



INSTITUTO DEL MAR DEL PERÚ

Billfish fisheries and environmental variability in Peru during 1997-2016

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World Champion
Billfish lifting

Foto: Omar Carrillo

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INTRODUCTION

Pelagic species cataloged as oceanic and highly migratory: marlines or needles, sailfish, swordfish.

- **In Peru they have a wide distribution, from north to south.**
- **Associated with the entrance of warm water masses.**
- **In many countries they are often caught in sport fishing.**
- **Regulations: With the exception of swordfish, all billfishes are prohibited from being caught - D.S. No. 009-2008-PRODUCE. Fishing is allowed (catch and release).**
- **Its capture in artisanal fisheries is incidental, although in recent years there has been directed fishing for swordfish, and it is oriented towards human consumption.**
- **In this context, we analyze available information of these species for 1996-2016, with emphasis on the environmental variability and distribution of these species during the period 2013 - 2016.**

Methodology

- The information comes from the IMARSIS Database, collected by the Artisanal Fishing Information Collection System, on a daily basis in the main landing sites of the Peruvian coast, from 1996 to the present.
- The data used comes from fishing trips oriented mainly to the capture of Eastern Pacific bonito, sharks, dolphinfish.



Main species of "Billfishes" in the Peruvian coast

Istiophorus platypterus ((Shaw, 1792)
"Sailfish"



Kajikia audax (Philippi, 1887), *antes Tetrapturus audax*,
"Stripped marlin"



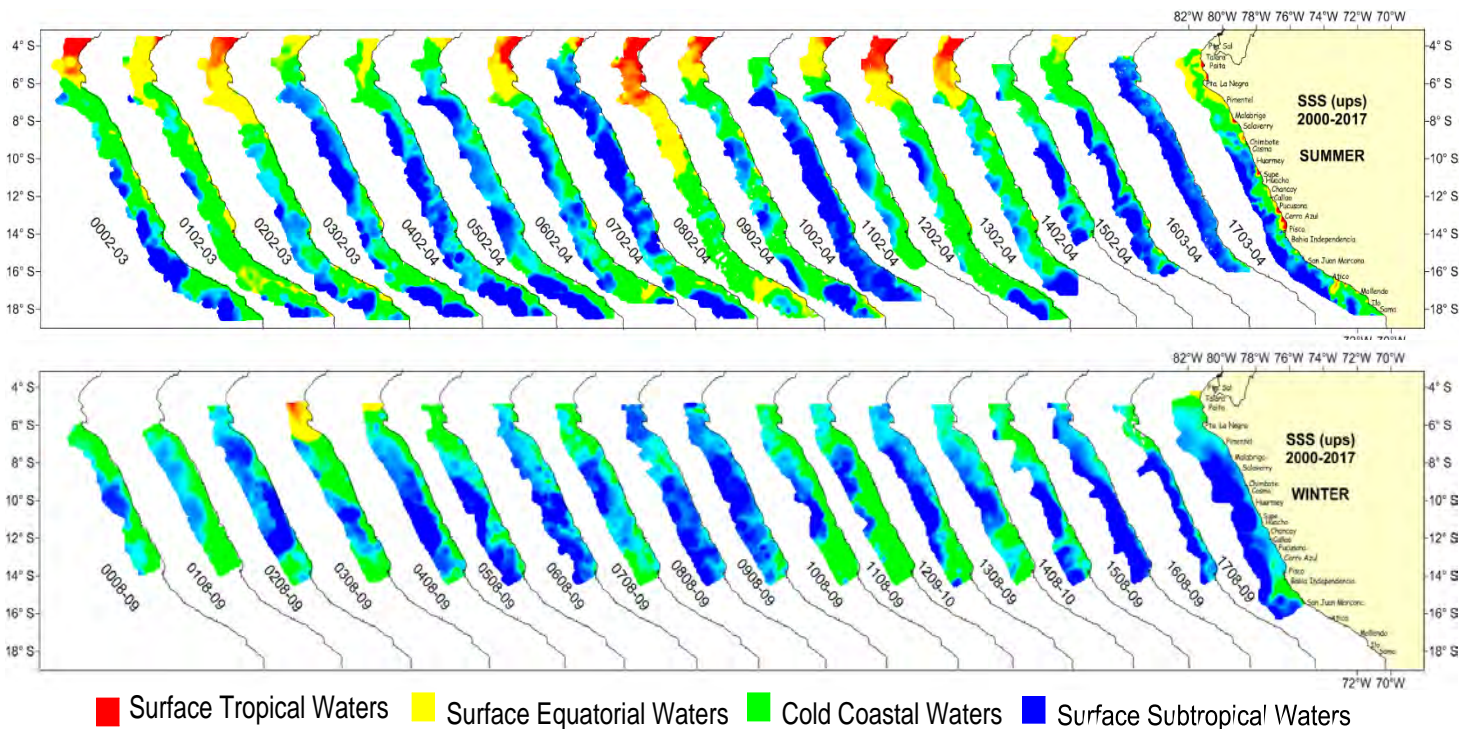
Xiphias gladius (Linnaeus, 1758)
"Swordfish"



Istiompax indica (Cuvier, 1832), *antes Makaira indica*,
"Black marlin"



Distribution of water mass off the Peruvian coast during summer and winter from 2000 to 2017



In warmer periods when the Subtropical Surface Water (STW) gets closer to the coast the Thermal front approaches the coast.

