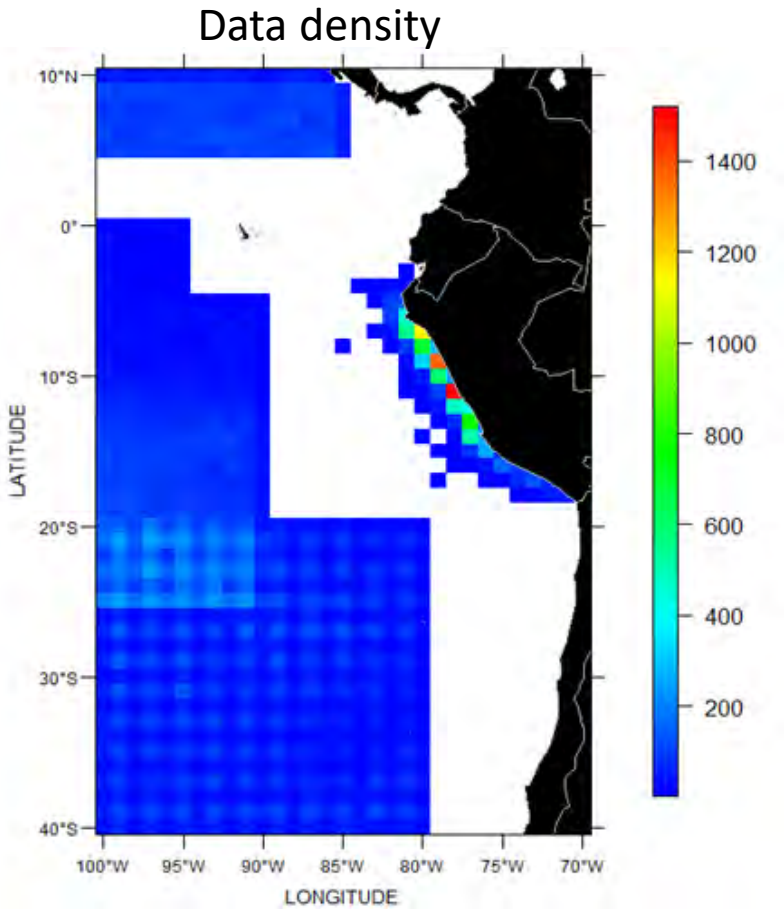
Distribution of anchovies:

- Presence records in the Peruvian coast between 1985 and 2008.
- Absence records (pseudo-absence where it is known that the anchovy is not distributed).

