Modelling the habitat of anchovy (*E. ringens*) between 2007 - 2016 off the coast of the Southeast Pacific.

Carolina B. Lang A., Álvaro Saavedra G., Úrsula Cifuentes O., Jorge Castillo P. & Jaime Letelier O.

IFOP

Drivers of dynamics of small pelagic fish resources International Symposium
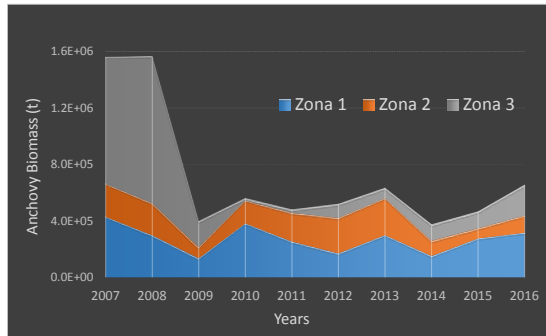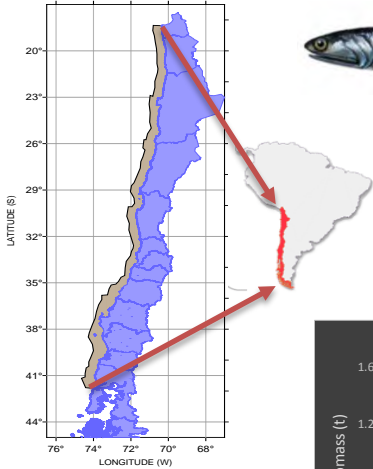
March 6-11, 2017.

Victoria, BC, Canadá.

Anchoveta
(*Engraulis ringens*)

The anchovy is distributed along the Humboldt current in the East coast of the South Pacific (4°-41° S). In Chile its distribution in the Upwelling Ecosystem is restricted to the coast until 40 mn, Covering a wide area from the northern limit (18°22' S) to 41° S.

Anchovy has shown a high variability in their biomass, whose fluctuations are associated, among others, with seasonal and interannual changes in the environmental factors.

MEI
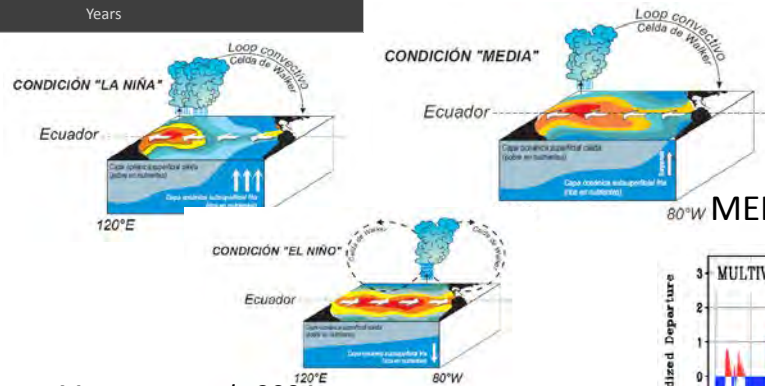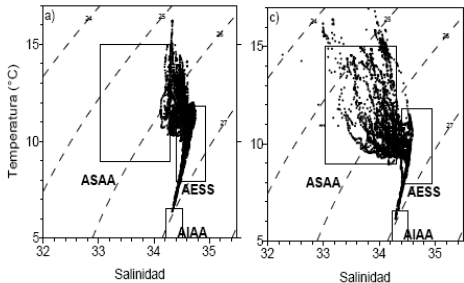
Maturana *et al.*, 2004
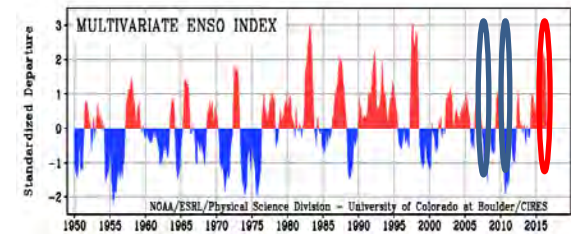
Seasonal & geographic variability

