ACOUSTIC AND BIO-ECOLOGICAL OBSERVATIONS OF MESOPELAGIC FISHES (*VINCIGUERRIA LUCETIA* AND MYCTOPHIDS) IN PERUVIAN HUMBOLDT CURRENT

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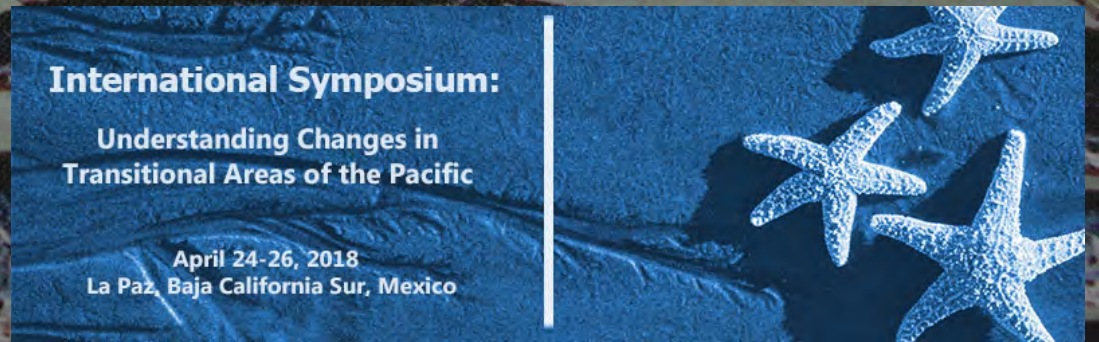
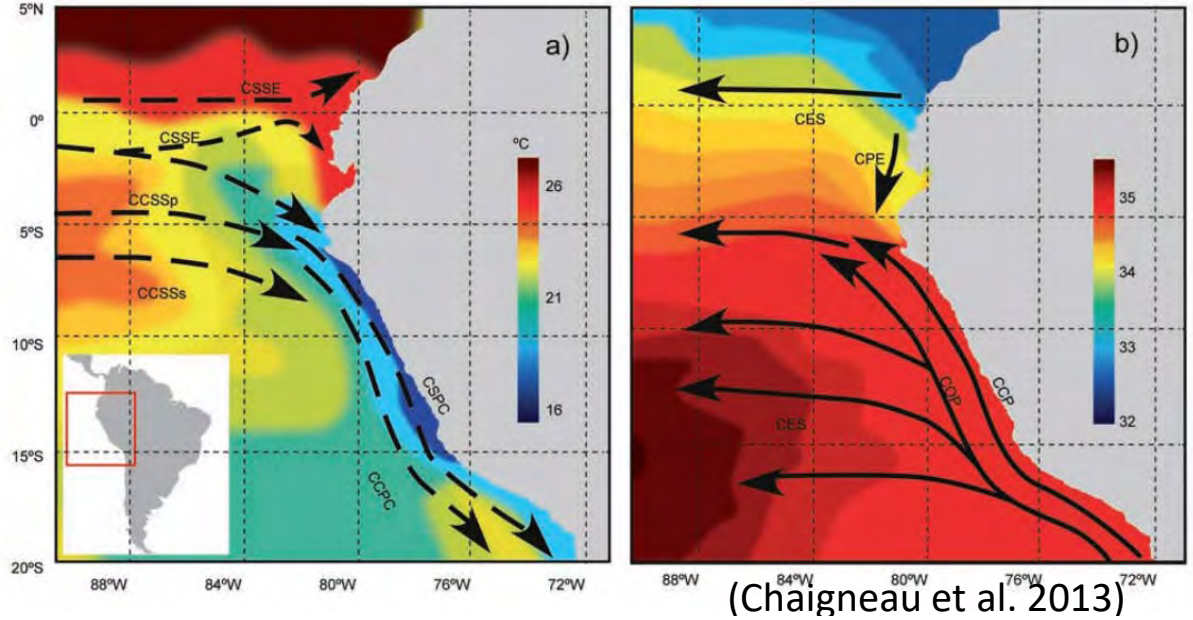
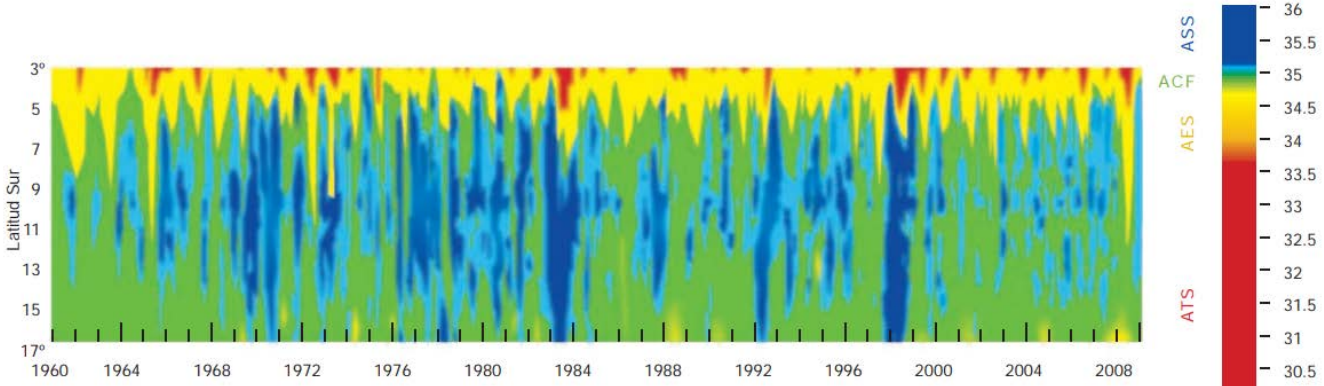


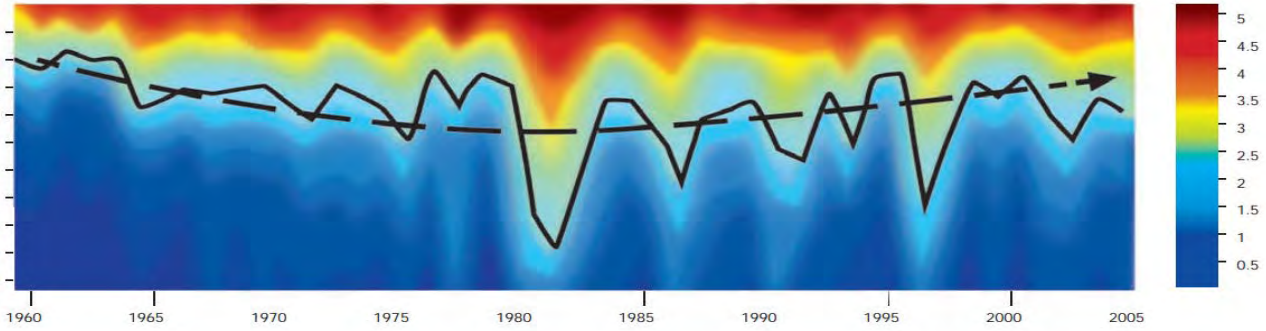
Oceanographic features



(Chaigneau et al. 2013)



(Moron, 2011)

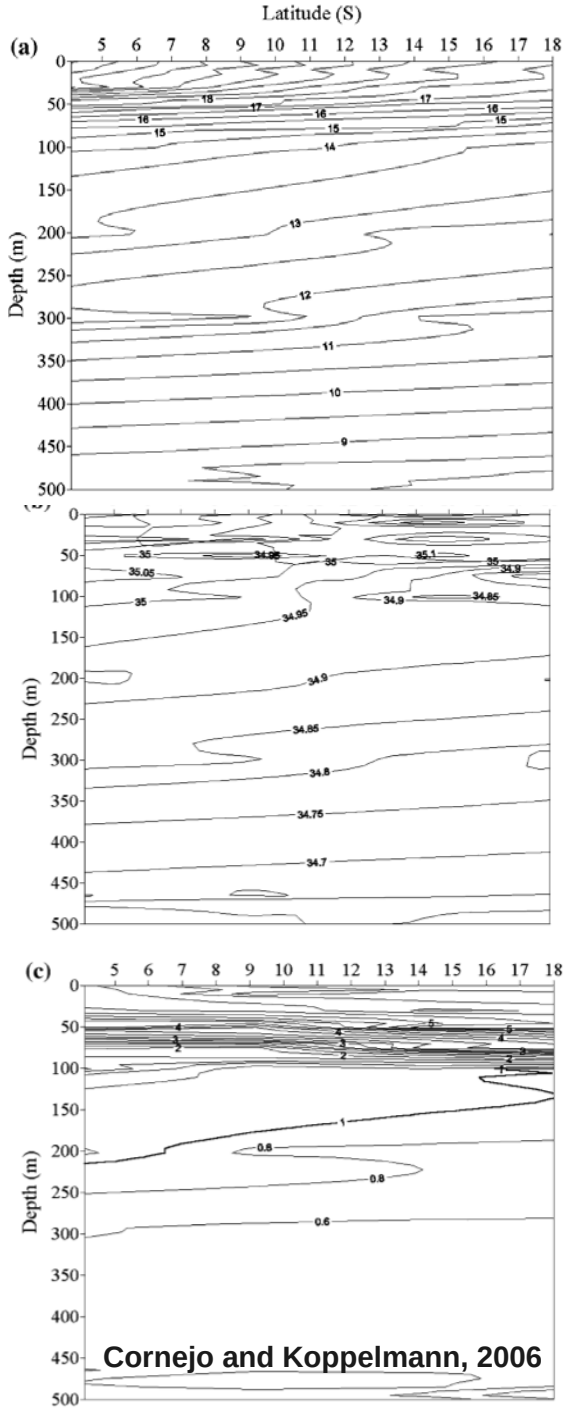


Climate variation seasonal, interanual, interdecadal

Temperature/Salinity
Equatorial and poleward flowing water
<15°C upwelling waters