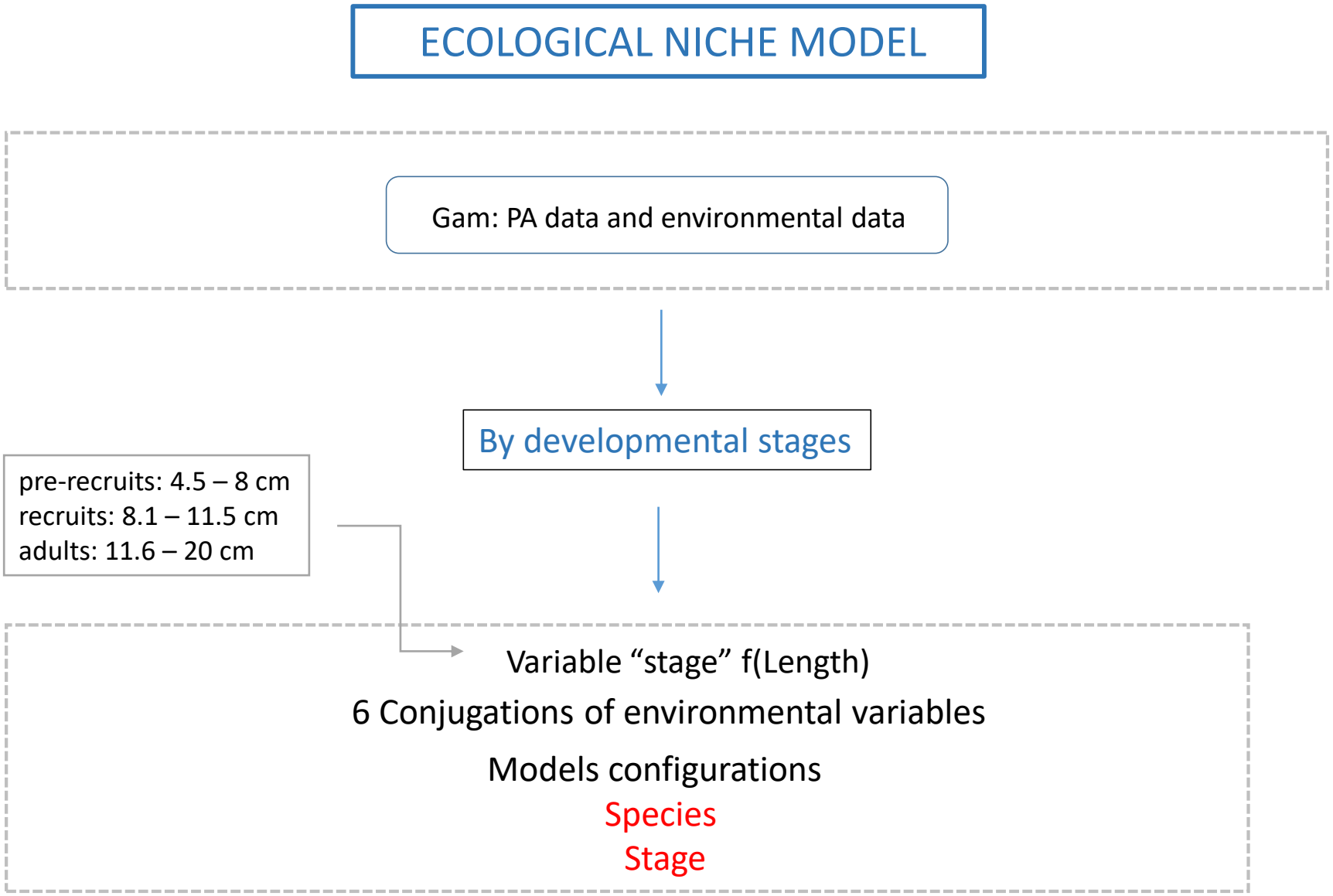
Environmental data:

- SST (°C)
- SSS (ups)
- Cl-a (mg/m^3)
- Oxy (depth 2 mlL^{-1}, m)

- Source: remote sensing,
  in situ data, model outputs.

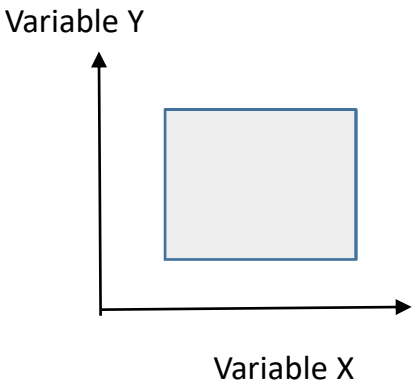


Methods


ECOLOGICAL NICHE MODEL
Gam: PA data and environmental data
By developmental stages
pre-recruits: 4.5 – 8 cm
recruits: 8.1 – 11.5 cm
adults: 11.6 – 20 cm
Variable “stage” f(Length)
6 Conjugations of environmental variables
Models configurations
Species
Stage

Methods

DETERMINATION OF LIMITED VARIABLES



sst – sss
sst – log10(cl)
sss – log10(cl)
sst – log10(oxy)
sss – log10(oxy)
log10(cl) – log10(oxy)