Interannual variability

(NOAA, 2017)

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The functional relationships between anchovy and the environmental conditions are generally non-linear (Maury,2001). Generalized Additive Models (GAMs, Hastie y Tibshirani 1990) is a semi-parametric and flexible method that through smoothed functions (Spline) allows to determine the shape of the relationship between the response and Environmental predictors (Swartzman,1997), without needing to specify the form of that relationship.

Response Variable

Acoustic data of Anchovy

(Presence (1) / Abscense (0))

ZONE 1 (18°25'-24° S)
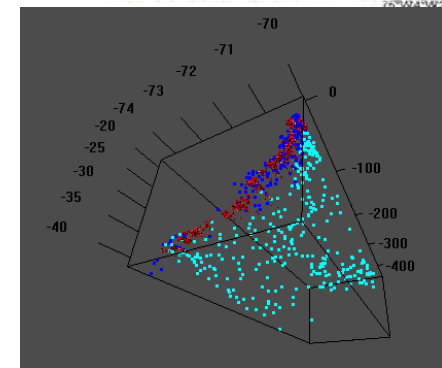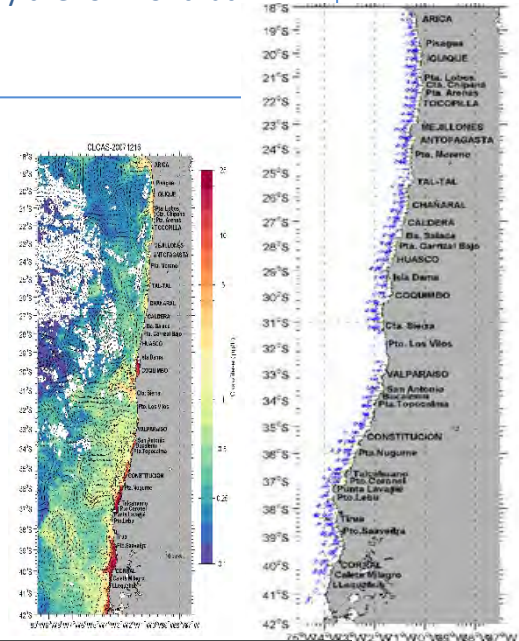
ZONE 2 (25°-31 30' S)

ZONE 3 (32°40'-41°40' S

Explanatory Variables
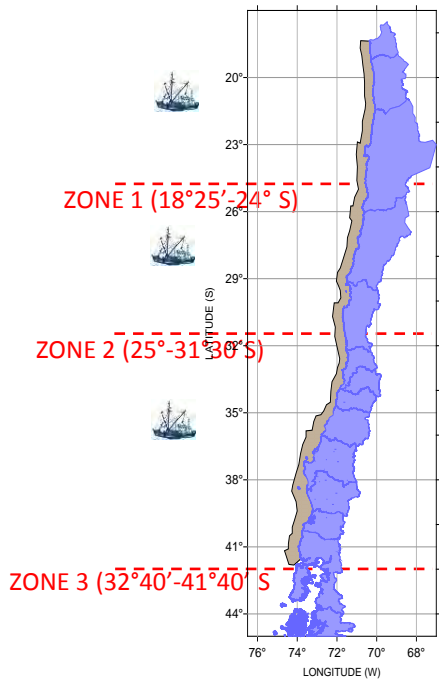
Oceanographic = profiles