Water masses
Cold CCW
Warm SSW
Deep SEW

Oxygen
OMZ (< 1ml/L)
Sloping upward north to south



Cornejo and Koppelmann, 2006

Introduction

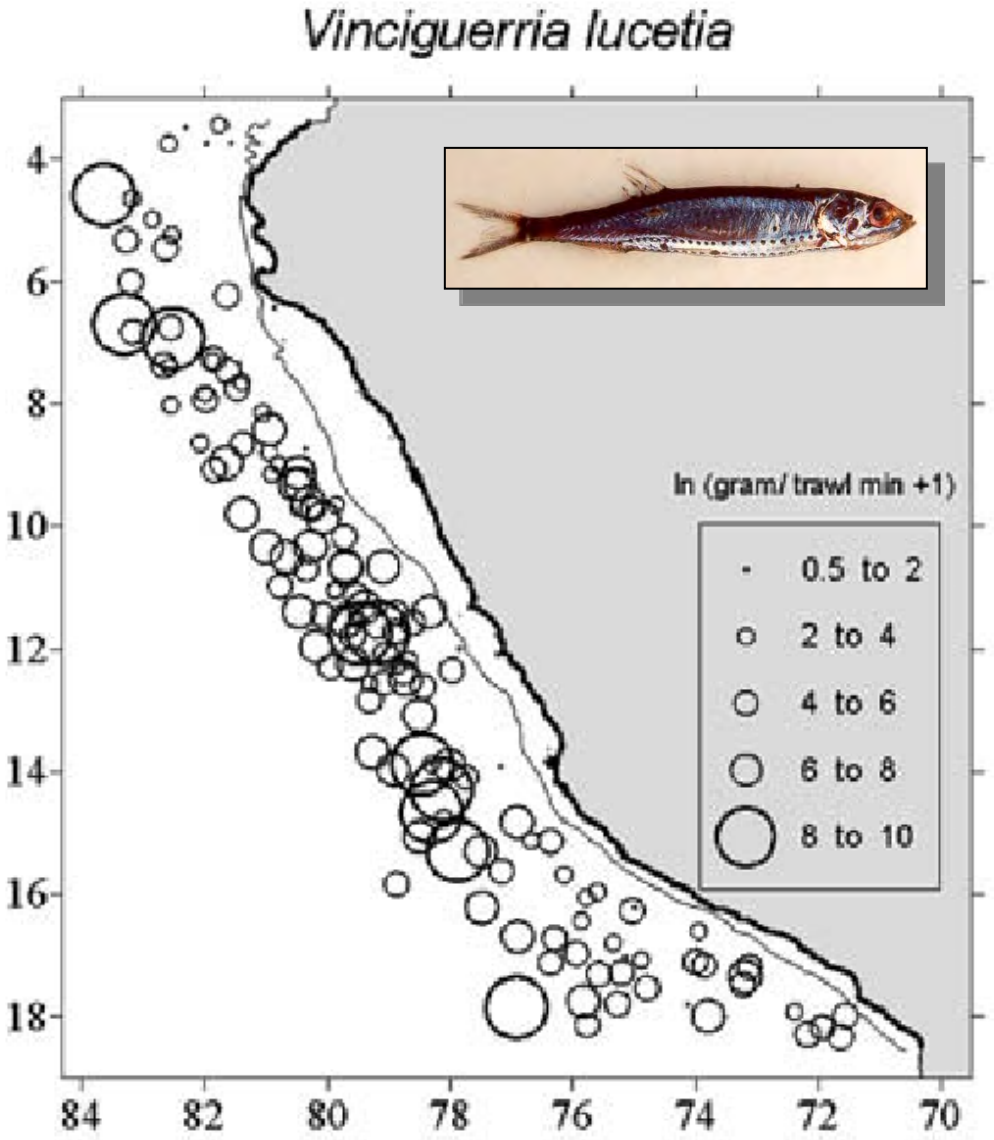
Mesopelagic fishes are an important component in oceanic ecosystems and transitional áreas **(Ahlstrom et al.1976, Mc Clatchie and Dunford, 2003).**

Vinciguerria lucetia (VL) is one of the most abundant and sub-exploited mesopelagic resources in the world **(Cure 2013, FAO).**

Global biomass of the mesopelagic fishes is very nearly one billion tonnes **(Lam and Pauly, 2005).**

VL has been researched in Peru since the late 90's: by 20 years **(Cornejo et al 2018 in press).**

Stock has anti-cyclical behavior with Peruvian anchoveta in El Niño-La Niña events **(Ñiquen this meeting).**