Niche model

Range intersection on each environmental variable

By stages

SST
SSS
CL
OXY

1. In situ information (SST, SSM, CL and OXY)

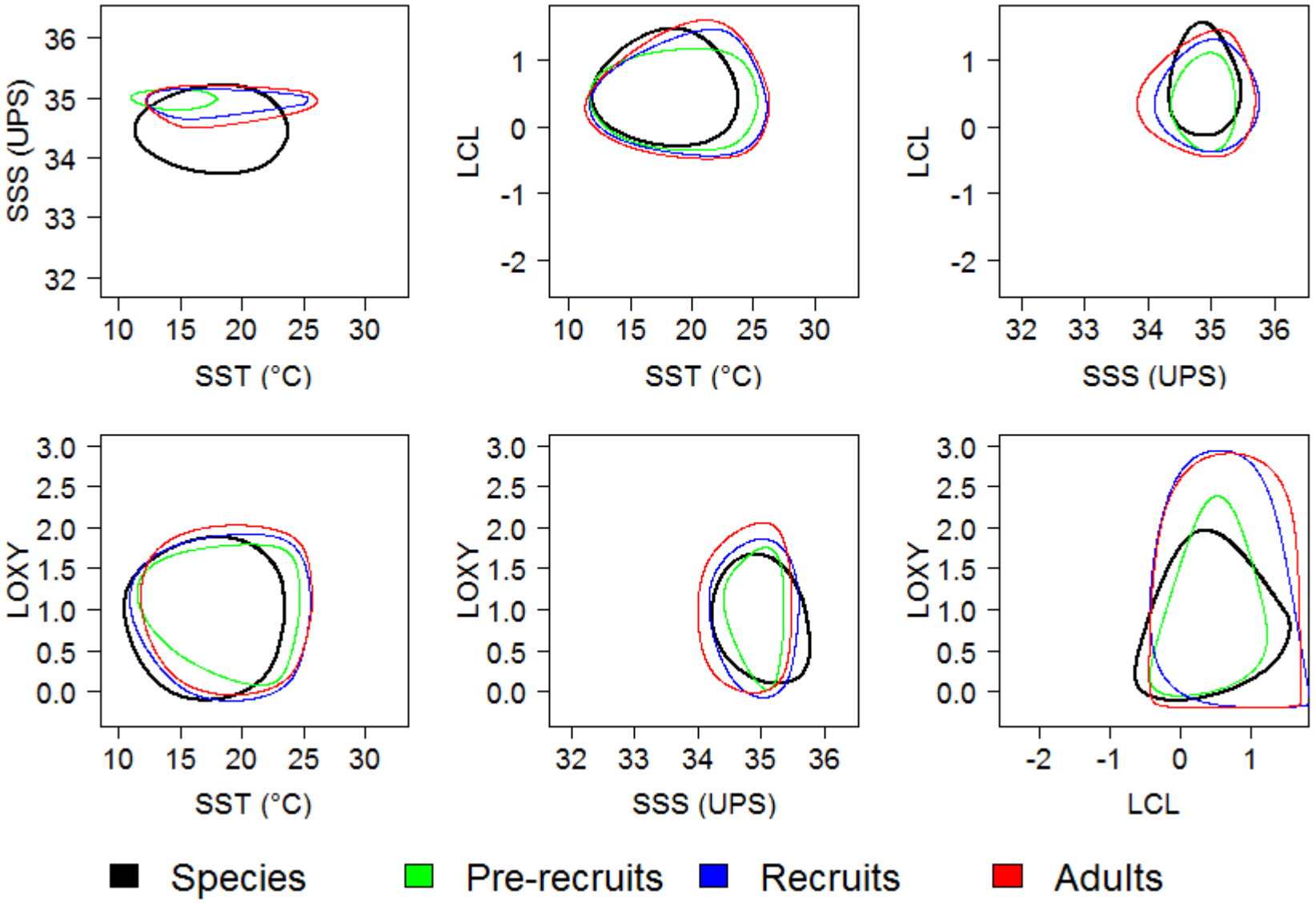
Classification of environmental information f (rank)

