Victoria, 06 – 11 March 2017

Spatial analysis of SPF dynamic off the North West African shelf within its upwelling ecosystem.

Najib Charouki[1], Mansour serghini[1], Issa Benazzouz[2], Marek Ostrowski[3] and Souad Kifani[1]

1.INRH, Morocco. 2.ISEM, Morocco. 3 IMR, Norway

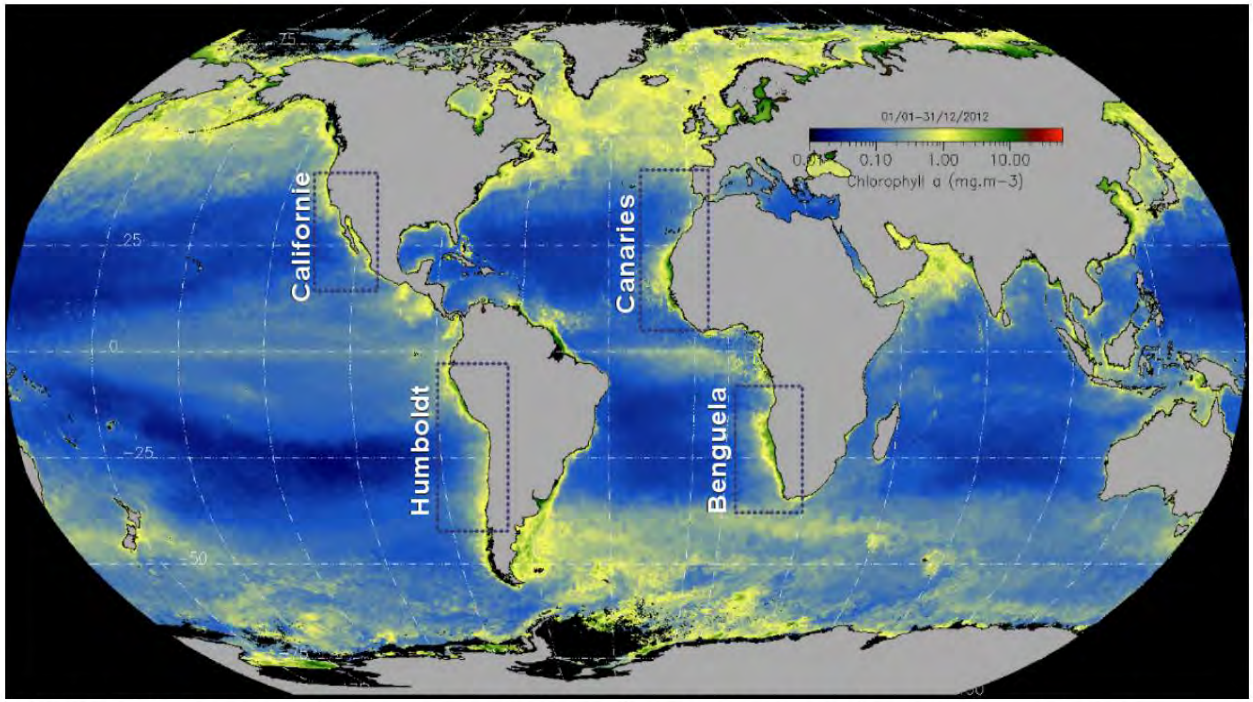
PICES Symposium

Victoria, 06 – 11 March 2017

Outlines

- North West African (NWA) Context
- Long term change in small pelagics (SPF) distribution: Case of Sardine and Sardinella
- Short term dynamic of SPF
- SPF associations from surveys
- SPF and hydrographic parameters

The Canary Current Upwelling Ecosystem: Hydrographic context



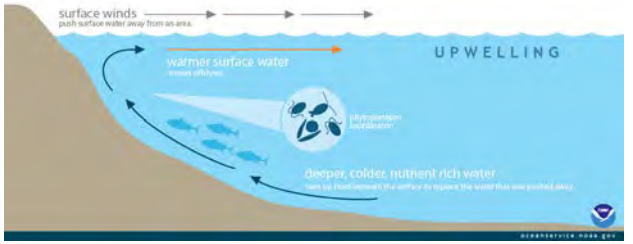


***Figure 1.4**: Image satellite mondiale de la couleur de l'eau représentant une moyenne annuelle (2012) de la concentration en chlorophylle « a » de surface (traceur de phytoplancton) provenant du capteur Modis-Aqua mettant en valeur les quatre EBUEs.*

A. Benazouz, 2014

Canary Current Upwelling Ecosystem: A productive ecosystem in terms of marine ressources

- CCLME is the third ecosystem in the world in terms of primary productivity.