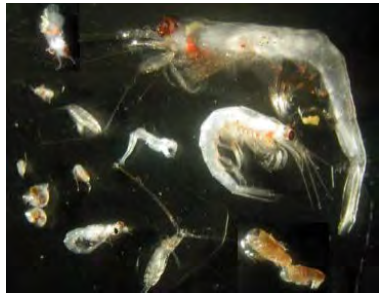
Cornejo and Koppelmann, 2006

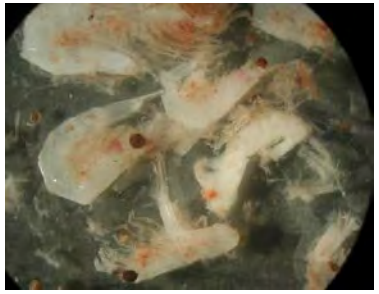
Bioecological Importance

PREY BIOMASS

Nekton

DOM+POM
Biological pump

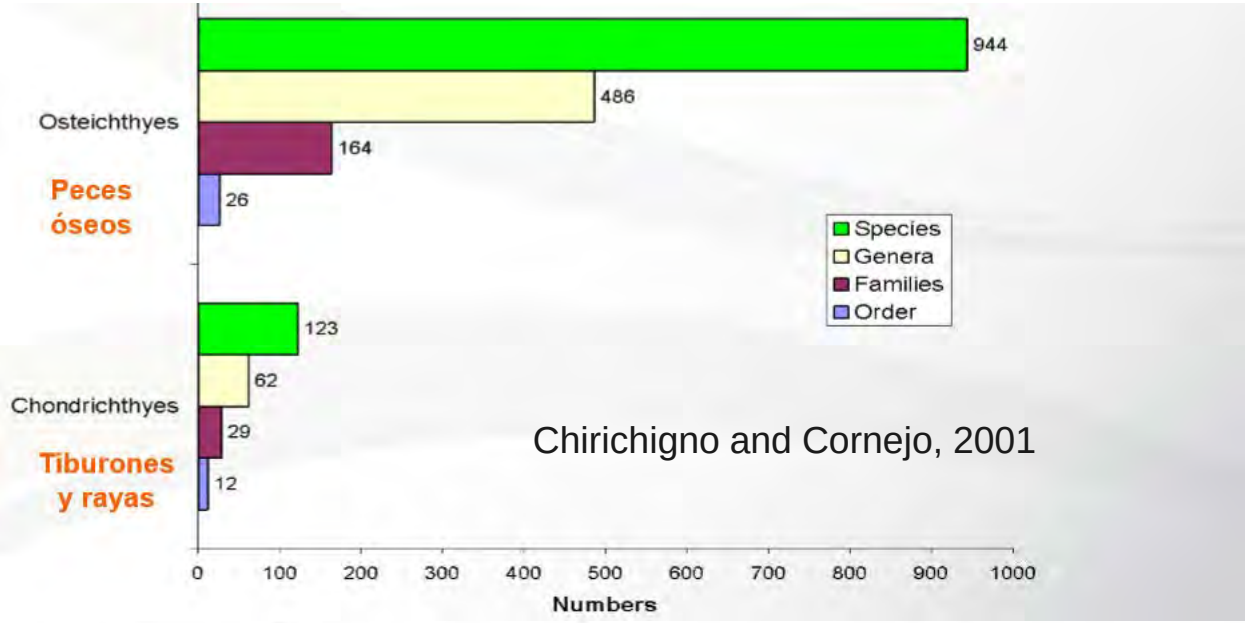




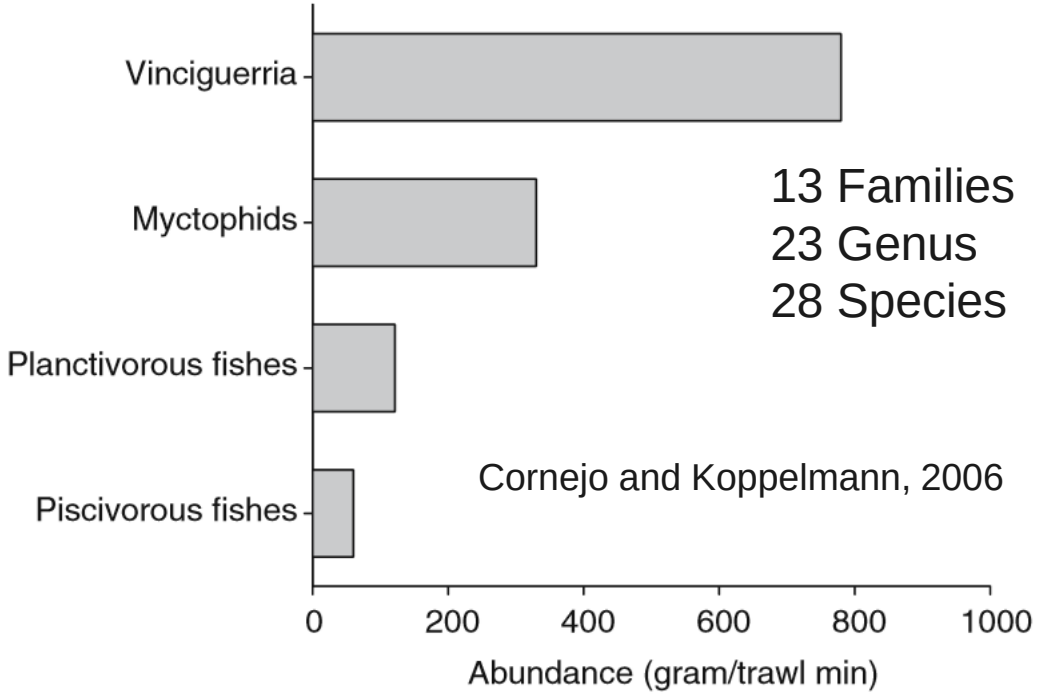
Zooplankton

PREDATOR BIOMASS

Marine fishes biodiversity off Peru



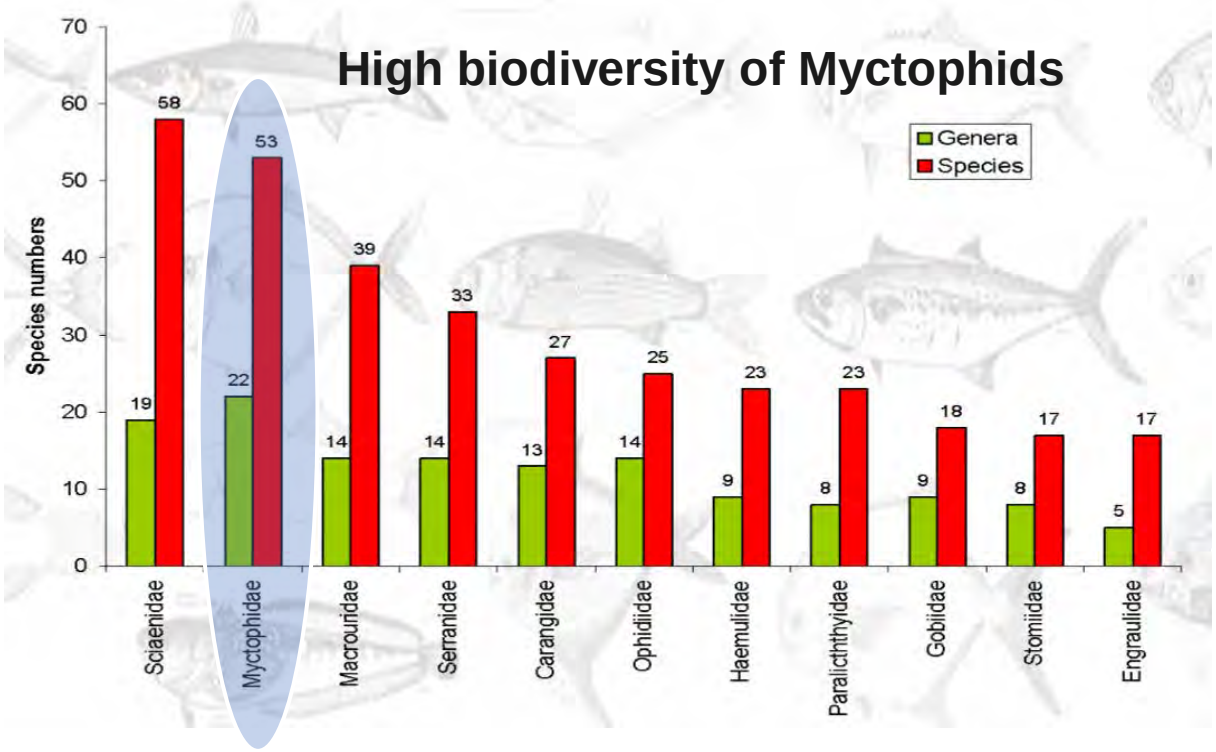
Chirichigno and Cornejo, 2001



13 Families
23 Genus
28 Species

Cornejo and Koppelmann, 2006

High biodiversity of Myctophids



Composition of Mesopelagic fishes off Peru

Order	Familiy	Species	Functional group	Total catch 169 samples (kg)	Mean abundance (g trawl min^{-1})		Relative abundance (%)
					Day	Night	
Anguilliformes	Nemichthyidae	*Nemichthys fronto*	PISCIV	0.92	1.00	5.66	0.26
	Serrivomeridae	*Serrivomer sector*	PISCIV	1.60	53.00	0.26	2.06
Osmeriformes	Bathylagidae	*Bathylagus berycoides*	PLANCT	9.52	0.00	24.65	0.95
		Leuroglossus stilbius	PLANCT	4.31	4.34	12.15	0.64
		Leuroglossus urotranus	PLANCT	29.19	0.00	96.27	3.73
Stomiiformes	Stomiidae	*Stomias* sp.	PISCIV	3.09	7.85	5.86	0.53
		Chauliodus sp.	PISCIV	0.27	5.01	0.00	0.19
	Idiacanthidae	*Idiacanthus* sp.	PISCIV	0.23	0.47	4.32	0.19
	Sternoptychidae	*Argyropelecus affinis*	PLANCT	8.83	34.45	0.96	1.37
		Sternoptyx obscura	PLANCT	0.31	1.56	0.00	0.06
	Gonostomatidae	*Gonostoma elongatum*	PLANCT	0.20	4.65	3.00	0.30
		Polymetme sp.	PISCIV	1.08	0.00	6.30	0.24
	Phosichthyidae	*Vinciguerria lucetia*	VINCI	2,449.92	722.46	836.92	60.36
Aulopiformes	Paralepididae	*Paralepis* sp.	PISCIV	1.50	0.00	6.86	0.27
	Scopelosauridae	*Scopelosaurus* sp	PISCIV	2.75	0.13	7.92	0.31
	Scopelarchidae	*Scopelarchoides nicholsi*	PISCIV	1.56	14.20	1.99	0.63
Myctophiformes	Myctophidae	*Diogenichthys laternatus*	MYCTO	238.84	34.22	127.37	6.51
		Gonichthys tenuiculum	MYCTO	0.57	0.40	4.98	0.21
		Hygophum reinhardti	MYCTO	2.93	0.00	14.31	0.55
		Hygophum proximun	MYCTO	1.26	0.00	16.37	0.63
		Lampanyctus idostigma	MYCTO	66.03	4.58	106.15	6.25
		Lampanyctus omostigma	MYCTO	63.21	24.07	144.11	4.29
		Lampanyctus sp.	MYCTO	20.27	13.54	17.51	1.20
		Myctophum aurolaternatum	MYCTO	11.15	0.00	36.84	1.43
		Myctophum nitidulum	MYCTO	7.47	1.47	66.34	2.62
		Triphoturus oculeus	MYCTO	16.61	20.10	27.82	1.85
Stephanoberyciformes	Melamphaeidae	*Melamphaes* sp.	PLANCT	6.77	8.75	37.42	1.79
		Scopeloberyx sp.	PLANCT	1.44	11.30	3.59	0.58
			Sum	2,951.84	967.56	1,615.95	100.00

MYCTO myctophids, *PISCIV* piscivorous fishes, *PLANCT* planctivorous fishes, *VINCI* Vinciguerria

