VIZCAINO BAY AS A TRANSITIONAL AREA FOR FISH LARVAE COMMUNITIES IN THE SOUTHERN CALIFORNIA CURRENT (1997-2014)

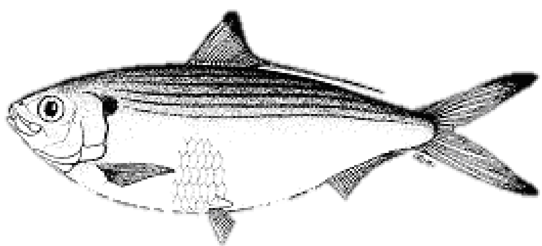
Jiménez Rosenberg, S. Patricia

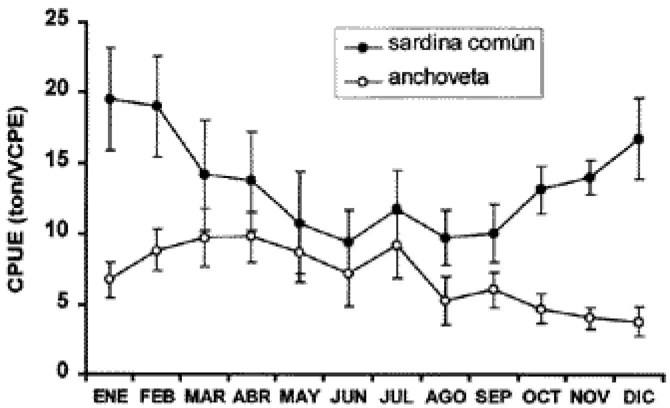
Aceves Medina, Gerardo

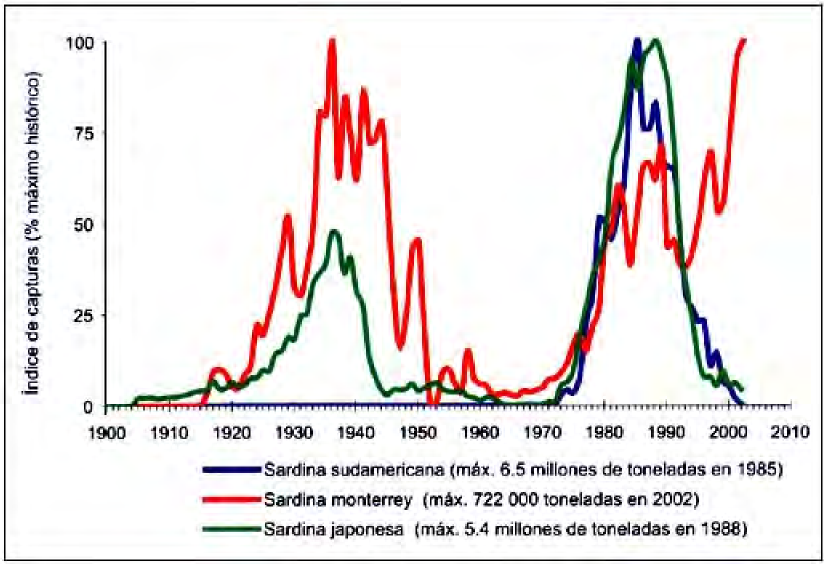
CICIMAR-IPN

INTRODUCTION

How climate affects marine ecosystems?