1: inside the rank
0: outside the rank

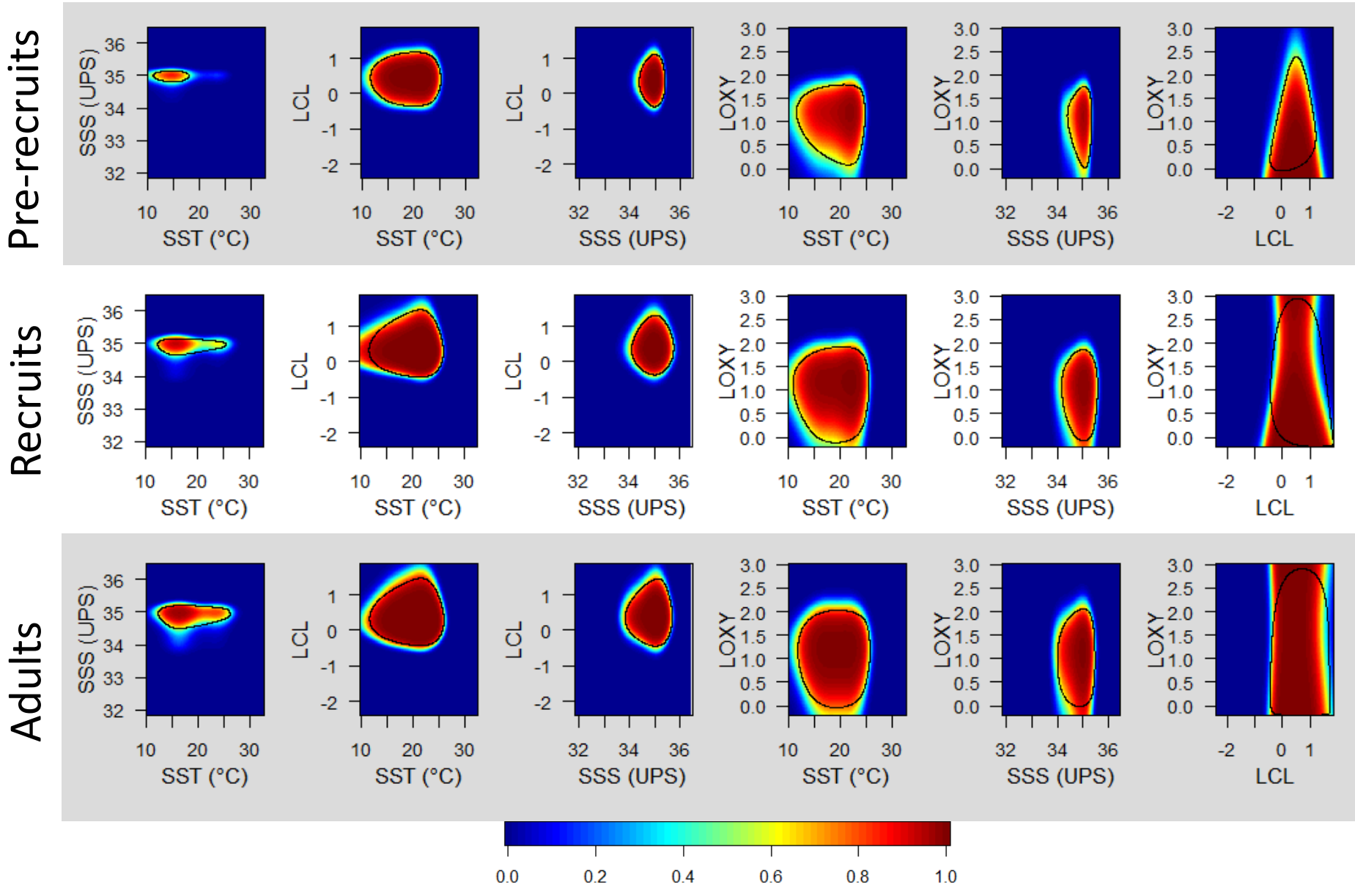
2. Average of the environmental classification f (rank)