Vinciguerria lucetia is dominant species of oceanic waters

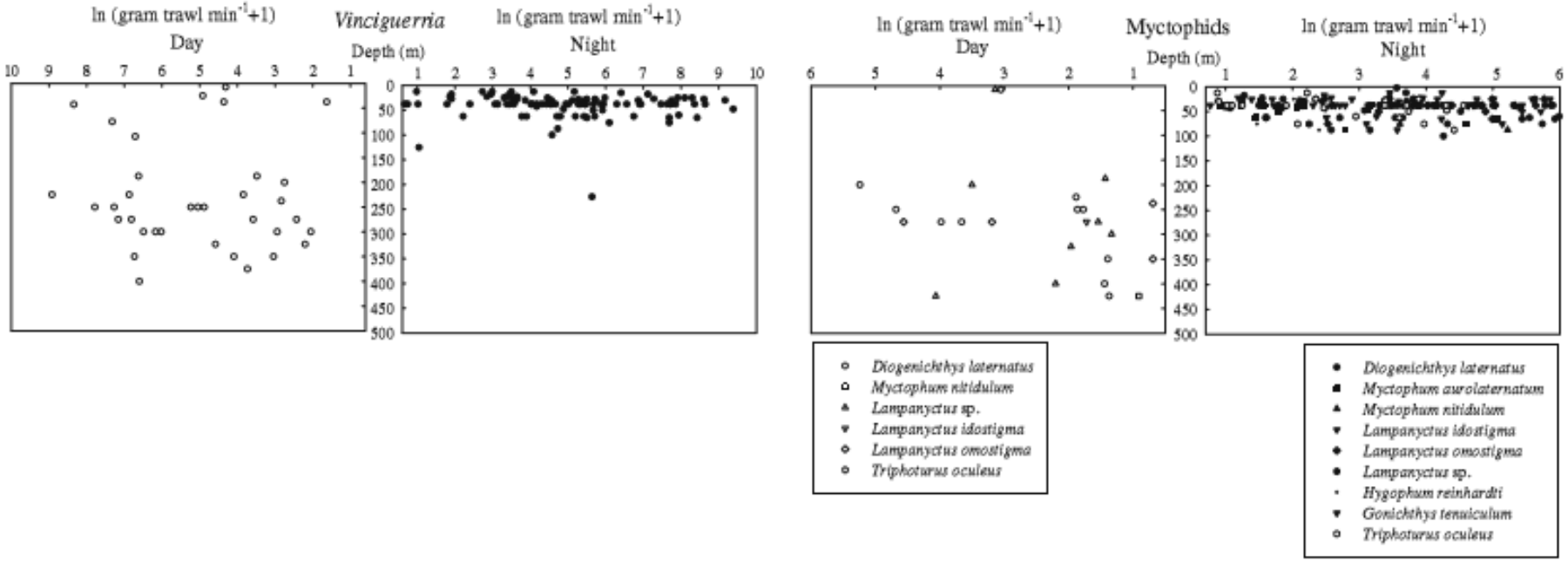
Other species
Myctophids
Diogenichthys laternatus
Lampanyctus spp
Triphoturus oculeus

Bathylagids
Leuroglossus urotranus

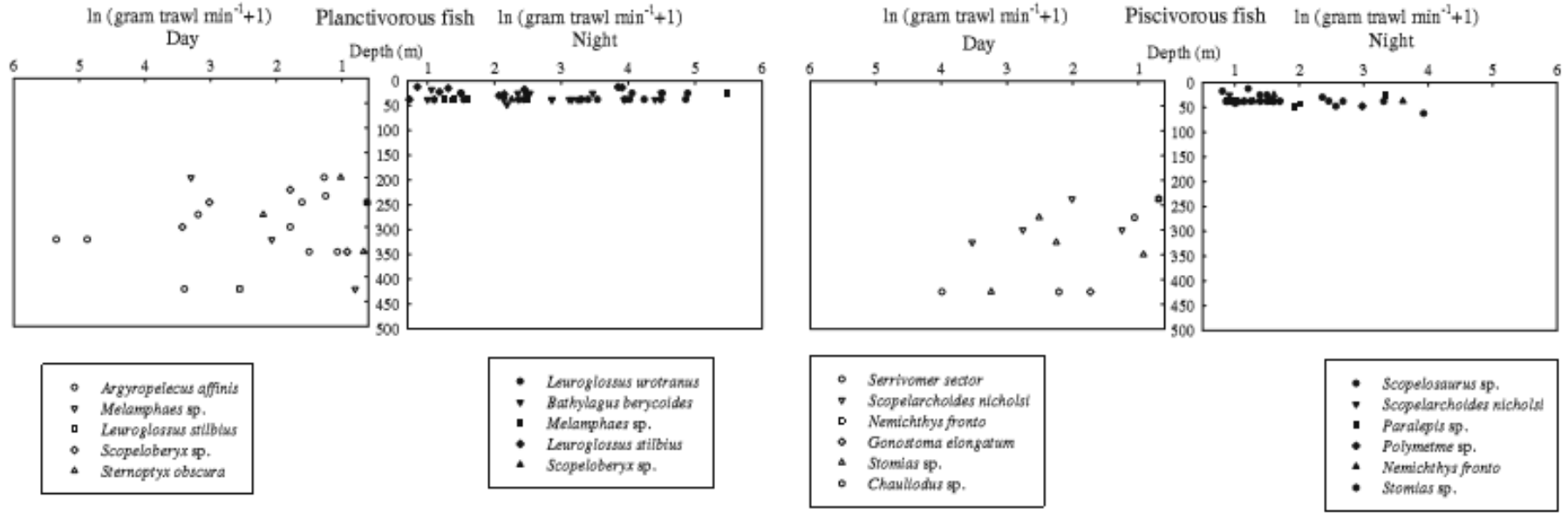
Cornejo and Koppelmann, 2006

Diel vertical migration

Biological sampling (Midwater trawl)