Upwelling
Eddies
Fronts
Water masses
Currents
ENSO

Indicator species

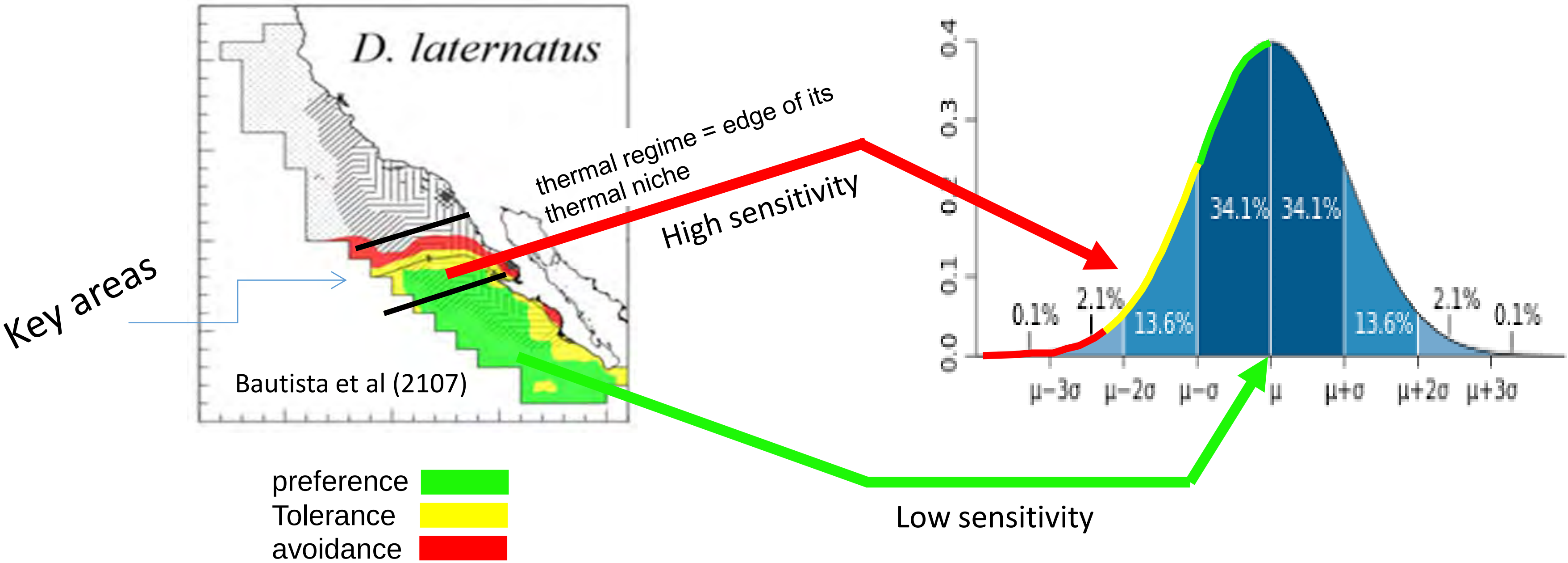
species highly sensitive to environmental changes

denotes either the composition or condition of a particular habitat, community or ecosystem

Indicator species

Ecological niche

Tolerance range of a species when several factors are taken together



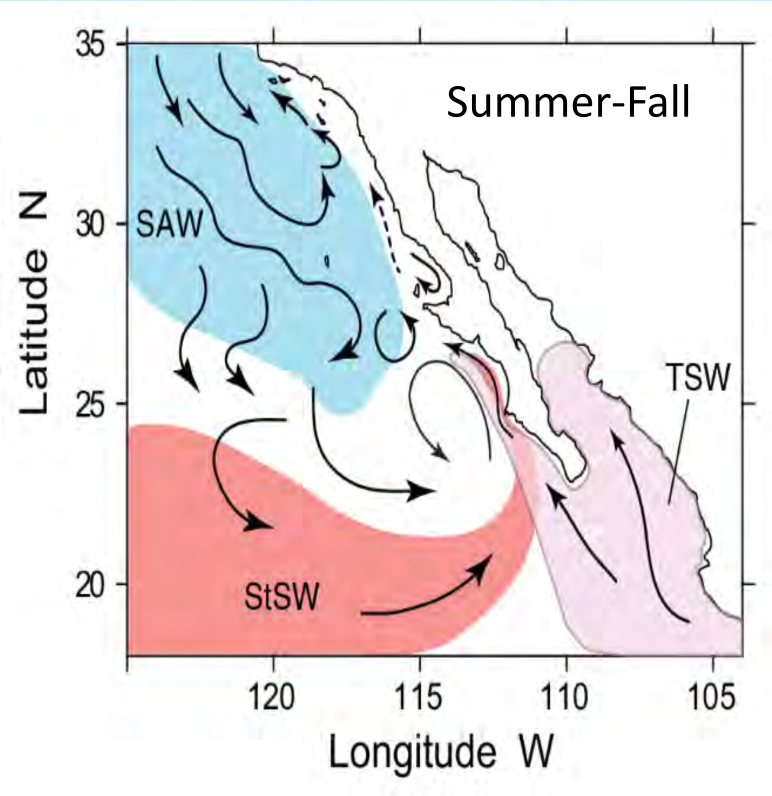
egg and larval stages critical in fish life cycles