Temperature (°C)
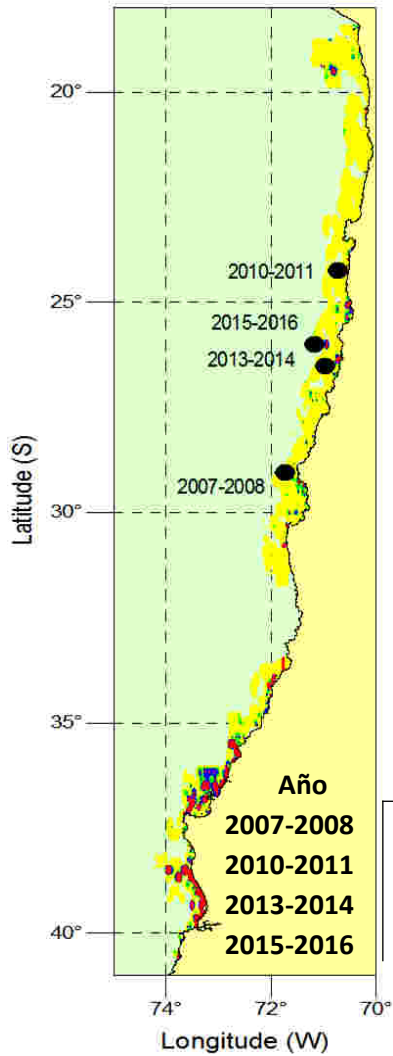Salinity (psu)
Density (sigma-t)
DO (ml/l)

Satellite = Information

Surface gradient (tem, den)
Chlo-a
Geostrofica (vorticity & magnitude)

Depth mínimum oxygen (DMO)
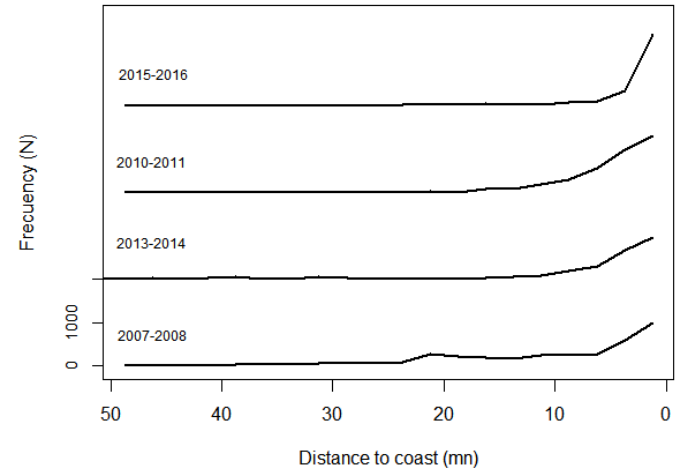Depth isotherm 15°C (DI15)

Spatial Distribution

Distance to coast

Bathymetry
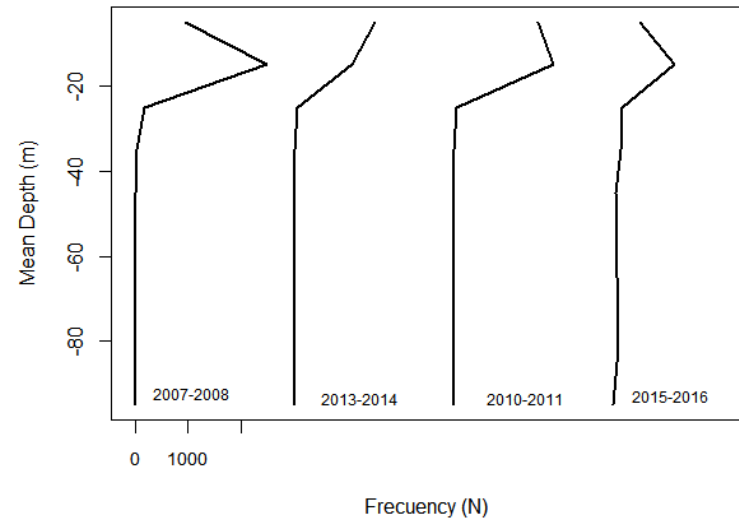
Año	Max distance (mn)
2007-2008	40.38
2010-2011	50.3
2013-2014	27.94
2015-2016	36.98