Probability maps by environmental variables

Results: Estimation of ecological niche of anchovy



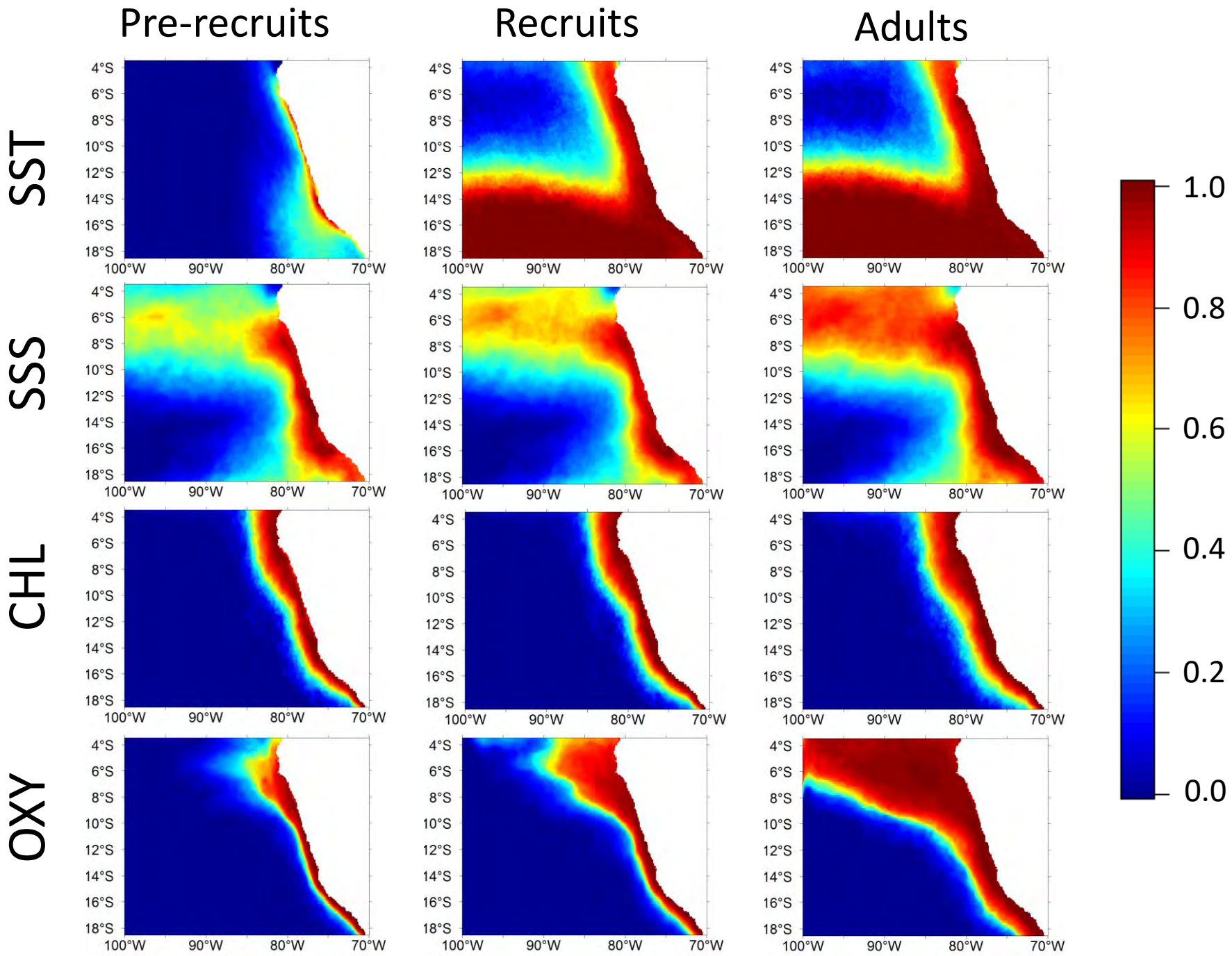
Results: Estimation of ecological niche of anchovy