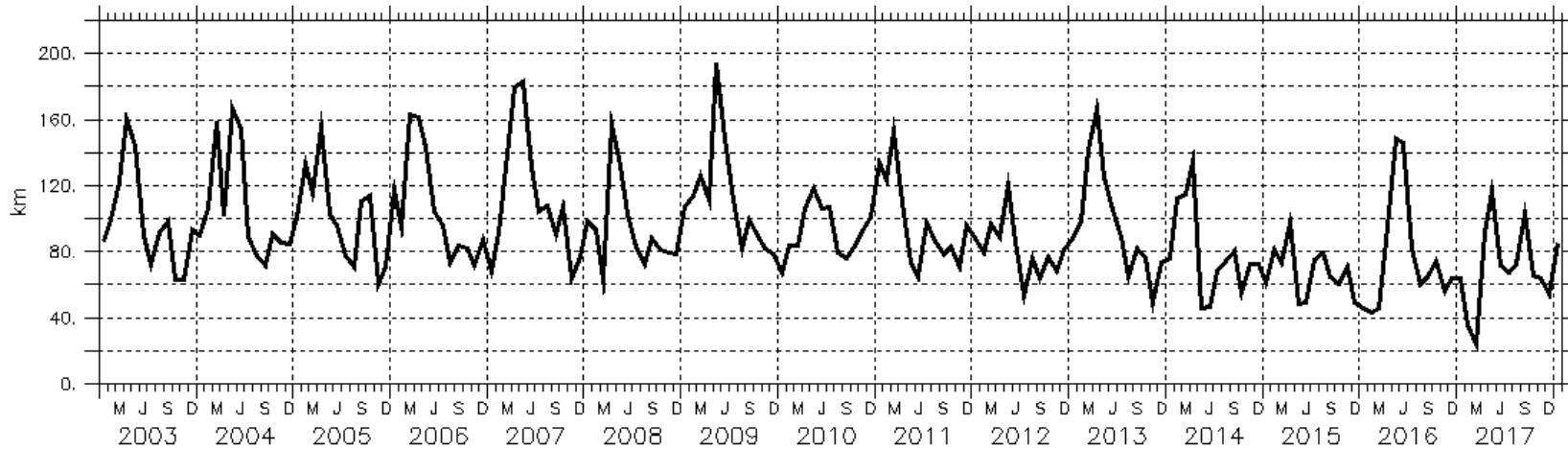
In some cases the thermal front location can be associated with upwelling and chlorophyll concentrations.

Thermal Front Index (TFI)

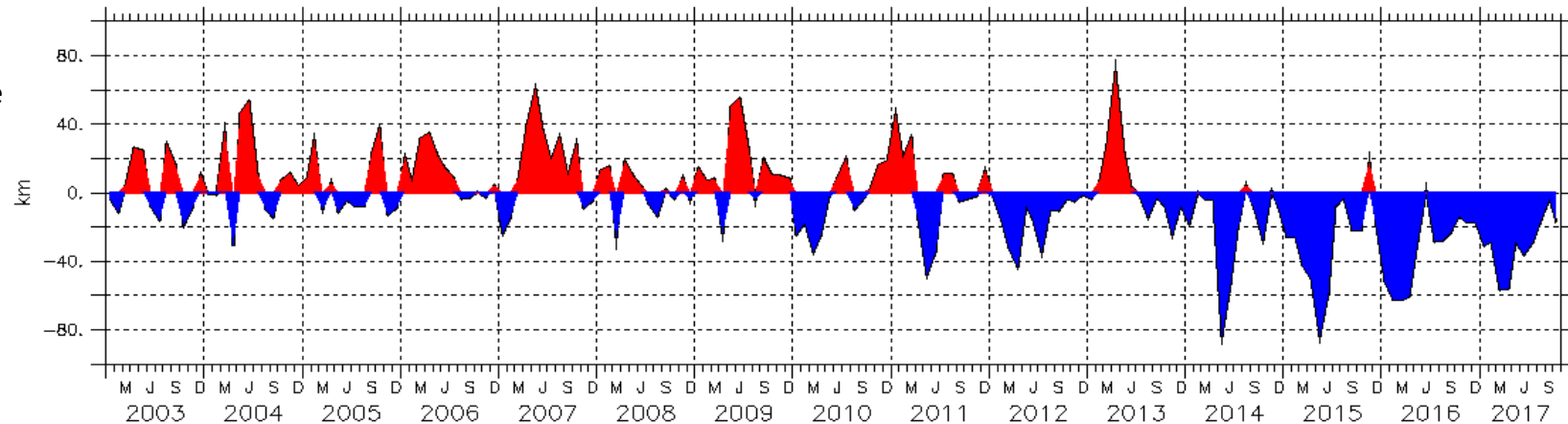
Proxy of oceanic waters horizontal displacement (inshore/offshore)

Developed from satellite SST at 1km resolution (L4, Multiscale UltraHigh Resolution MUR, JPL-NASA)(Romero *et al.*, 2014)

Distance from the thermal front to the coast (4-16°S)



Anomaly distance (km) of the thermal front upwelling between 4°S and 16°S of the coast of Peru.



Distancia al frente termico entre 4S -16S (anomalia)