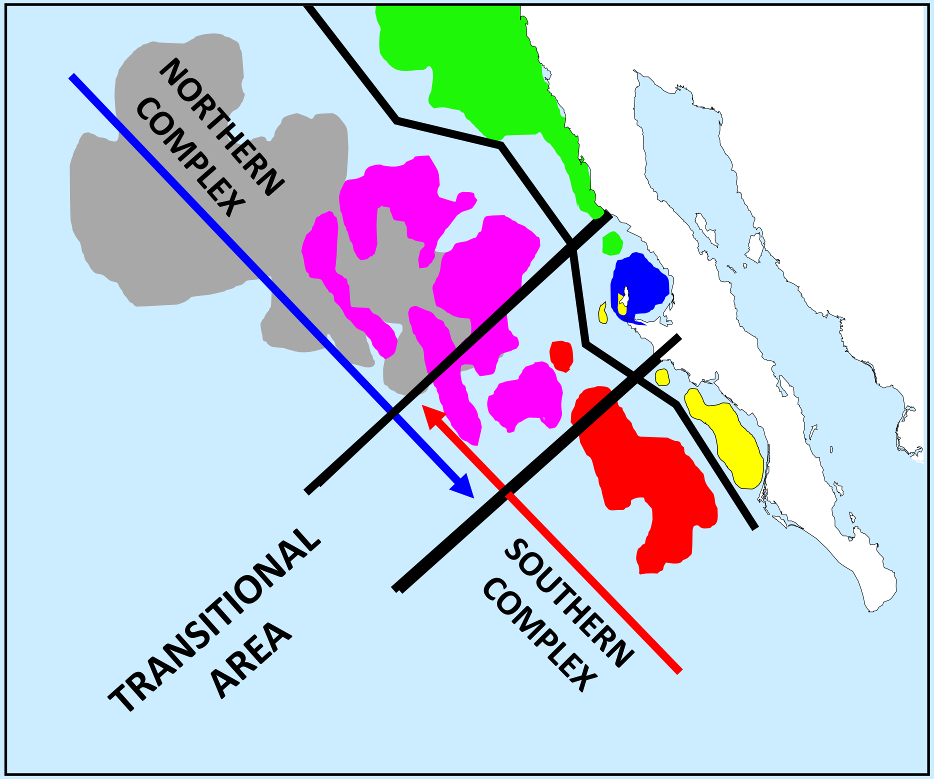
Low displacement capacity

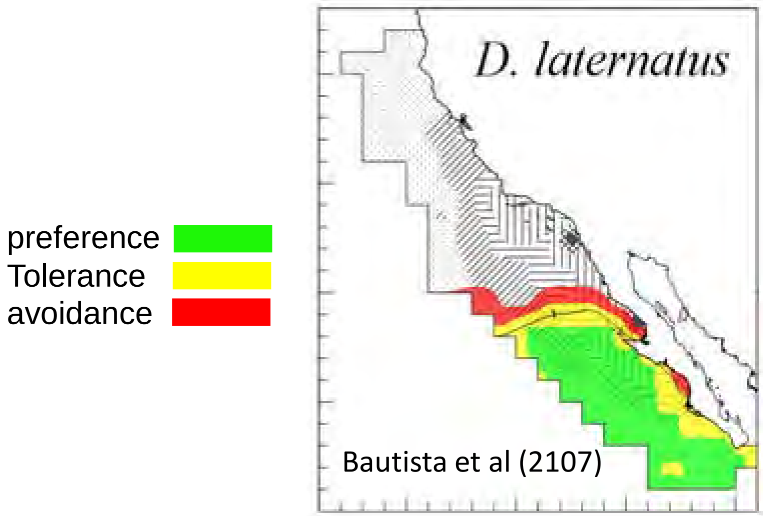
Highest mortality rates

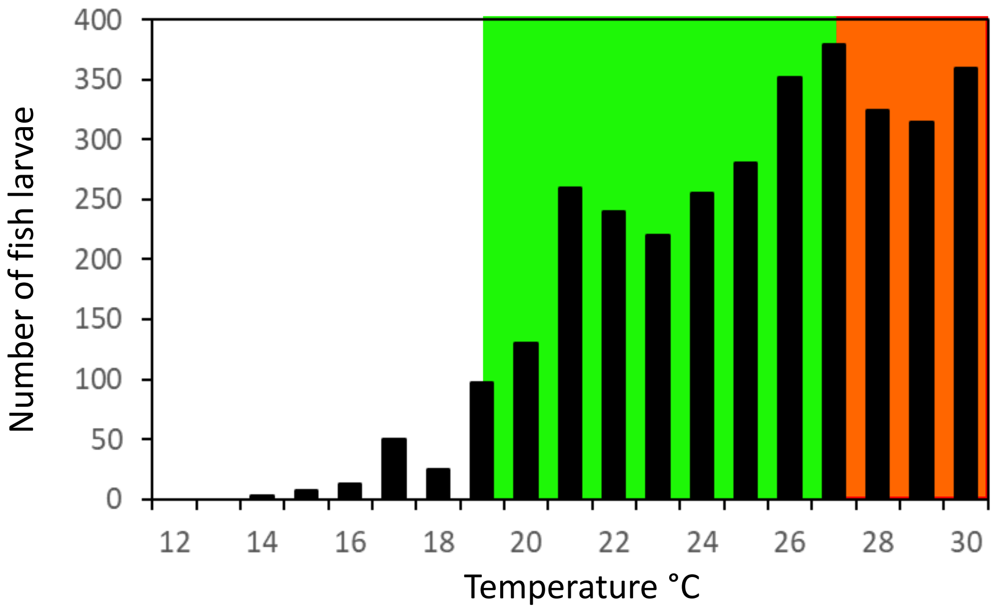
Fish larvae assemblages

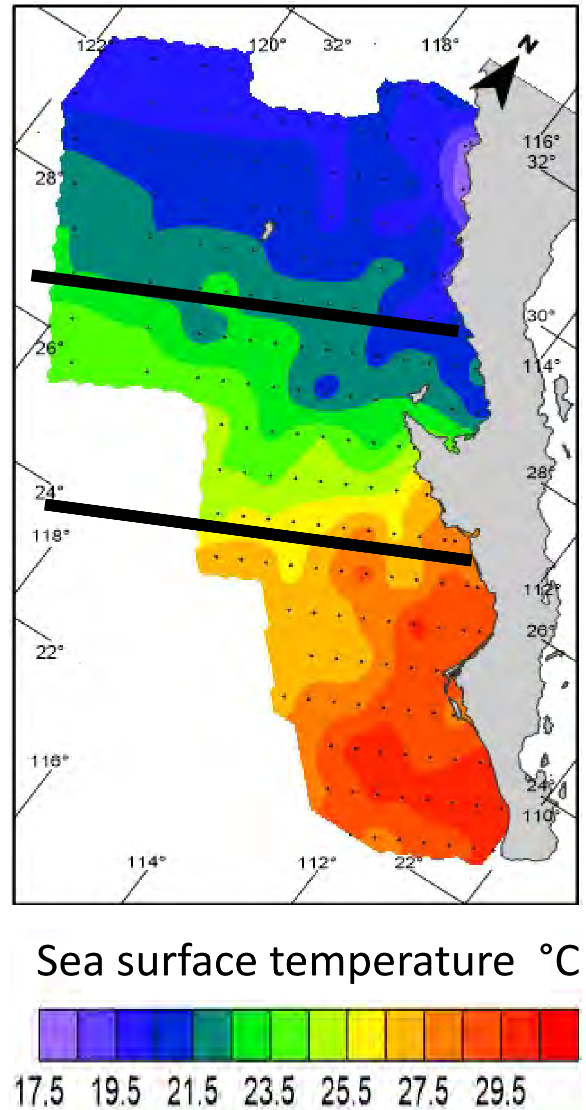
(California Current, 1951- 2015)






D. laternatus
preference
Tolerance