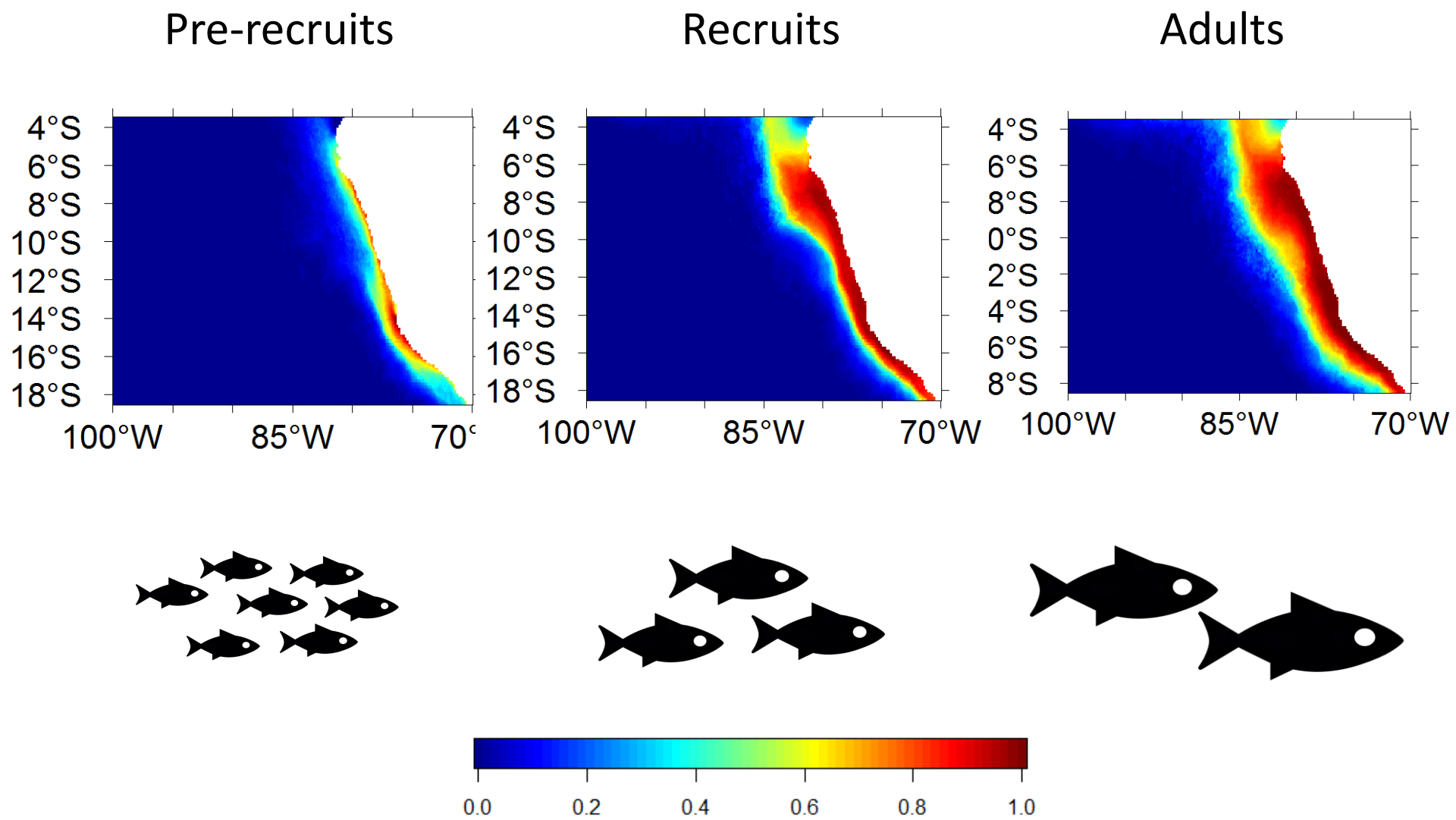
Results: Determination of limiting variables