Año	Max Depth (m)
2007-2008	44.5
2010-2011	39.5
2013-2014	55
2015-2016	99

Año	CGx	CGy	Inercia
2007-2008	-71.74	-29.06	60.88
2010-2011	-70.73	-24.23	15.73
2013-2014	-70.97	-26.51	25.38
2015-2016	-71.17	-26.00	58.17

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North Zone

Explanatory Var.	Pr(>F)	Pseudo R2	Histograma Aporte variable	AIC
Chloropyll	< 2.2E-16	10.46		31482.19
Temperature	< 2.2E-16	19.44		28335.78
Depth.iso15	< 2.2E-16	23.88		26784.32
Salinity	< 2.2E-16	25.77		26125.47
Sal. Grad	< 2.2E-16	27.22		25625.06
Oxygen	< 2.2E-16	28.27		25262.60

South Zone

Explanatory Var.	Pr(>F)	Pseudo R2	Histograma Aporte variable	AIC
Salinity	1.04E-11	6.65027		11699.71
Dissolved Oxygen	<2,2E-16	17.18676		10388.28
Chlorophyll	<2,2E-16	21.94821		9800.02
Depth min. Oxygen	<2,2E-16	25.47505		9366.38
Temperature Grad.	2.64E-11	29.04684		8927.10
Density Grad.	1.95E-05	29.23120		8912.01

Pseudo coefficient of determination
(Pseudo - r²)

1-residual deviance

nulll deviance

(Swartzman *et al*, 1992)
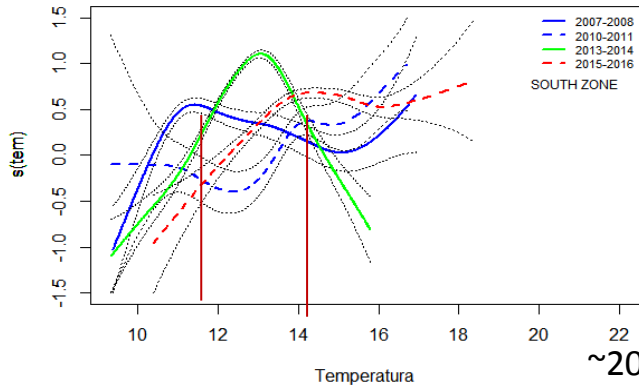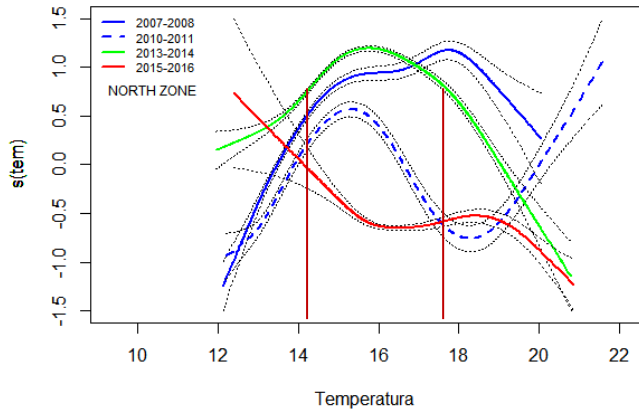
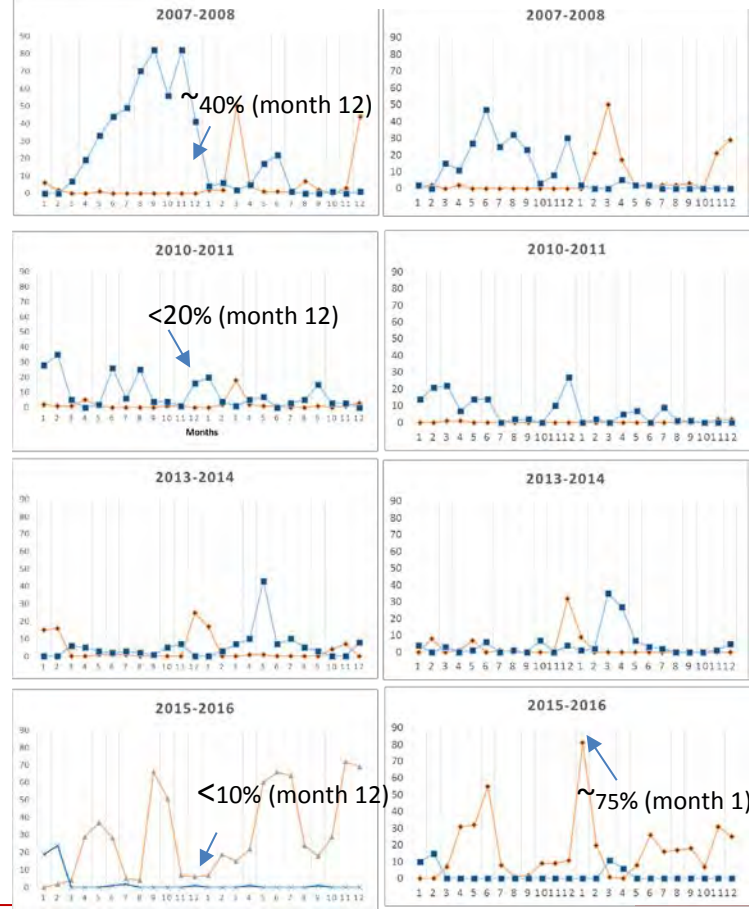Introduction Methodology Results Conclusion