■ + Near

■ + Far

The water masses dynamic modulates the position of the Thermal Front

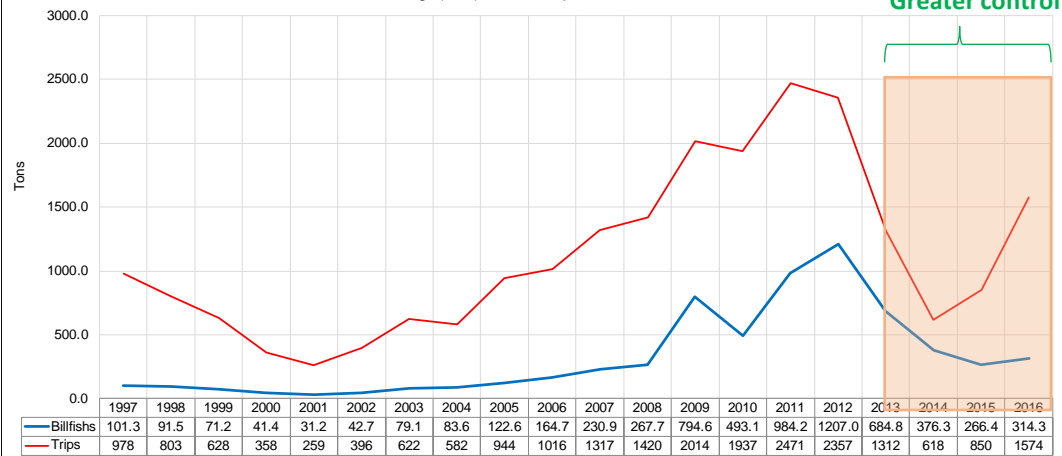
Fishing aspects



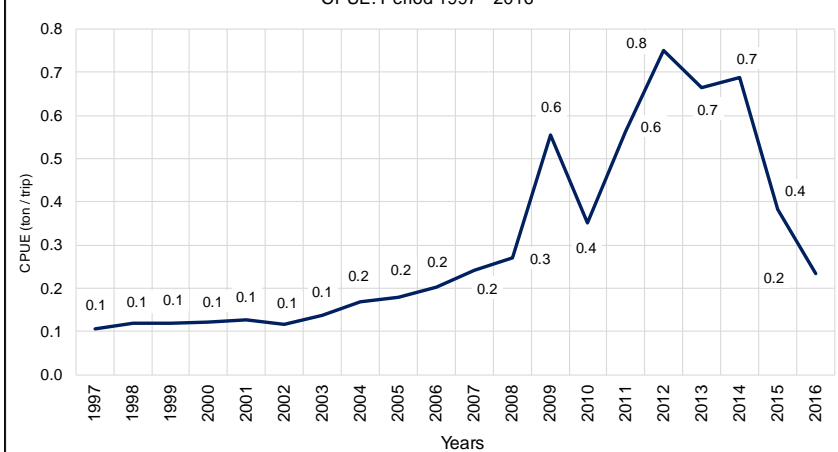
Landings, effort and CPUE, 1997 - 2016

Landings (tons) of billfishes, period 1997 - 2016

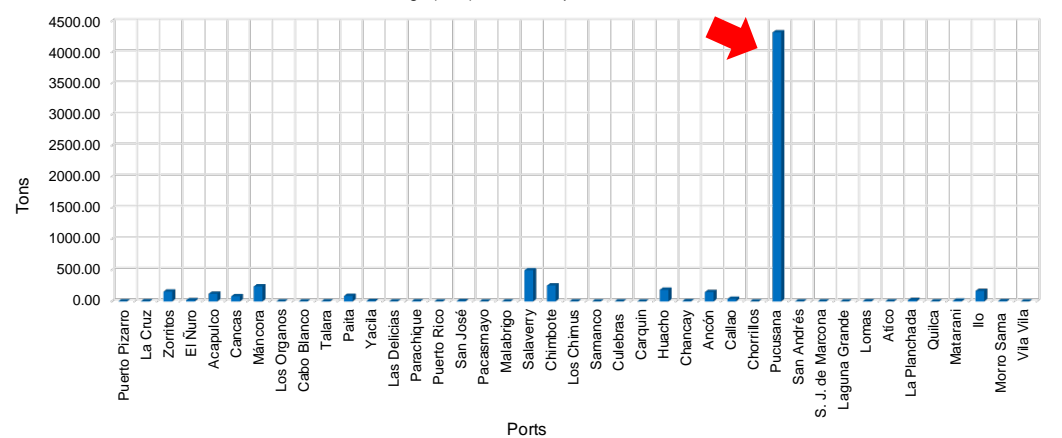
Greater control



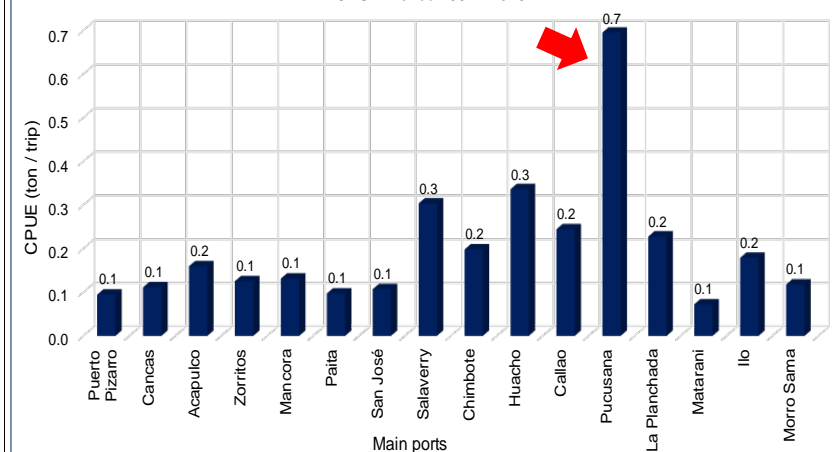