Niche Ranges by Developmental Stage

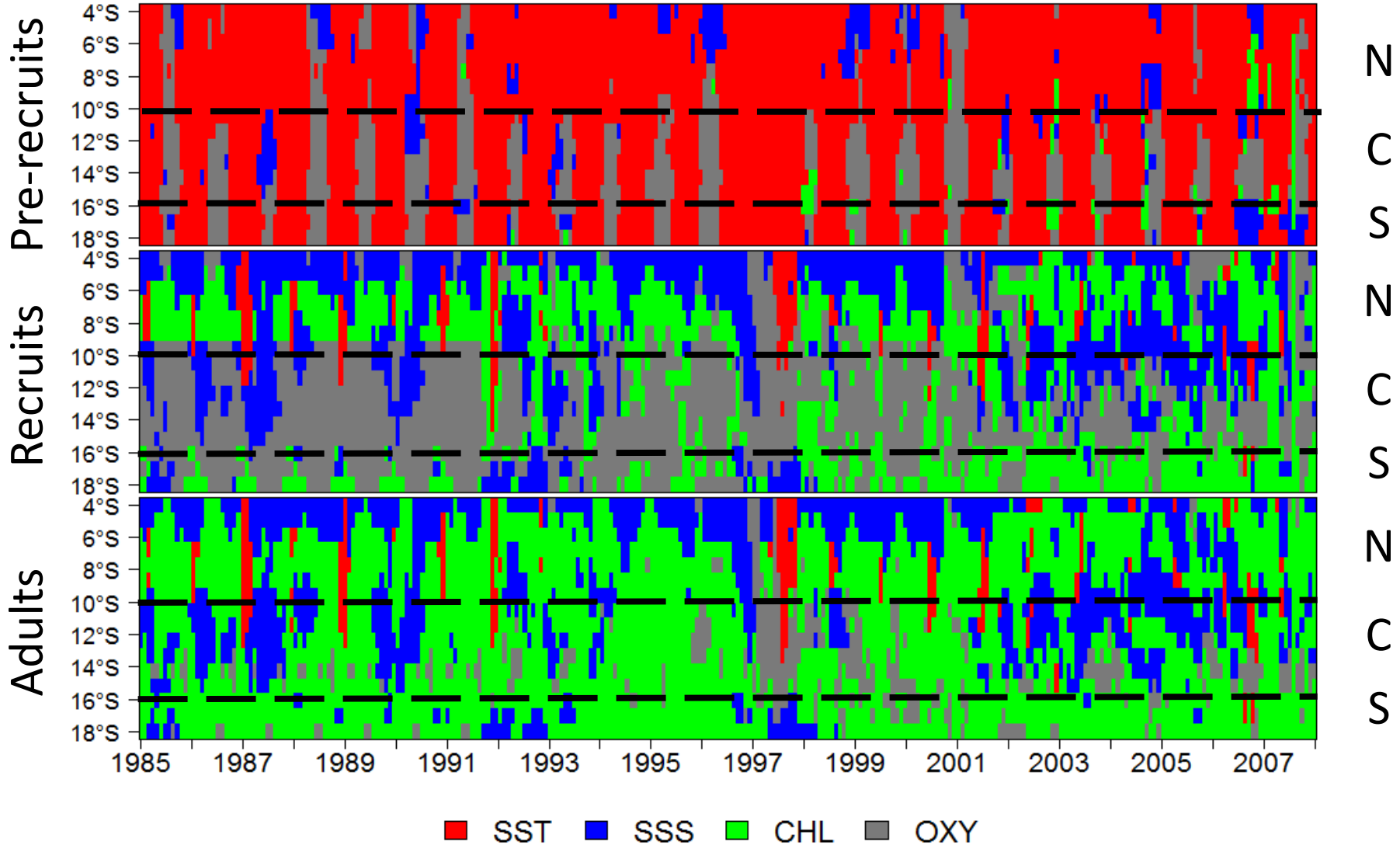
Stage	Variable	Rank
Pre-recruits	SST	11.69 °C – 18 °C
	SSS	34.80 UPS – 35.15 UPS
	CL	0.45 mg/m3 – 12.88 mg/m3
	OXY	1.20 m – 57.54 m
Recruits	SST	12.24°C – 25.34 °C
	SSS	34.65 UPS – 35.15 UPS
	CL	0.43 mg/m3 – 20.42 mg/m3
	OXY	0.85 m – 72.44 m
Adults	SST	12.19 °C – 25.70 °C
	SSS	34.50 UPS – 35.20 UPS
	CL	0.35 mg/m3 – 28.18 mg/m3
	OXY	0.98 m – 107.15 m


Pre-recruits
Recruits
Adults
SST
SSS
CHL
OXY
4°S
6°S
8°S
10°S
12°S
14°S
16°S
18°S
100°W
90°W
80°W
70°W
1.0
0.8
0.6
0.4
0.2
0.0