avoidance
Bautista et al (2107)


Number of fish larvae
400
350
300
250
200
150
100
50
0
12
14
16
18
20
22
24
26
28
30
Temperature °C

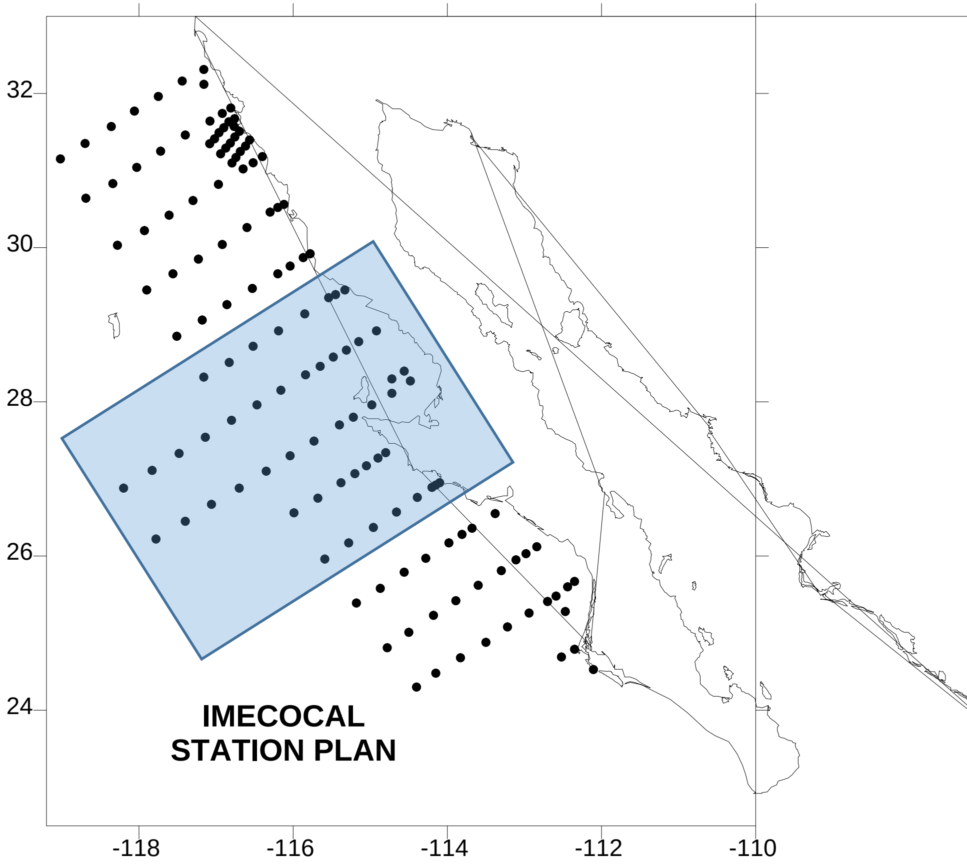

Sea surface temperature °C
17.5
19.5
21.5
23.5
25.5
27.5
29.5

¿ARE THERE INDICATOR SPECIES OF INTERANUAL CLIMATE CHANGE IN THE VIZCAINO BAY AREA?