CPUE. Period 1997 - 2016



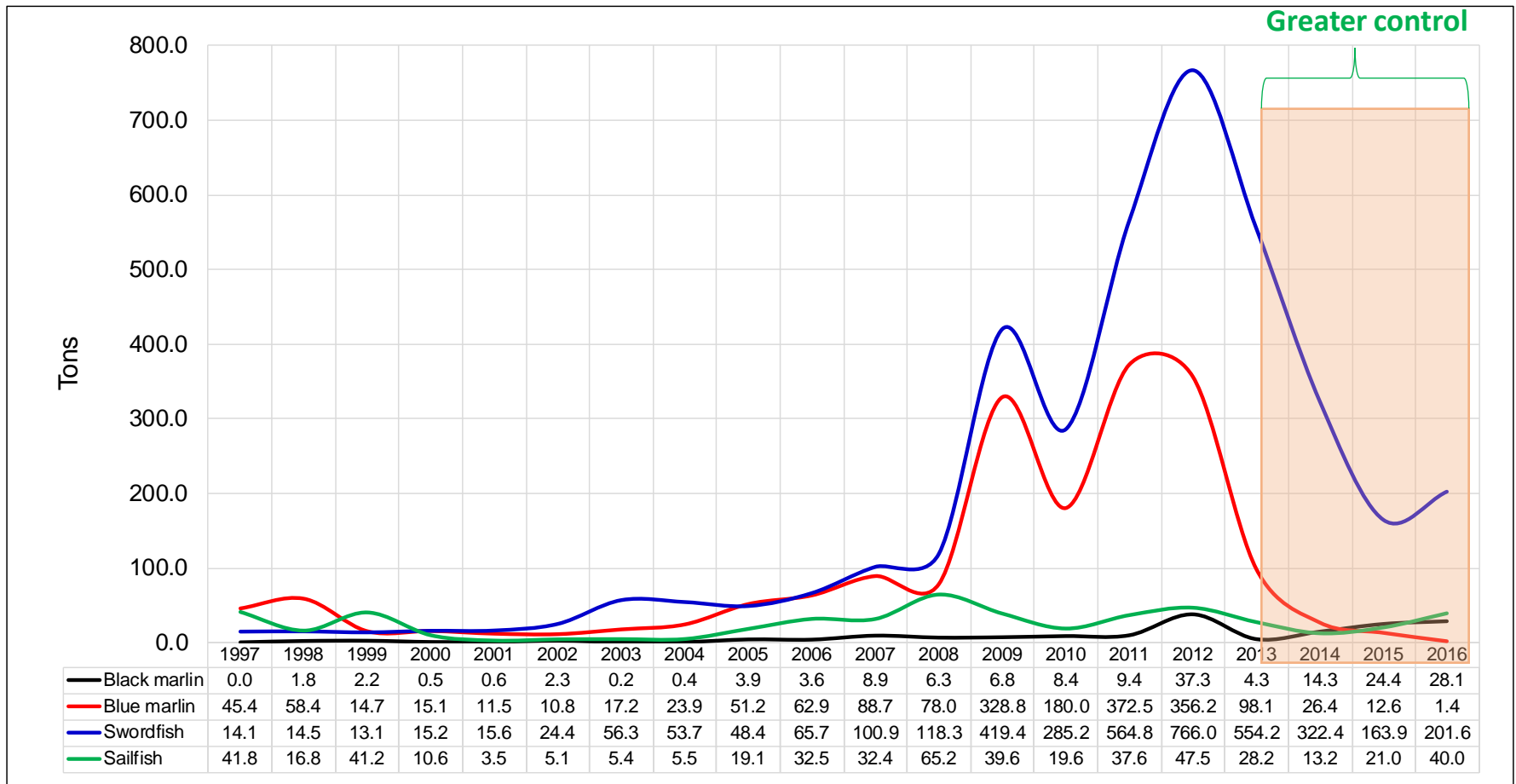
Landings (tons) of Billfishes, period 1997 - 2016



CPUE. Period 1997 - 2016



Landings by species, 1997 - 2016

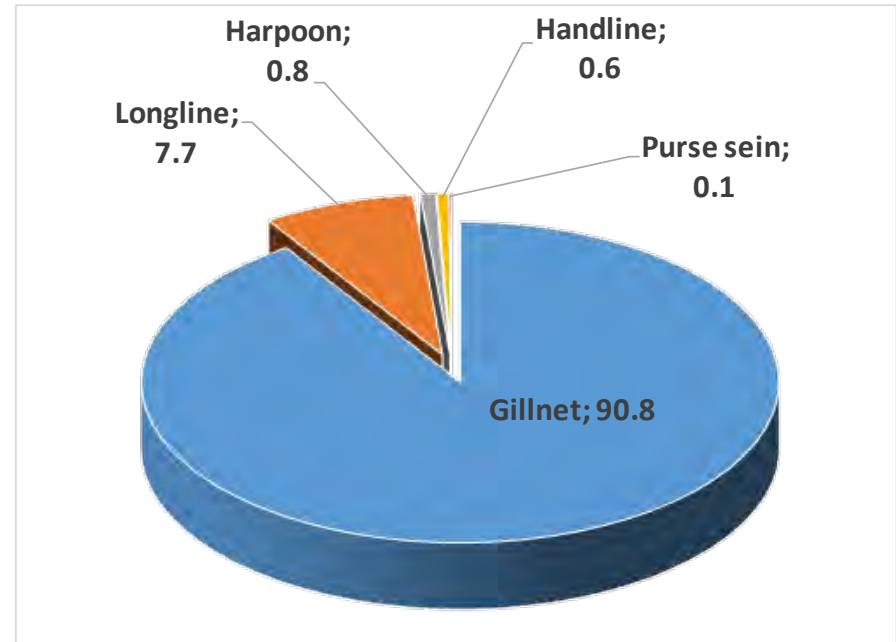


The swordfish is the main species, followed by the blue marlin, and in smaller volumes the sailfish and black marlin.