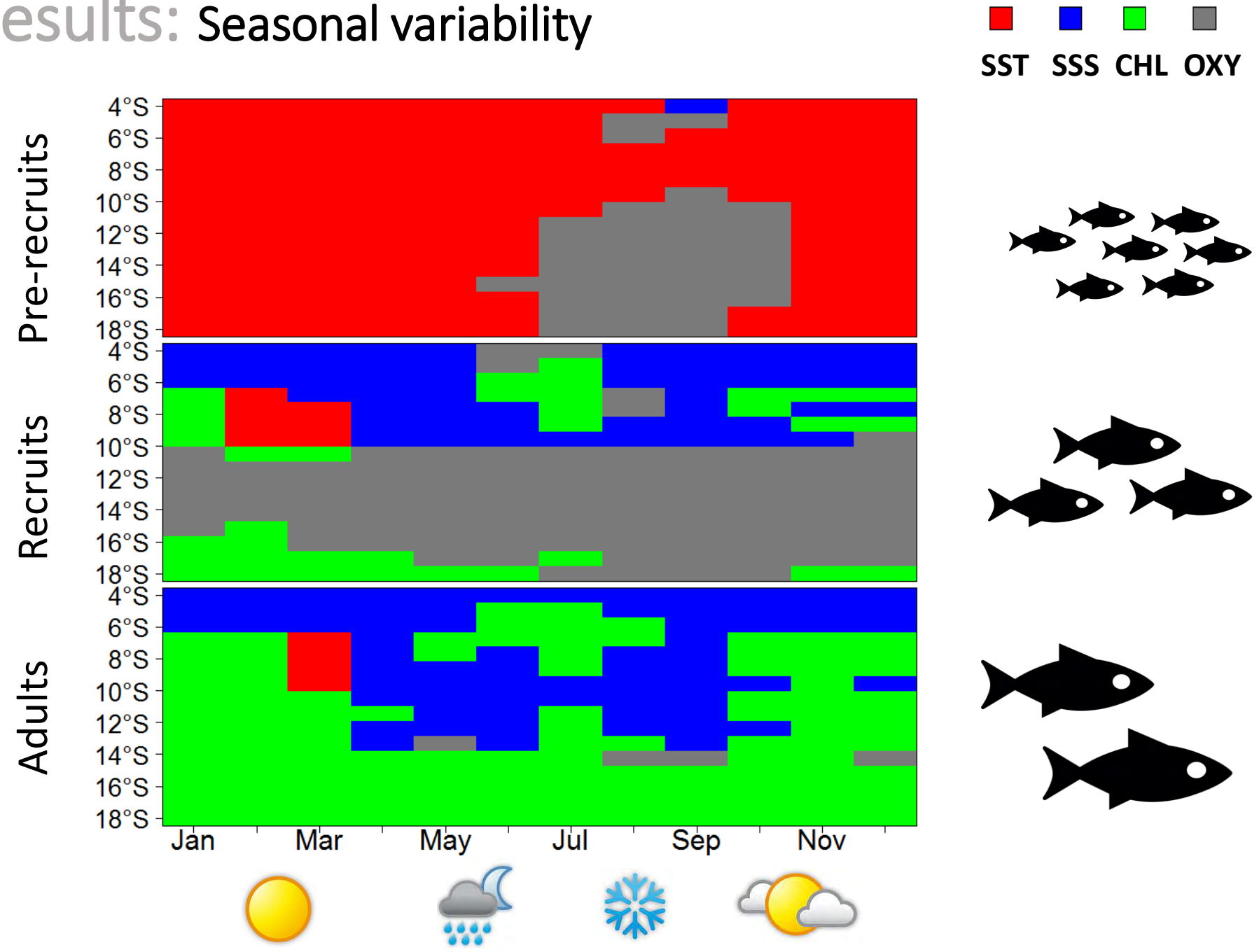
Results: Potential habitat



Results: Interannual variability



Results: Seasonal variability



Conclusions

- Each developmental stage of anchovy has different tolerances to the environmental variables considered.
- The potential habitat of pre-recruits is more coastal than recruits and adults.
- The main limiting environmental factors for the distribution of Peruvian anchovy show an important seasonal, interanual and spatial variability.
- Despite temporal and spatial variability, the main limiting factor are:
  - Pre-recruits: SST
  - Recruits: CL and OXI
  - Adults: CL

Perspectives

- Improve the estimation of tolerance ranges for environmental variables using in-situ data.
- We need to do simulations with this model including more environmental variables.
- We have to include the size of the fish as a variable in the model with the purpose of having a classification of new stages of development in function of the environmental tolerance.

Thank you!!!!

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