- CCLME ensures one of the most important fisheries productions among the large marine ecosystems of Africa, with 2 to 3 million tons annualy.

- More than 80% of the catchs are small pelagics:


Sardina pilchardus


Sardinella aurita


Trachurus trachurus


Engraulis encrasicolus


Scomber colias

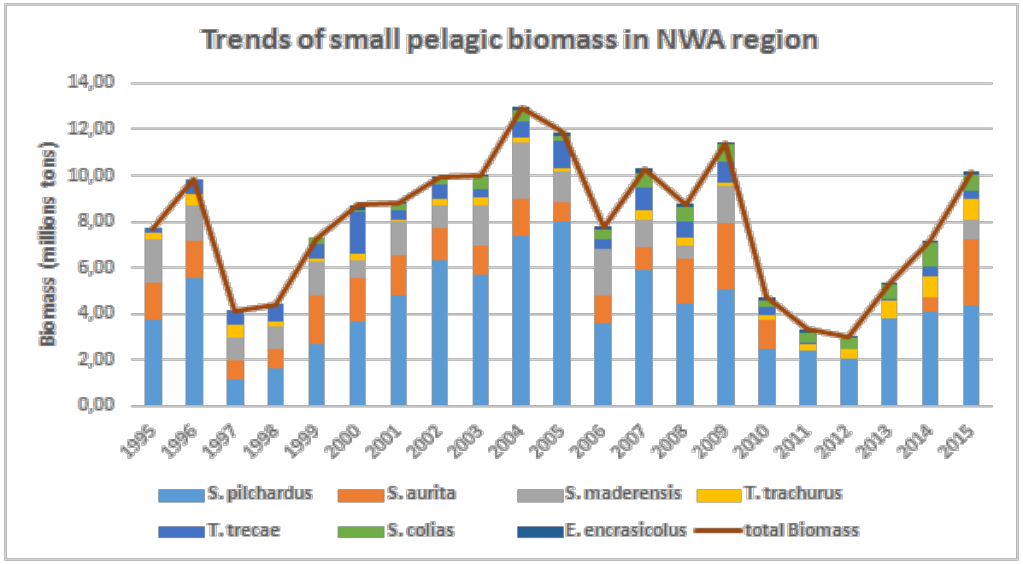

Sardinella maderensis


Trachurus trecae

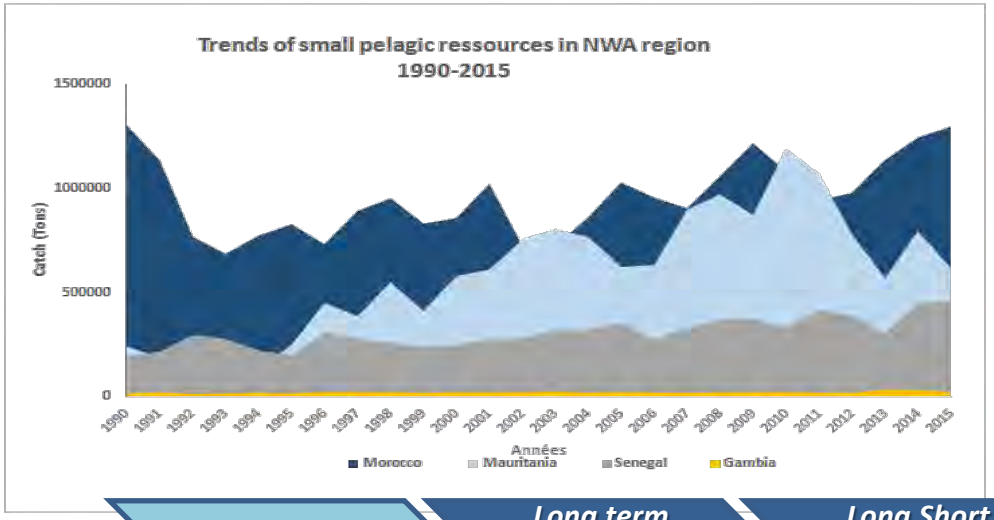

Ethmalosa fimbriata

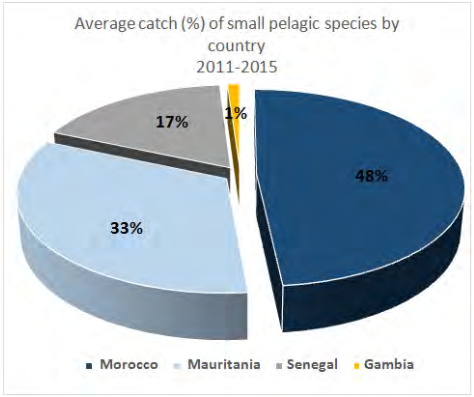
Small pelagics are a key species of the Canary Current Ecosystem