RESULTS...

But, what does the shape of models say?

LAI(Local Anomaly Index)

~40% (month 12)

<20% (month 12)

<10% (month 12)

~75% (month 1)

~20%
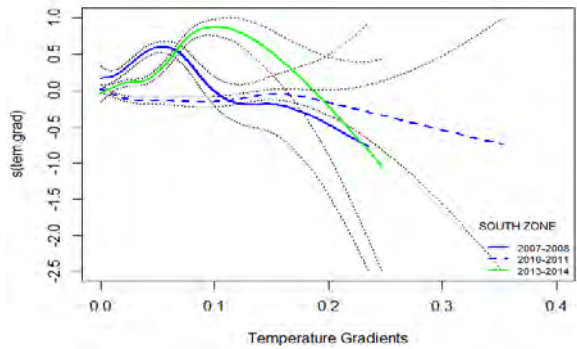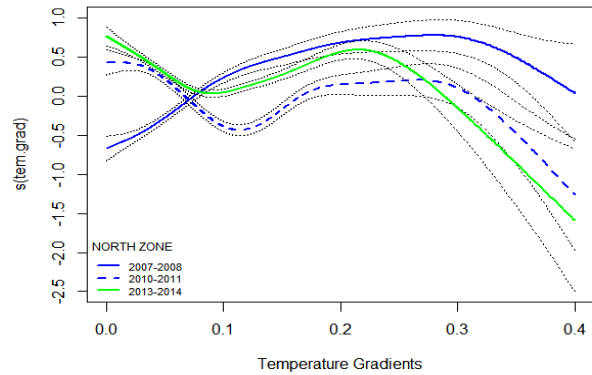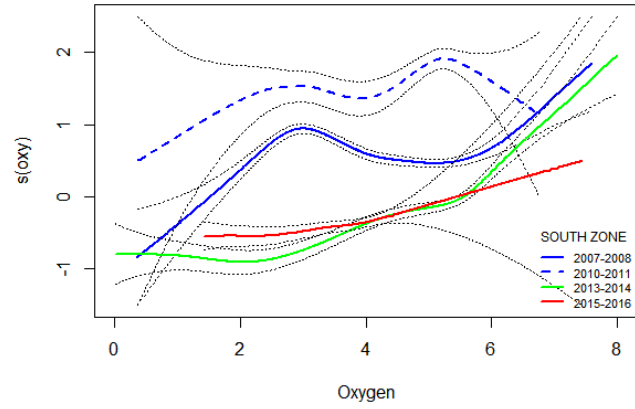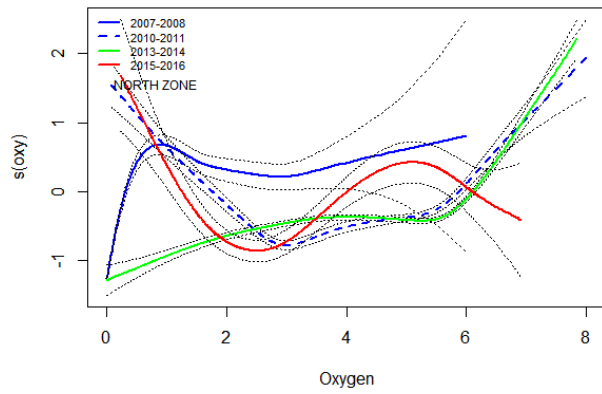
Percentage of Cells (>1°C</red & 1°C</blue)
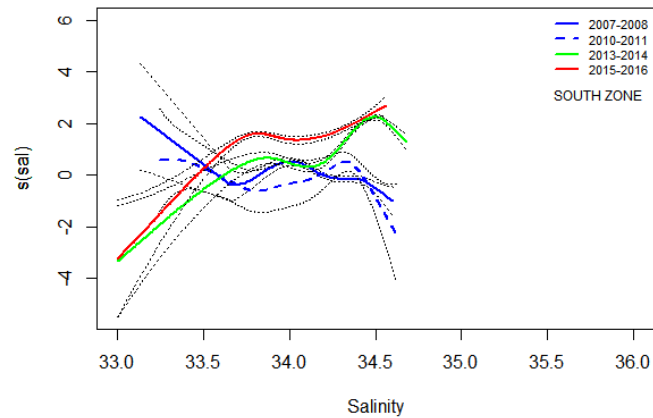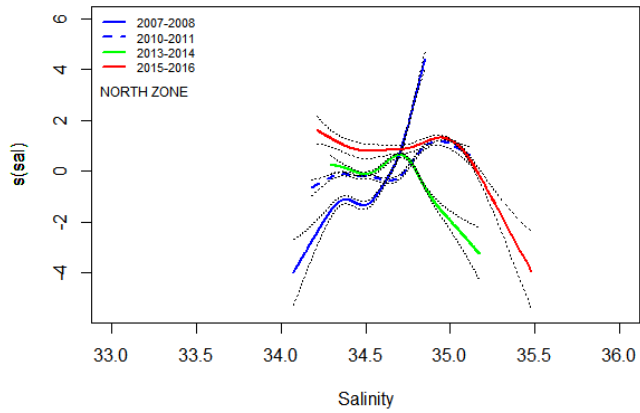
MONTHS

Introduction — Methodology — Results — Conclusion

But, what does the shape of models sav?

But, what does the shape of models say?

CONCLUSIONS...

The anchovy´s response, during la Niña and El niño were related with positive and negative relationships, also showing an optimal environmental window, with changes in the optimus range of distribution. This differences may also be associated with the area covered by anomalies during cold and warm periods.

Anchovy showed diferences in the preference range between north and south zone, in the north dominated warmer waters, less oxygen and higher salinity, while in the south anchovy was distributed in cold waters, more oxygen and less salinity by de presence of rivers. The temperatura gradients were more intense in the north, denoting fronts where anchovy has more probability of presence.

The Gravity center was concentrated in the north zone for all periods evaluated (<30°S).

Thanks for your Attention…