IMECOCAL PROGRAM

Investigaciones Mexicanas de la Corriente de California

- 60 surveys from 1997 to 2013
- CalCOFI sampling procedures
- CTD and Bongo



IMECOCAL 1997-2013
(60 surveys)

Winter	16
Spring	16
Summer	14
Fall	14

Taxa	491
families	82
genus	99
species	310

DATABASE

1114 data for each environmental variable

Main Matrix
Fish larvae abundance
(80% for each survey)

Env. Matrix
Sea surface temperature (SST)
Sea surface salinity (Sal)
Zooplankton volume (ZV)

Transformation with CUSUM (Cumulative Sums)
sequential analysis technique

$$C = \sum x_j - \mu / \sigma$$

MEI Index (not transformed) obtained from
https://www.esrl.noaa.gov/psd/enso/mei/

Correlation: species *vs* environmental variables

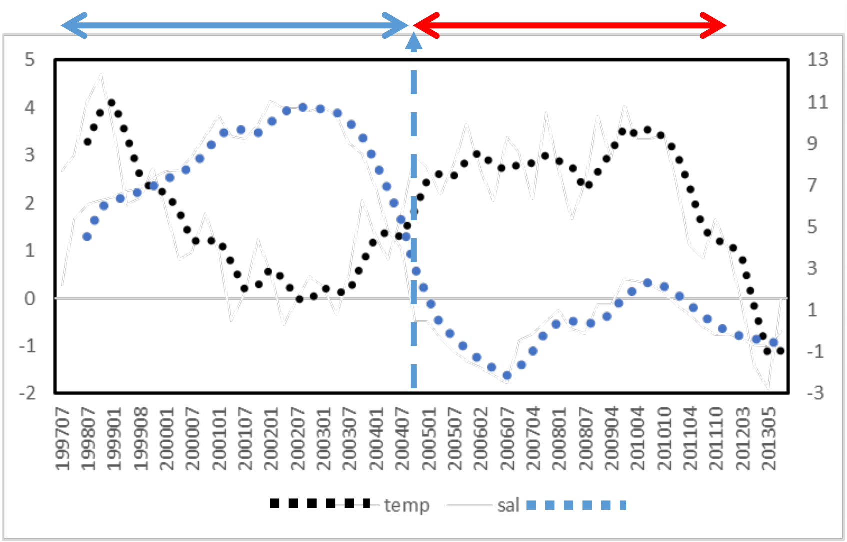
CANONICAL CORRESPONDENCE ANALYSIS

AXIS SUMMARY STATISTICS
Number of canonical axes: 3
Total variance ("inertia") in the species data: 3.8982

	Axis 1	Axis 2	Axis 3
Eigenvalue Variance in species data	0.324	0.178	0.054
% of variance explained	8.3	4.6	1.4
Cumulative % explained	8.3	12.9	14.3
Pearson Correlation, Spp-Envt*	0.773	0.665	0.513

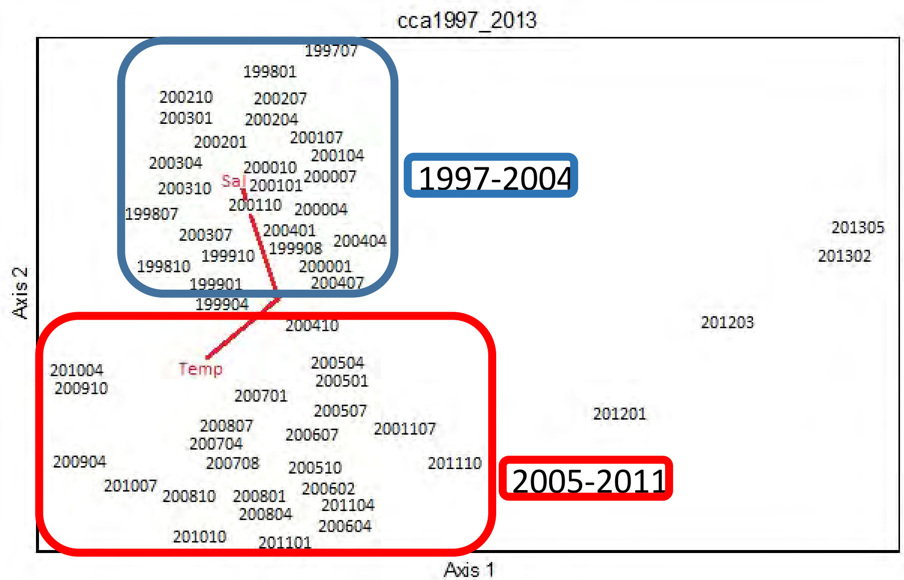
Variable	Axis 1	Axis 2	Axis 3
1 MEI	-0.093	0.396	0.913
2 temp CUSUM	-0.936	-0.182	-0.043
3 sal CUSUM	-0.898	0.622	-0.506
4 VZ CUSUM	0.583	0.351	-0.065