Fishing methods, period 1997 - 2016

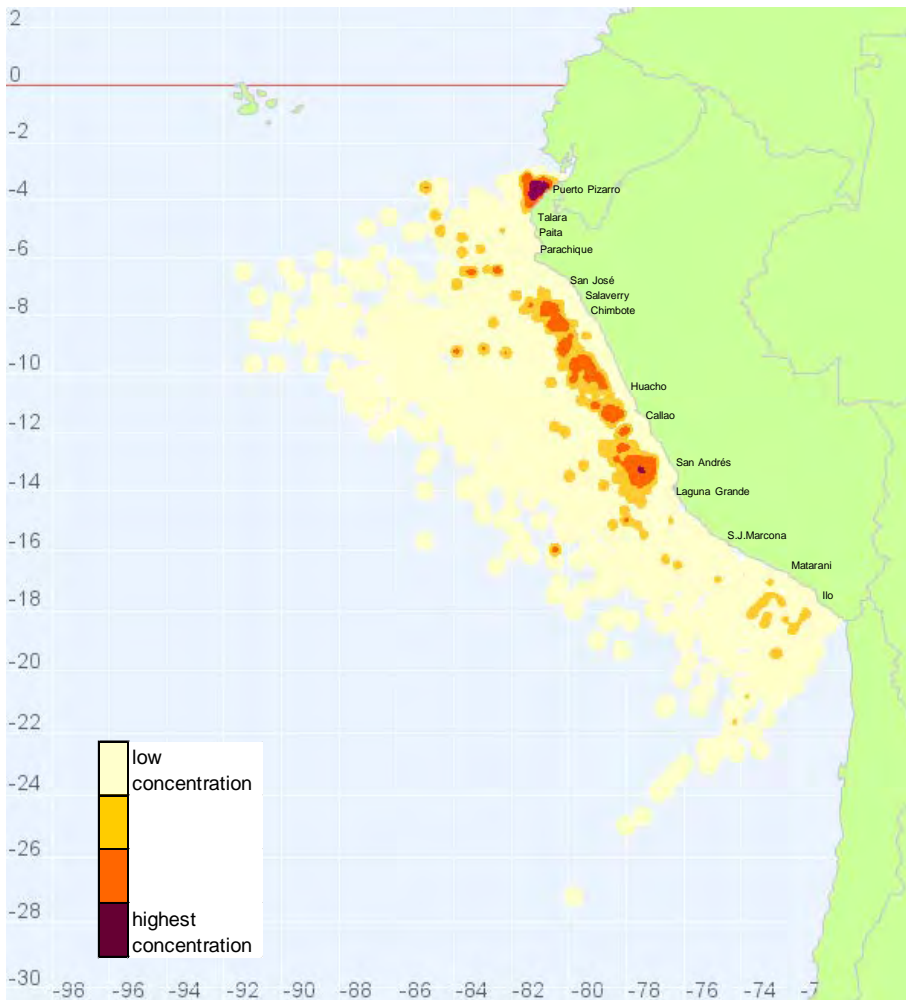
- The main method of fishing is the gillnet "Cortina",
- in vessels of 5 to 15 t.