Nighttime
Above Thermocline
Peaks abundance
Upper 50m depth

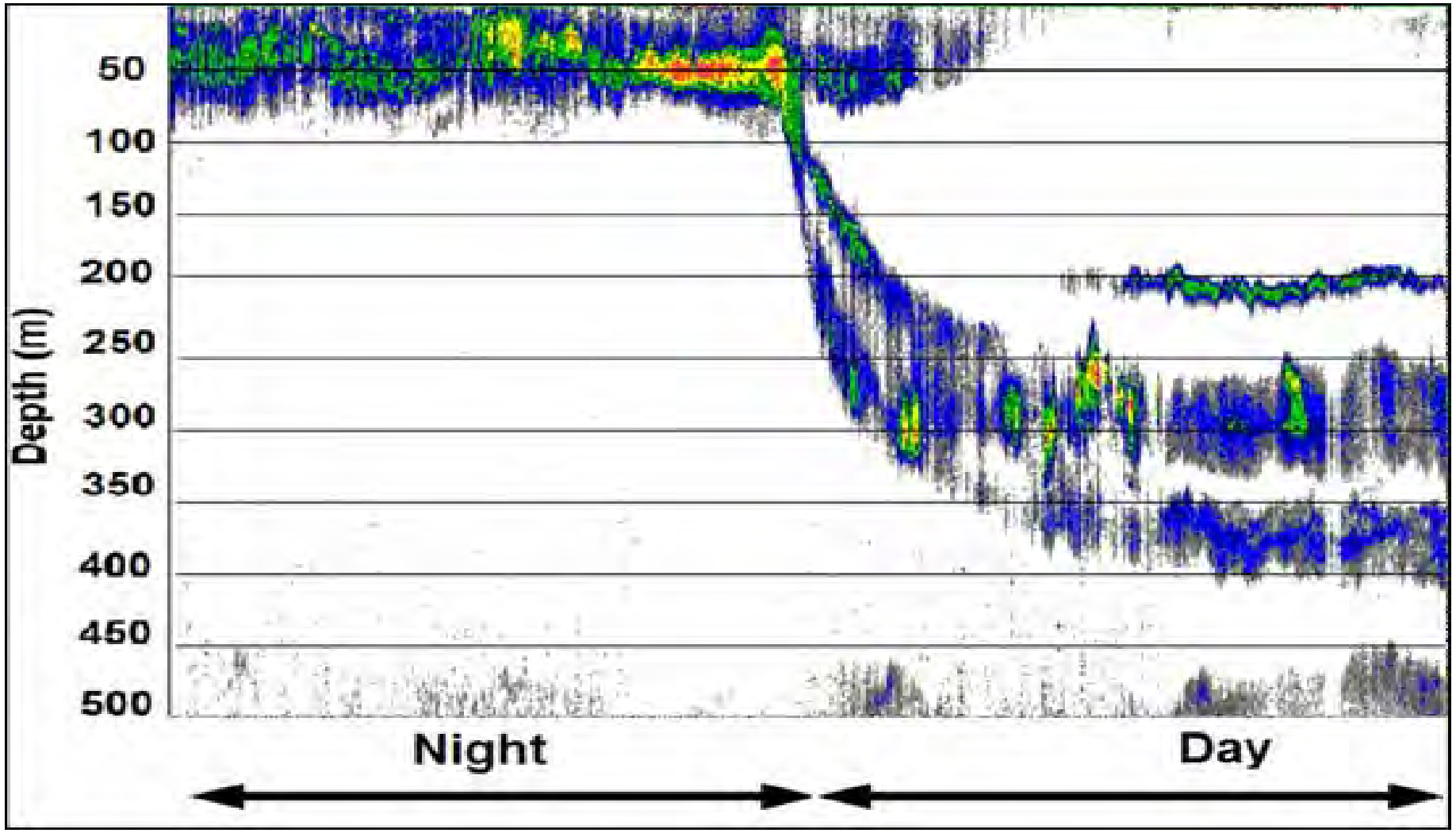


Daytime
Core OMZ
(< 1ml/L)
Peaks abundance
Below 200 – 500 m depth

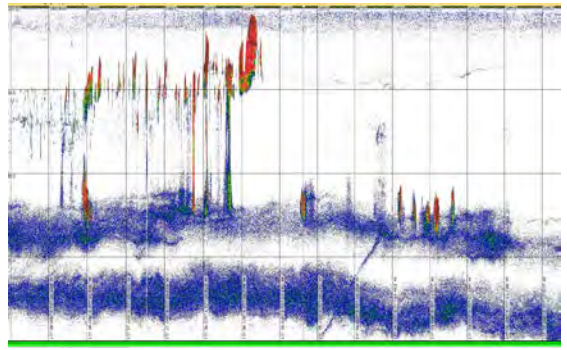
Cornejo and Koppelmann, 2006

Diel vertical migration

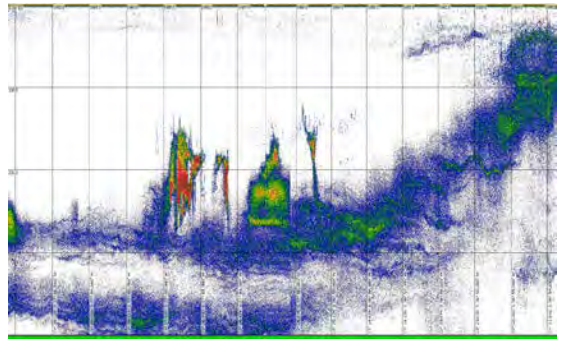
Sound scattering layers



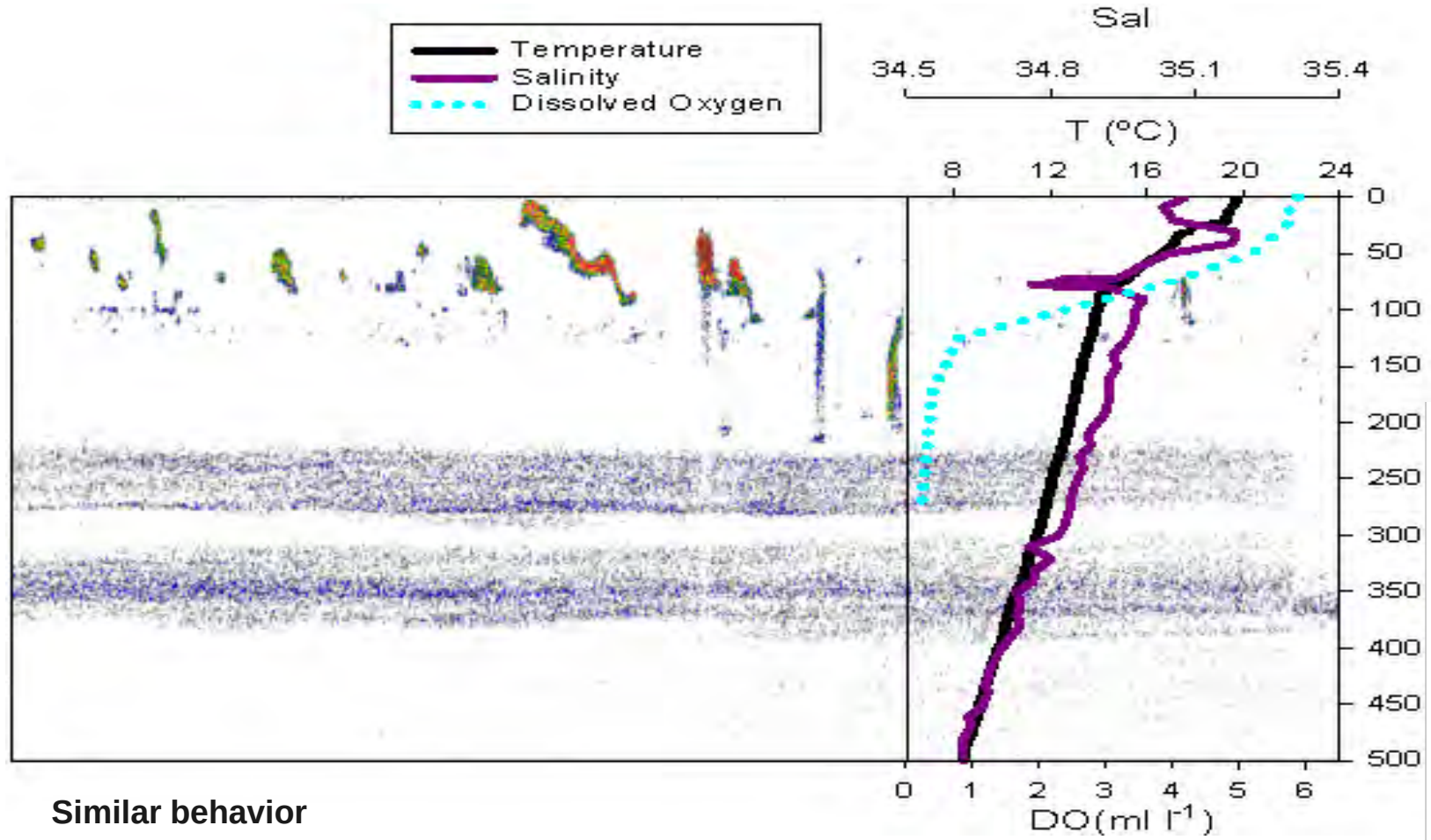
Acoustic sampling (EK60 38-120 kHz)

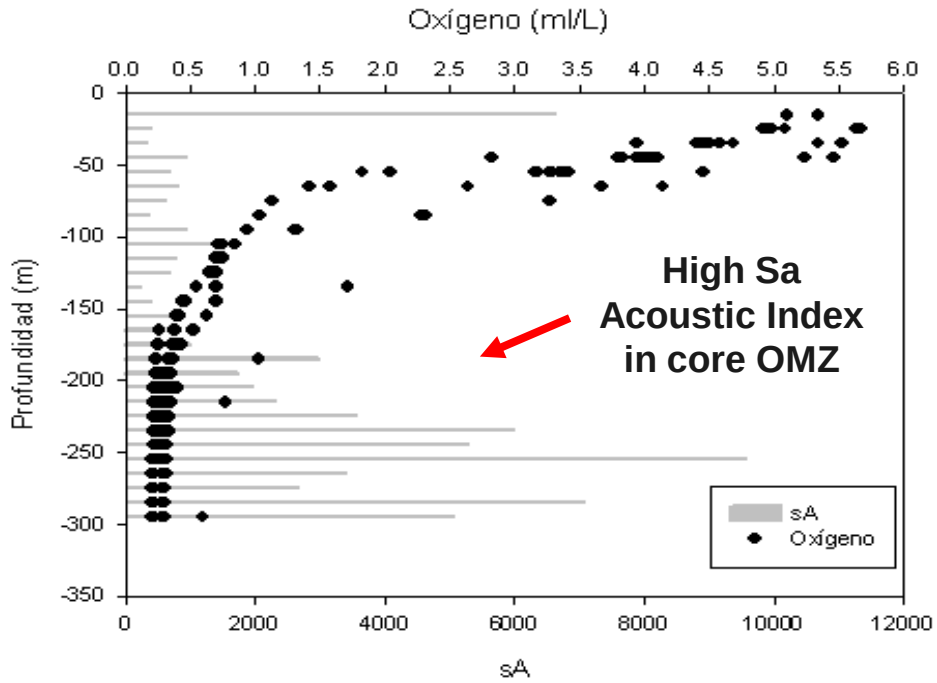


Mesopelagic fishes
+Strong vertical migrators
Day and nighttime
Layers (Multispecies) MN
Patch (Monospecific) VL