Trends in Temperature and Salinity 1997- 2013

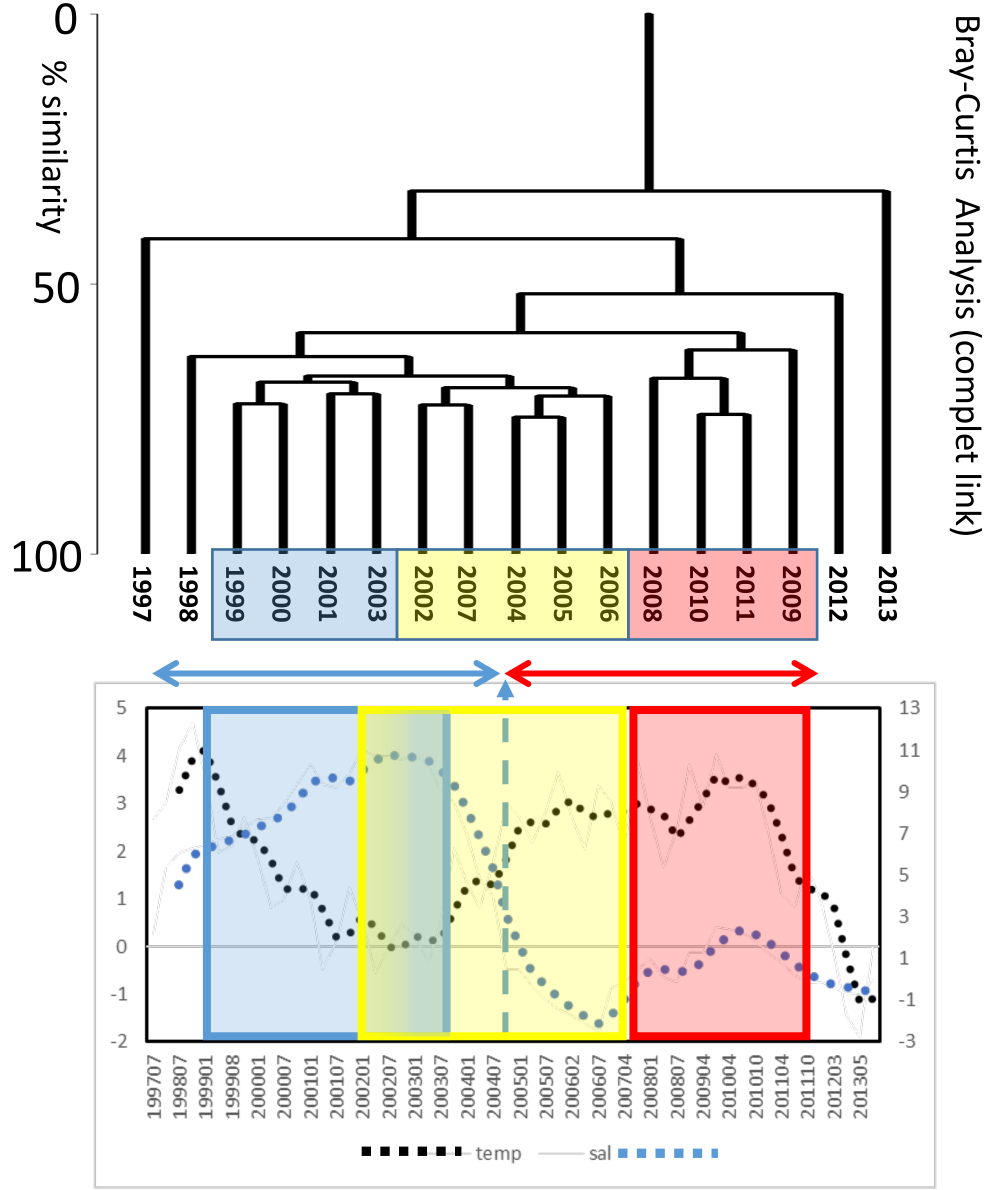


CUSUM

CANONICAL CORRESPONDENCE ANALYSIS



CLUSTER ANALYSIS 1997-2013

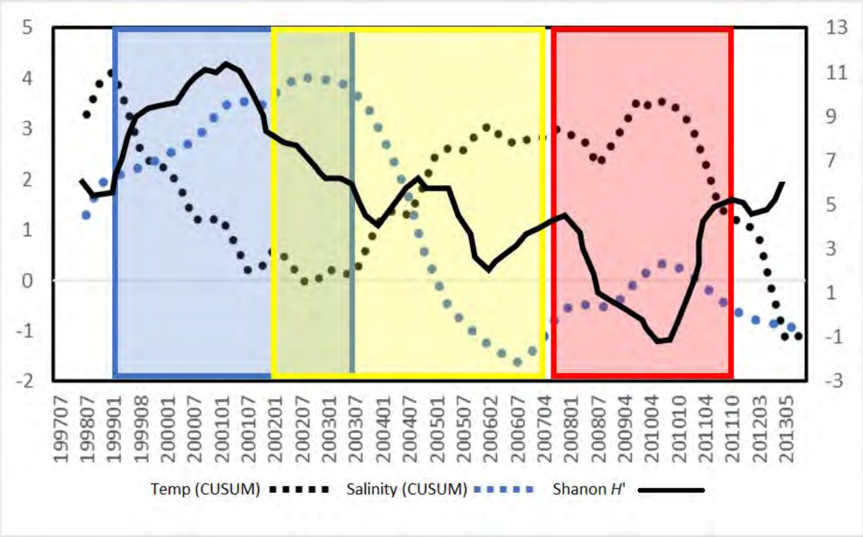


Mesopelagic → Demersal

T

Most diverse → Most diverse

Most abundant → Most abundant



	1993-2003	2002-2007	2008-2011
Dominant species (ab>85%)	16 spp	16 spp	13 spp
Mesopelagics %	56	44	31
Epipelagics %	25	25	15
Demersal %	19	31	54

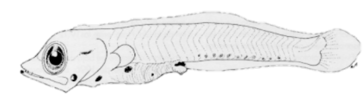
	1998-2003		2002-2007		2008-2011
species richness (avg/year)	93 spp		96 spp		92 spp
species	%		%		%
V. lucetia	44.27	*V. lucetia*	29.52	*S. lucioceps*	34.84
T. mexicanus	12.76	*S. lucioceps*	15.27	*V. lucetia*	11.30
D. laternatus	5.24	*T. mexicanus*	12.48	*S. japonicus*	10.40
S. sagax	4.21	*D. laternatus*	7.65	*T. mexicanus*	8.94
S. lucioceps	3.79	*E. mordax*	7.45	*E. mordax*	6.09
E. mordax	2.74	*B. wesethi*	2.80	*D. laternatus*	5.29
B. wesethi	2.51	*S sagax*	2.07	*S. atricaudus*	1.61
M. productus	1.72	*C. signata*	1.21	*C. sordidus*	1.45
L. stilbius	1.50	*T. symmetricus*	1.15	*L. negropinna*	1.34
C. townsendi	1.15	*S. japonicus*	1.13	*P. stephanophrys*	1.25
C. signata	1.13	*L. stilbius*	1.03	*S. dallii*	1.10
S. japonicus	1.10	*S. macdonaldi*	0.84	*B. wesethi*	1.06
N. resplendens	1.08	*L. negropinna*	0.77	*C. fragilis*	0.85
T. symmetricus	1.01	*C. fragilis*	0.73		
C. acclinidens	0.72	*C. townsendi*	0.71		
Sebastes sp. 1	0.70	*C. sordidus*	0.67		
Total relative abundance (%)	85.63		85.45		85.51