Percentage (%) of catch according to fishing method

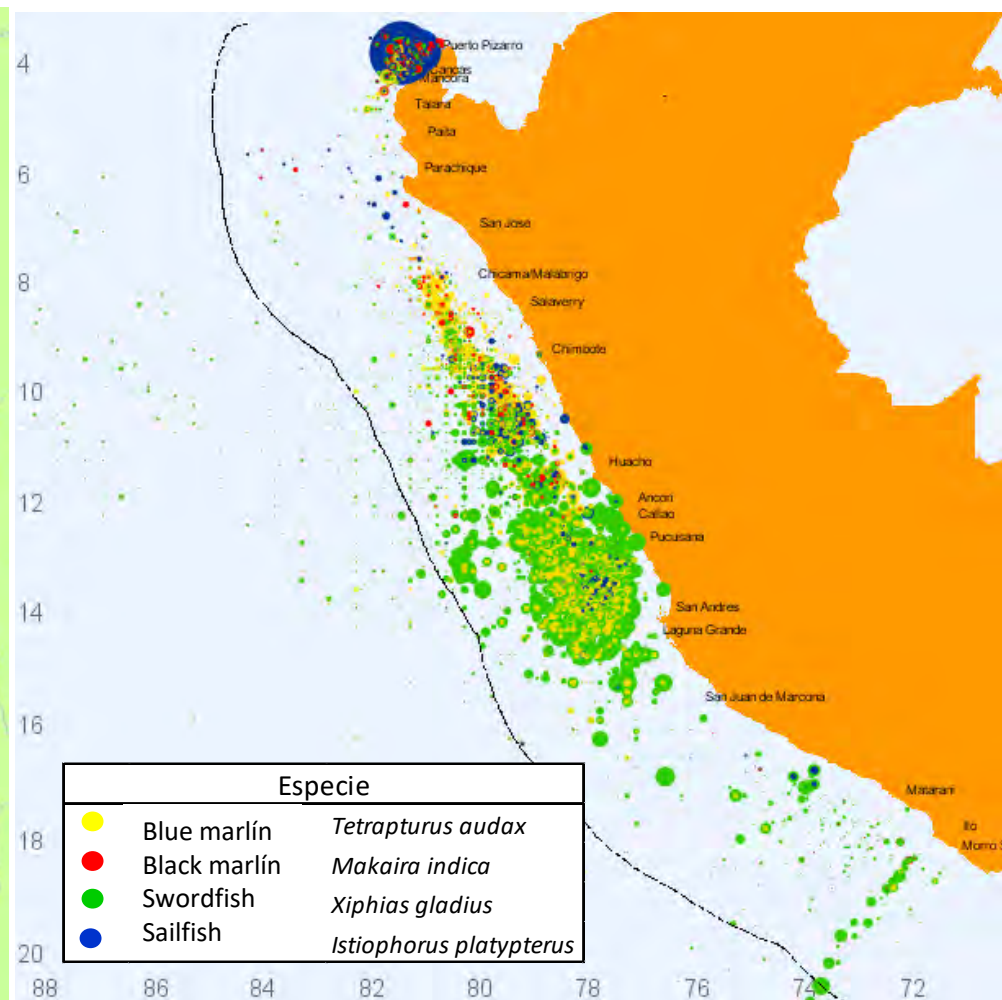


Fishing areas of the main species of "Billfishes" in the Peruvian sea, 1997-2016

General distribution of catches



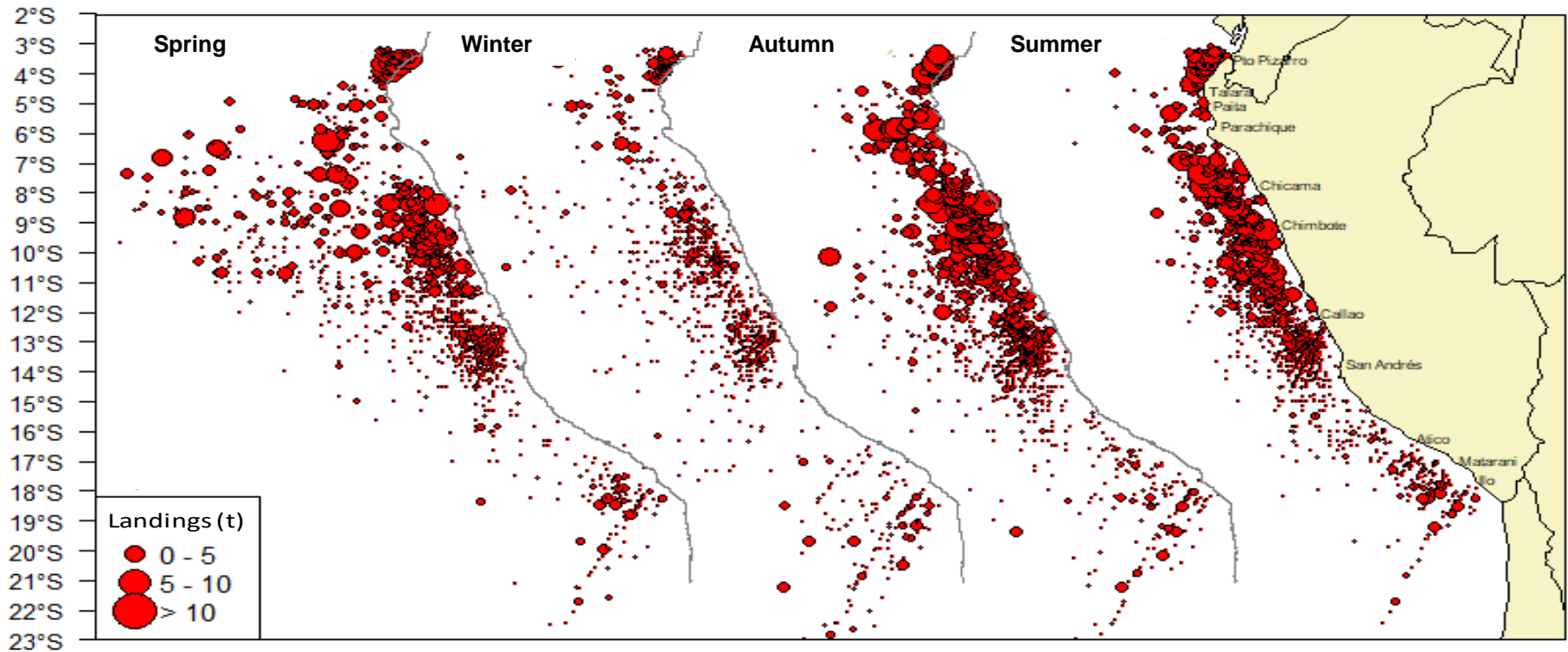
Distribution of catches by species



The distribution of catches is wide.

Sailfish are mainly found in the north of the Peruvian littoral, blue merlin and black merlin in the north and center. The swordfish is recorded all along the coast, with higher concentrations in the center and south.

Record fishing areas for “Billfishes” in the Peruvian sea, 1997-2016



Fishing areas were incidental catches were registered are concentrated closer to the coast, mainly during summer and autumn. In spring and winter its distribution is wide and is more offshore.