Atypical vertical behavior of Vinciguerria in surface during daytime





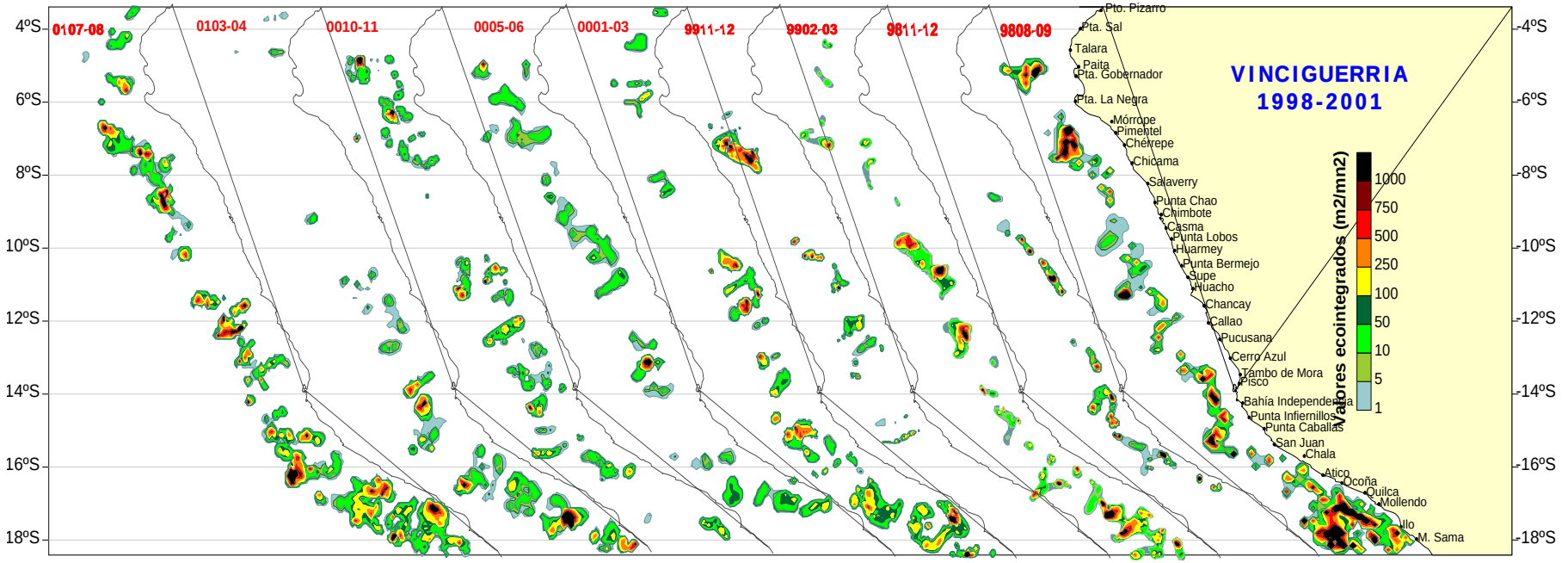
Similar behavior

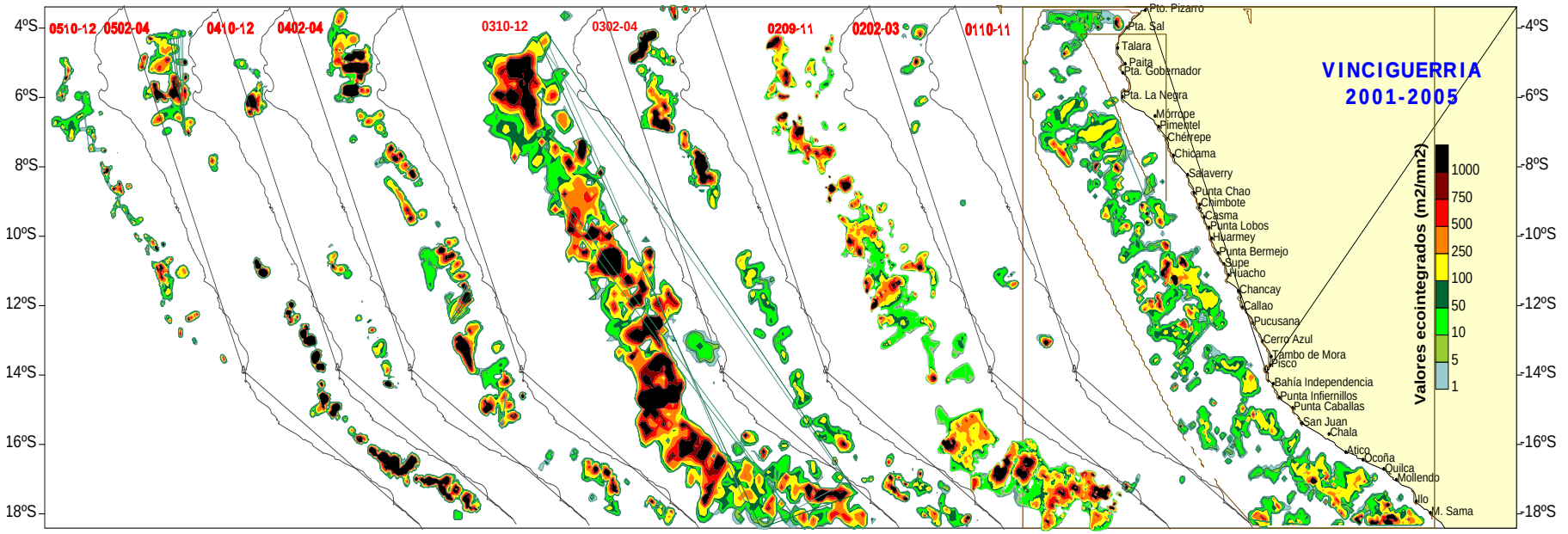
Vinciguerria nimbaria
Maurolicus muelleri
Benthosema pterota

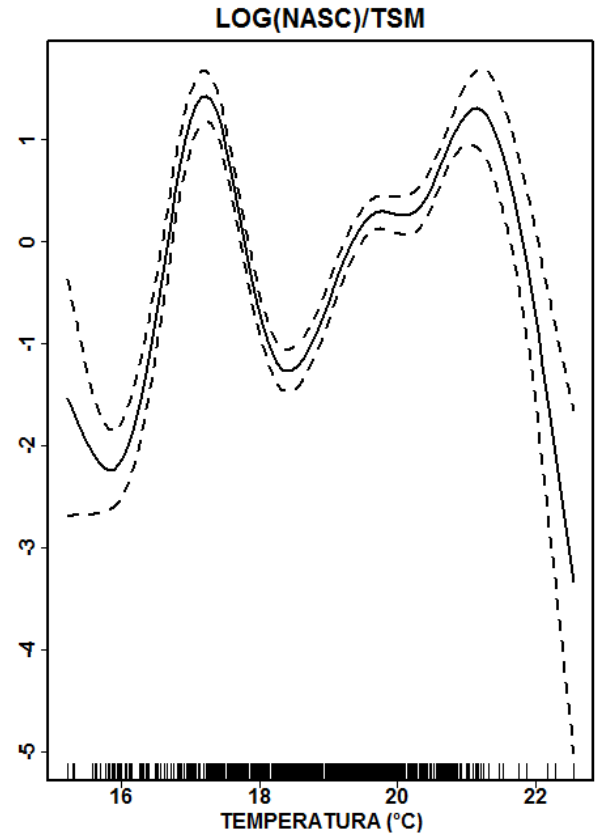
Factors:

- *Antipredator window by upwelled waters*
- *Food availability of zooplankton*

Vinciguerria biomass 1998-2018

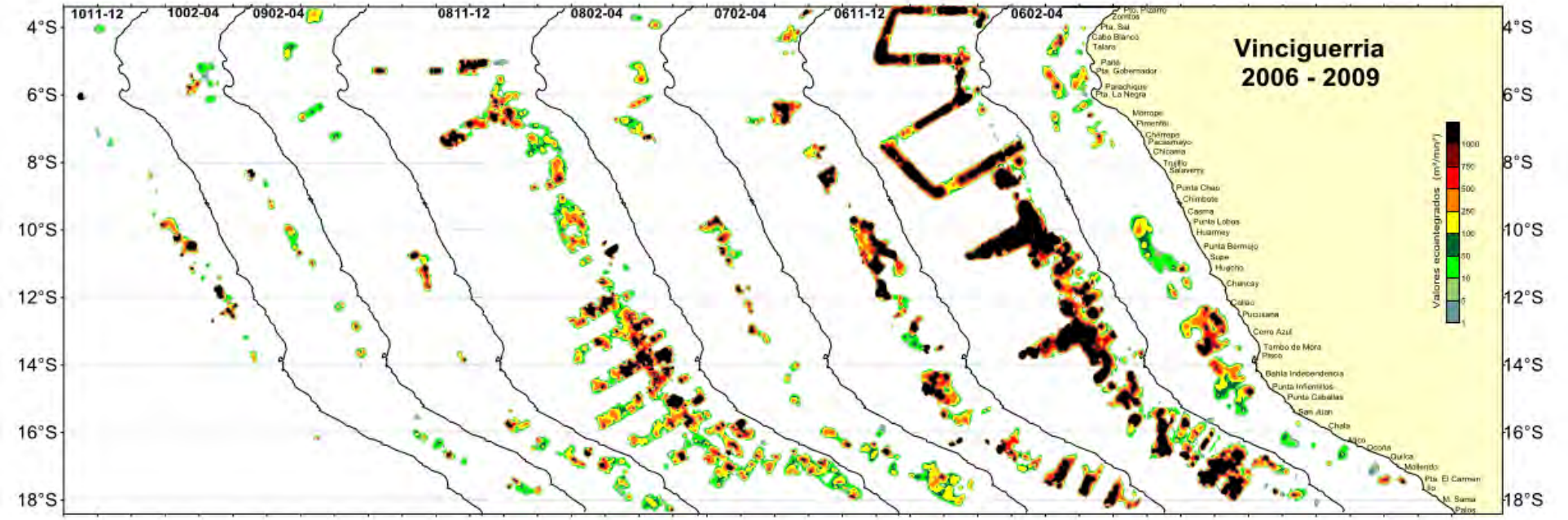


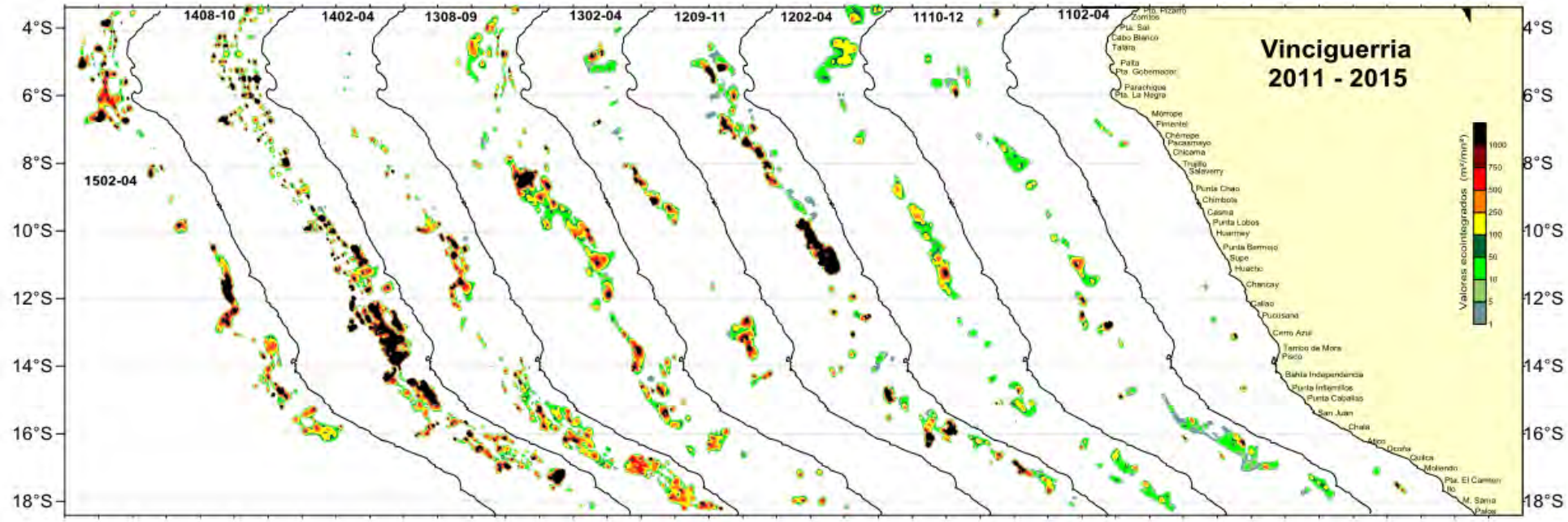


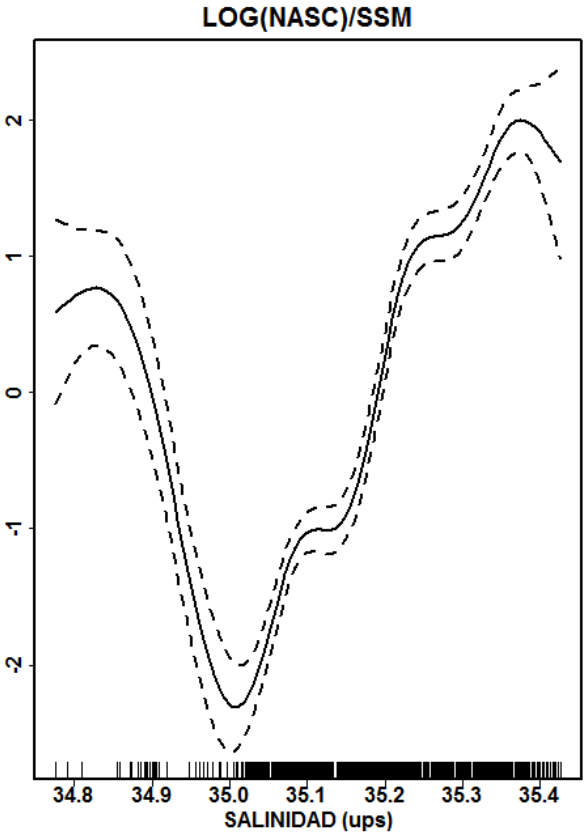


High Biomass
Spring and summer

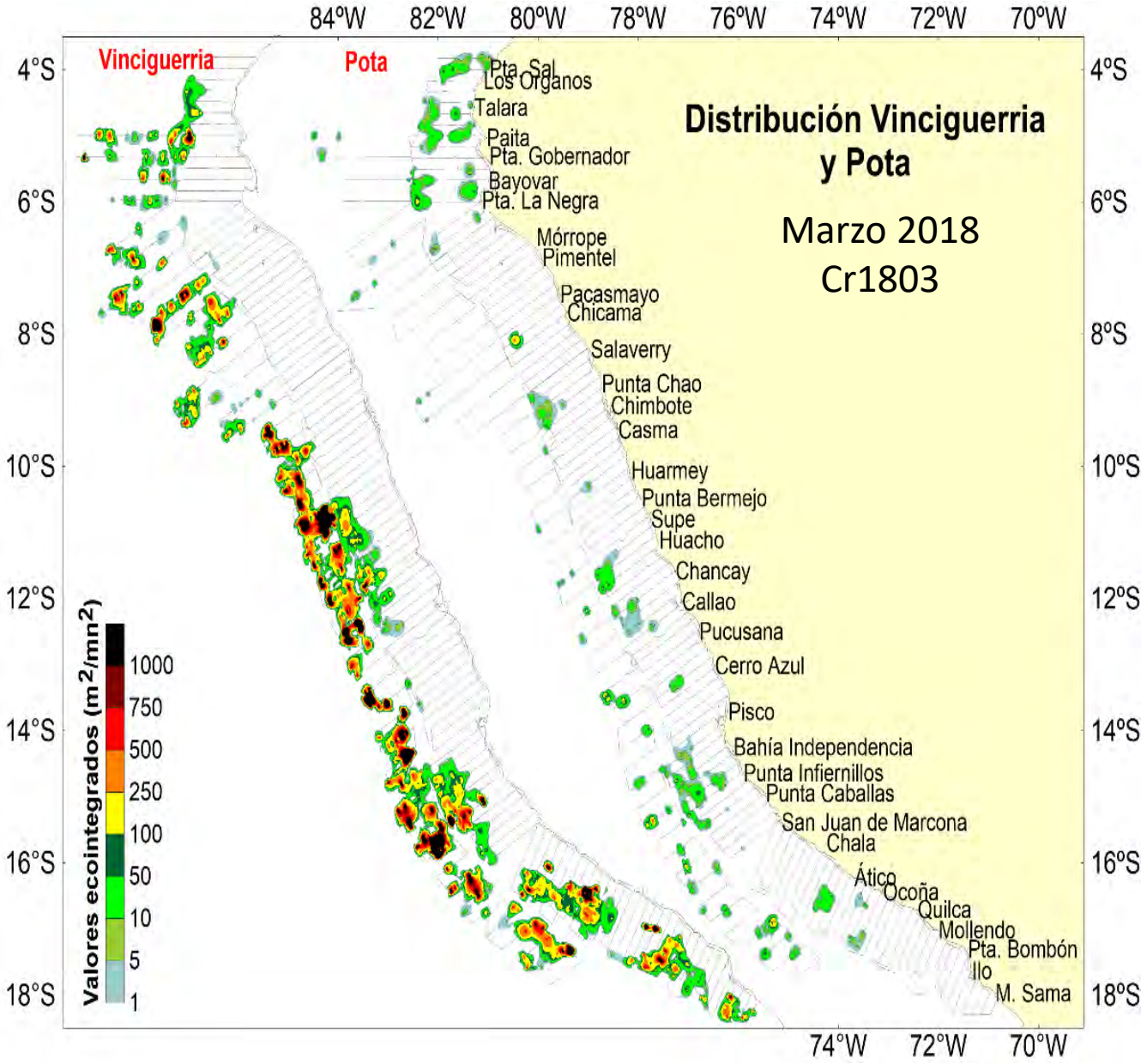
IMARPE

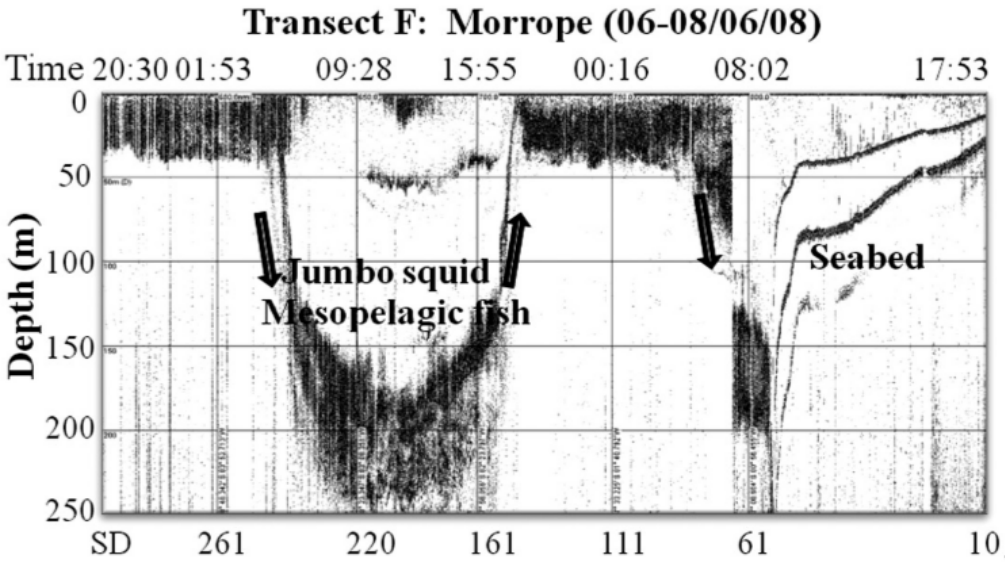

1011-12
1002-04
0902-04
0811-12
0802-04
0702-04
0611-12
0602-04
Vinciguerria
2006 - 2009
Valores ecointegrados (m²/mn²)
4°S
6°S
8°S
10°S
12°S
14°S
16°S
18°S