Most abundant, most frequent and easy identification

Vinciguerria lucetia Mesopelagic

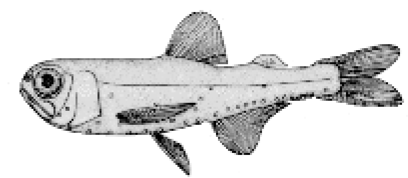
Lightfish

Diogenichthys laternatus Mesopelagic

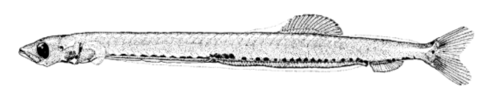


Lanternfish

Diogenichthys atlanticus Mesopelagic

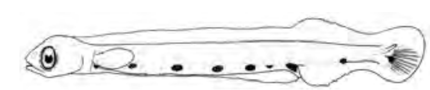


Sardinops sagax Epipelagic

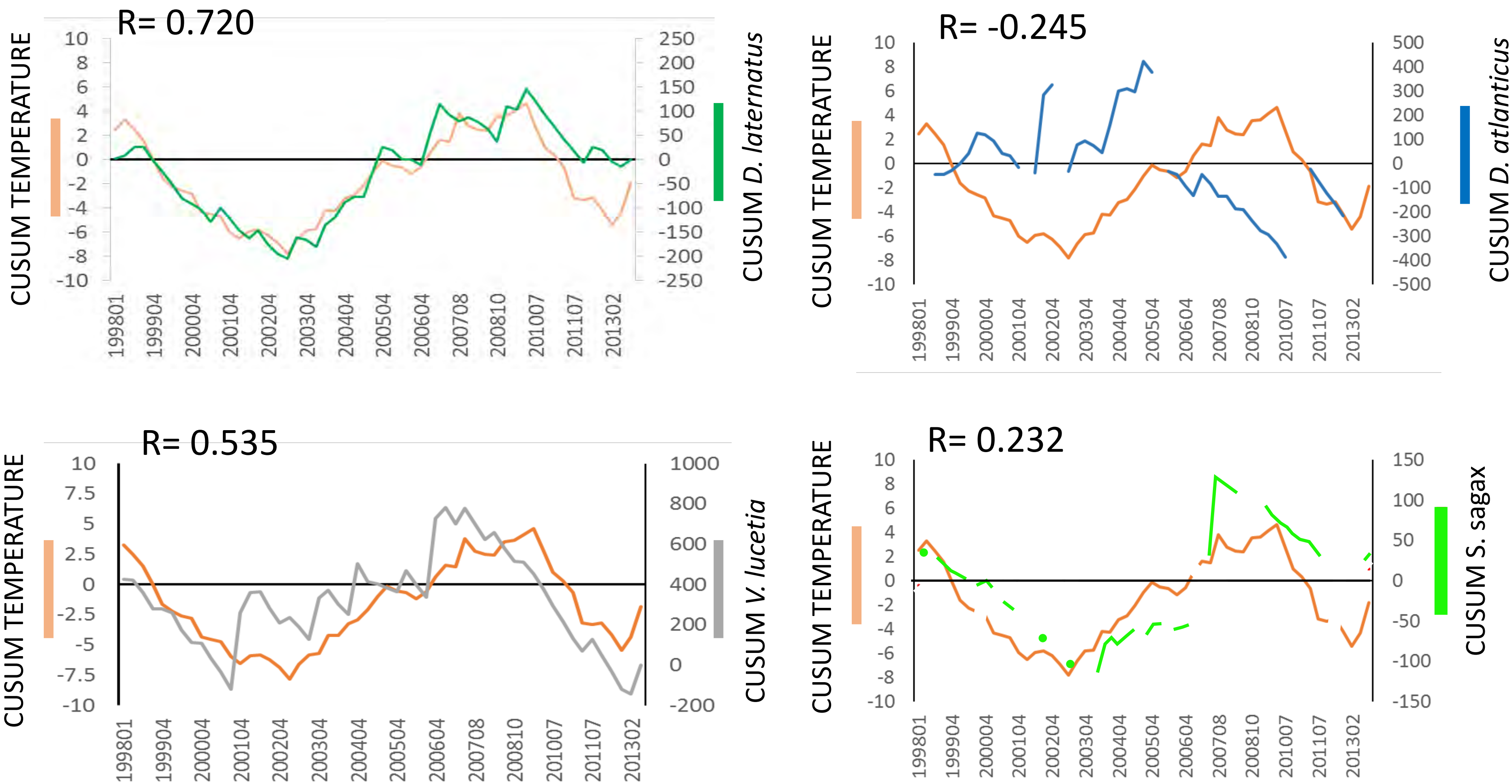


Pacific Sardine

Synodus lucioceps Demersal



Lizardfish



R= 0.720
CUSUM TEMPERATURE
CUSUM D. laternatus
R= -0.245
CUSUM TEMPERATURE
CUSUM D. atlanticus
R= 0.535
CUSUM TEMPERATURE
CUSUM V. lucetia
R= 0.232
CUSUM TEMPERATURE
CUSUM S. sagax
199801
199904
200004
200104
200204
200304
200404
200504
200604
200708
200810
201007
201107
201302

V. lucetia and *D. laternatus* are indicator species of interannual changes in the oceanic ecosystem off Vizcaino Bay

The transition area off Vizcaino Bay is a key area to study the effects of climate change

Abundance trends in the past 16 years show periods of 5 years approx. associated to changes of cooling and warming of the sea surface temperature.

The pelagic ecosystem went from a cold to a warm trend, which denotes changes from a more diverse community dominated by mesopelagic species to an less diverse ecosystem dominated by demersal species.

How are the tendencies north and south of Vizcaino Bay?

How are the tendencies when integrating the CALCOFI 1951-1984 database?