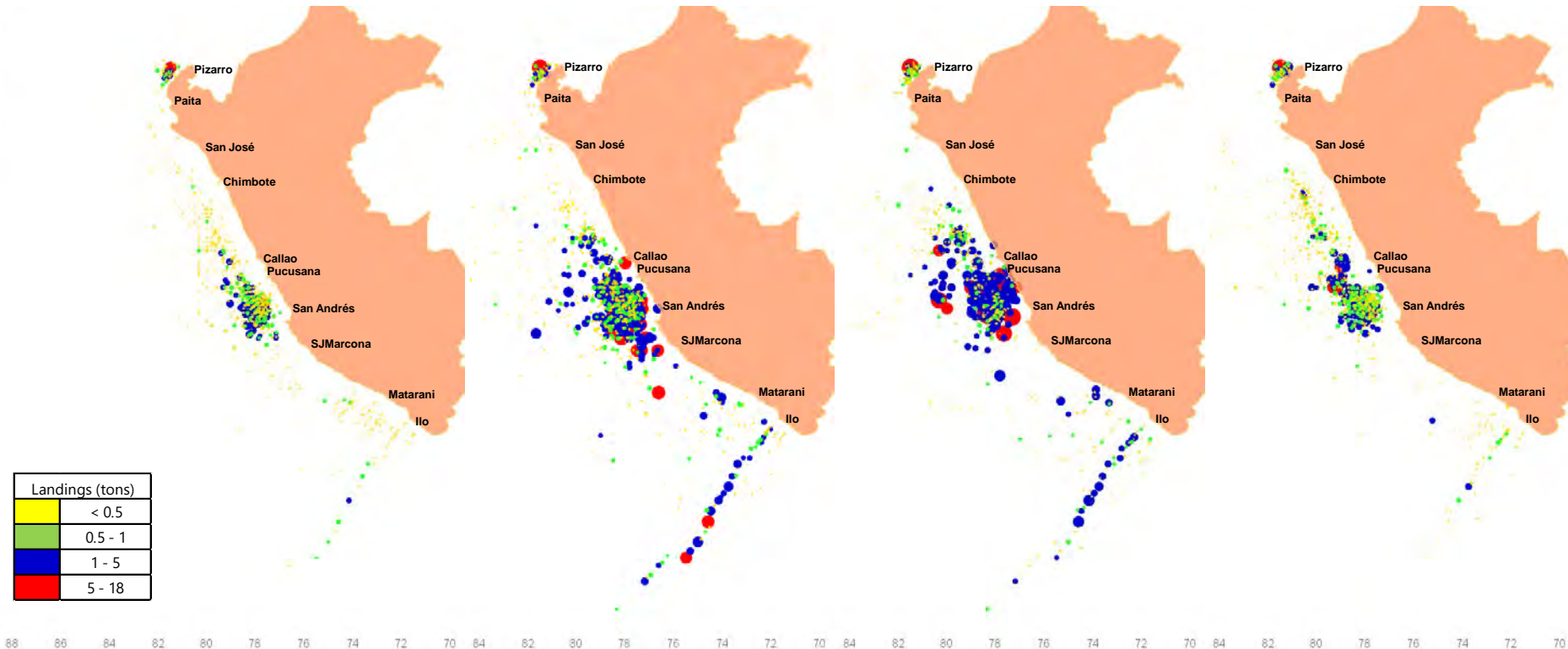
Fishing areas of “Swordfish” in the Peruvian sea, 1997-2016

Summer

Autumn

Winter

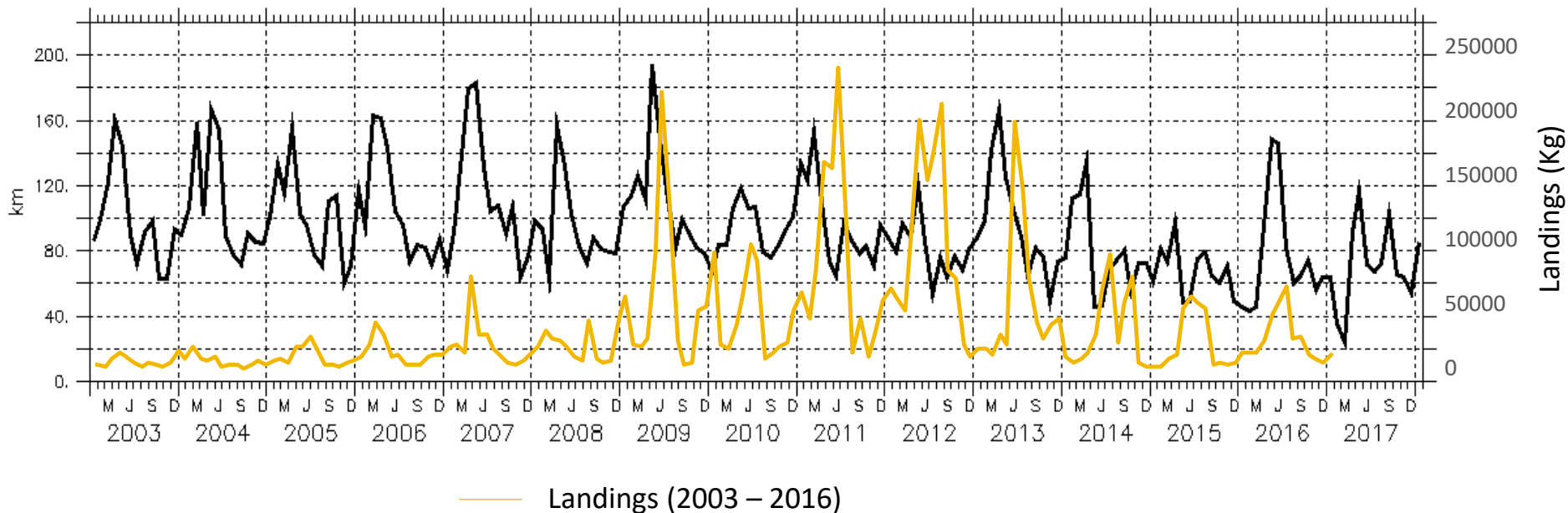
Spring



The swordfish fishing areas approach the coast in spring and summer, however, the highest incidental catches occur in autumn and winter. This is explained by being stations where incidental capture increases.

Results

Landings VS Thermal front index (4-16°S)



GLM:

Proportion in catch ~ factor(Year) + factor(Month) + SST + Salinity + TFI + FZDFT + FZDC

	Black marlin <i>Istiompax indica</i>		Blue marlin <i>Kajikia audax</i>		Swordfish <i>Xiphias gladius</i>		Sailfish <i>Istiophorus platypterus</i>	
	$r^2 = 0.26$		$r^2 = 0.15$		$r^2 = 0.46$		$r^2 = 0.56$	
	P-value	%	P-value	%	P-value	%	P-value	%
Year		8.0		43.5		19.8		17.9
Month		67.6		19.1		51.7		61.6
Temperature (°C)	0.12	1.0	0.48	0.1	0.27	4.3	0.05 (.)	0.0
Salinity	0.01 **	6.3	0.00 ***	31.5	0.01 **	3.9	0.67	0.2
Thermal front index	0.66	6.2	0.67	0.1	0.00 ***	1.4	0.81	0.2
Fishing zone - Distance to the Thermal front (m)	0.49	0.7	0.62	0.3	0.37	0.1	0.44	0.2
Fishing zone - Distance to the coast (m)	0.28	10.1	0.52	5.3	0.06 (.)	18.9	0.70	19.9