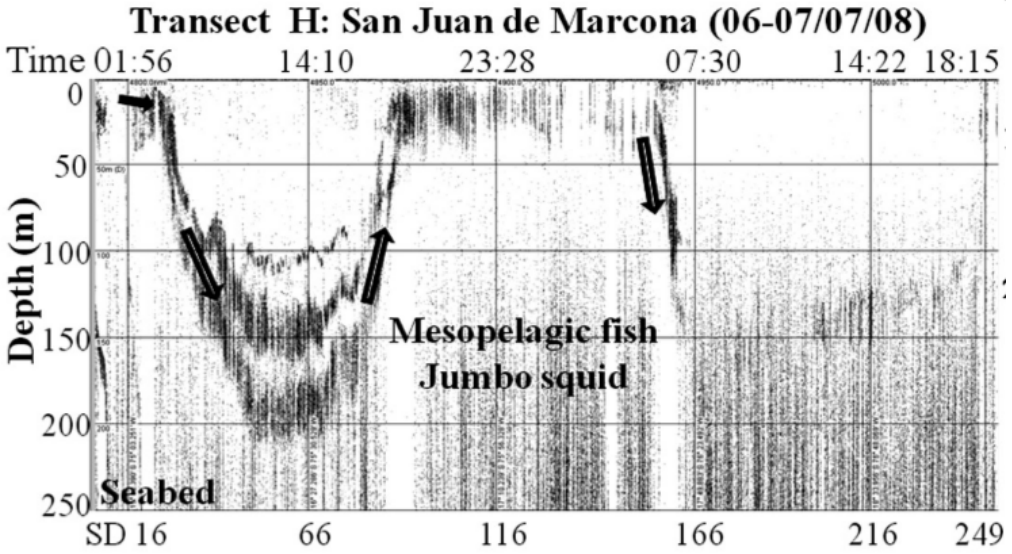

1408-10
1402-04
1308-09
1302-04
1209-11
1202-04
1110-12
1102-04
1502-04
Vinciguerria
2011 - 2015
Valores ecointegrados (m²/mn²)
4°S
6°S
8°S
10°S
12°S
14°S
16°S
18°S


LOG(NASC)/SSM
2
1
0
-1
-2
34.8
34.9
35.0
35.1
35.2
35.3
35.4
SALINIDAD (ups)

IMARPE



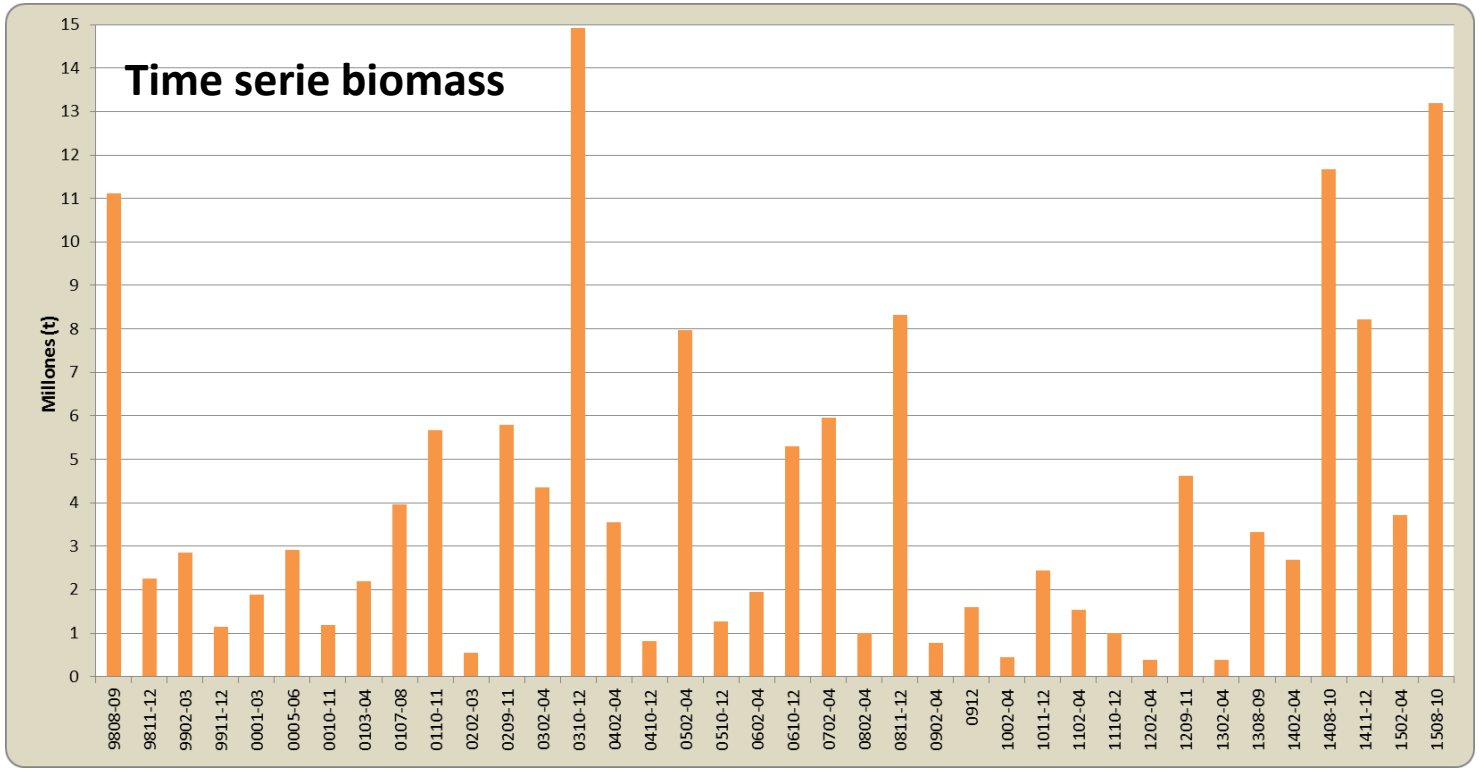


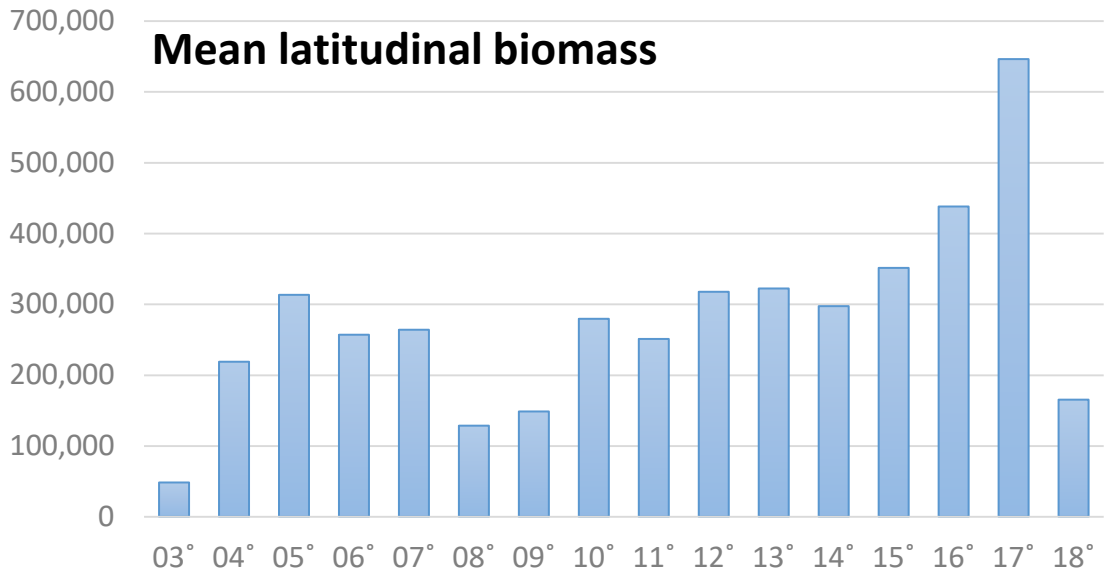


(Rosas-Luis, etal. 2011)

IMARPE

Vinciguerria biomass





Peru:
15 million tons (2003) spring
13 million tons (2015) autumm-spring
11.5 million tons (2014) autumm-spring
4.2 million tons (2018) Summer

Southeast Pacific 54.9 tons

FAO Area	A	B	C
Northwest Atlantic (21)	14.9	14.8	22.0
Northeast Atlantic (27)	14.7	14.7	15.9
Western Central Atlantic (31)	1.9	19.4	2.3
Eastern Central Atlantic (34)	77.5	77.0	80.7
Mediterranean Sea (37)	2.5	2.5	3.0
Southwest Atlantic (41)	33.0	39.0	33.4
Southeast Atlantic (47)	17.8	18.0	20.4
Western Indian Ocean (51)	133.0	257.0	263.2
Eastern Indian Ocean (57)	92.9	94.0	02.3
Northwest Pacific (61)	48.6	49.0	52.5
Northeast Pacific (67)	26.8	27.0	27.8
Western Central Pacific (71)	51.3	52.0	85.4
Eastern Central Pacific (77)	129.0	129.0	35.0
Southwest Pacific (81)	101.0	01.0	99.9
Southeast Pacific (87)	52.1	51.0	54.9
Total	**797.0**	**945.0**	**999.0**

(Lam and Pauly, 2005)

SUMMARY

- Peruvian waters are a zone of zoogeographic transition where mesopelagic fishes as indicator species of equatorial, central and sub-antartic waters occur.
- Mesopelagic fishes are a important predator and prey biomass providing a link between top predators and zooplankton.
- *Vinciguerria lucetia* is dominant species of oceanic waters and is an significant component of sound scattering layers off Peru.
- Mesopelagic fishes performed intensive diel vertical migration and form dense patches in sound scattering layers.
- High variability in Vinciguerria biomass by acoustic methods is observed off Peru .
- Occurrence of some mesopelagic fishes as inhabitants in OMZ is indicator that these fauna is highly adapted to hypoxia.
- Is necessary more research using other technologies such as ROV, genetics and others.


Thank you ¡¡