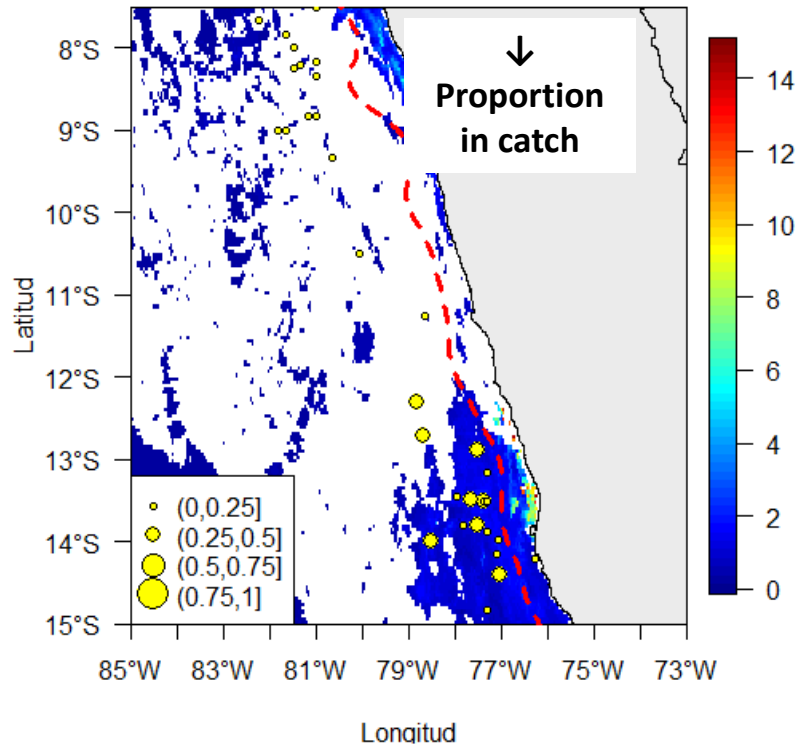
The model was able to represent a 46% of variance for the Swordfish and 56% for the Sailfish.

Swordfish : Thermal front index , Salinity, Fishing zone distance to the coast.

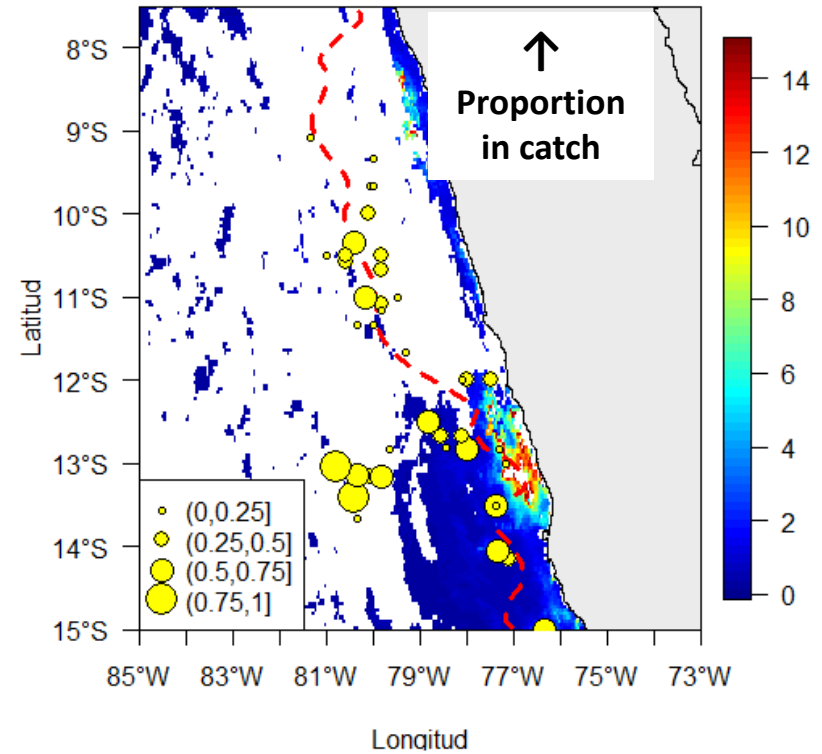
Sailfish: Sea Surface Temperature.

Swordfish

January 2013



April 2013



The availability of *Xiphias gladius* to be caught incidentally increases as the thermal front is more offshore

Conclusions

- The Peruvian levels of capture of billfishes have increased in recent years, mainly swordfish, except 2014-2015 produced by an increase on governmental control laws on these species.
- The main landings ports for billfishes is Pucusana (12°S), followed by Salaverry (08°S), Ilo (17°S). Pucusana also records the highest CPUE with 0.7 ton / trip.
- The highest concentrations are observed mainly in the autumn and winter seasons, when the fleet operates with a curtain net, and the incidental catch increases.
- The Billfishes have a wide distribution in the Peruvian sea. The swordfish is registered all along the littoral, with higher concentrations in the center and south. Sailfish are mainly recorded in the north, and blue merlin and black merlin were recorded in the northern and central areas.
- The incidental catch of billfishes like the swordfish is increased in relation to the location of the thermal front, not directly related to the temperature but probably related to the changes in prey distribution.
- The incidental catch occurrence of swordfish was higher when the oceanic front is localized more offshore, at temperatures between 17 and 22 °C.
- This is a preliminary work on these species in Peru, but during the present year there is a program collecting more information related to the biology and fisheries to improve the knowledge of the behavior of billfishes.

....Thanks for you atention...



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