- Trend of the annual biomasse estimates of Small pelagics in in North West Africa



- Trend of the annual catchs of Small pelagics in North West Africa region





Small pelagic fish assessment in NWA region by Acoustic surveys

2007-2016

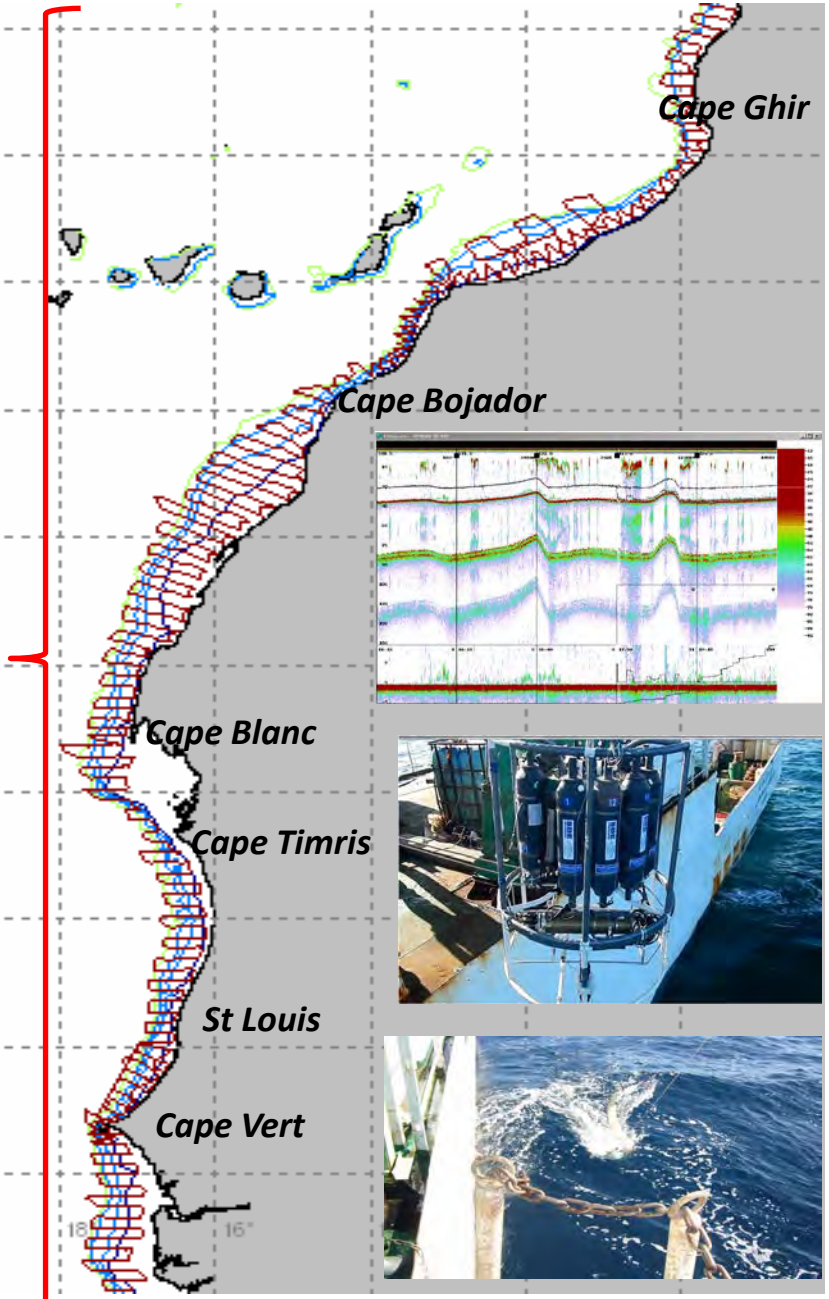
Amir My Abdallah

Al Awam

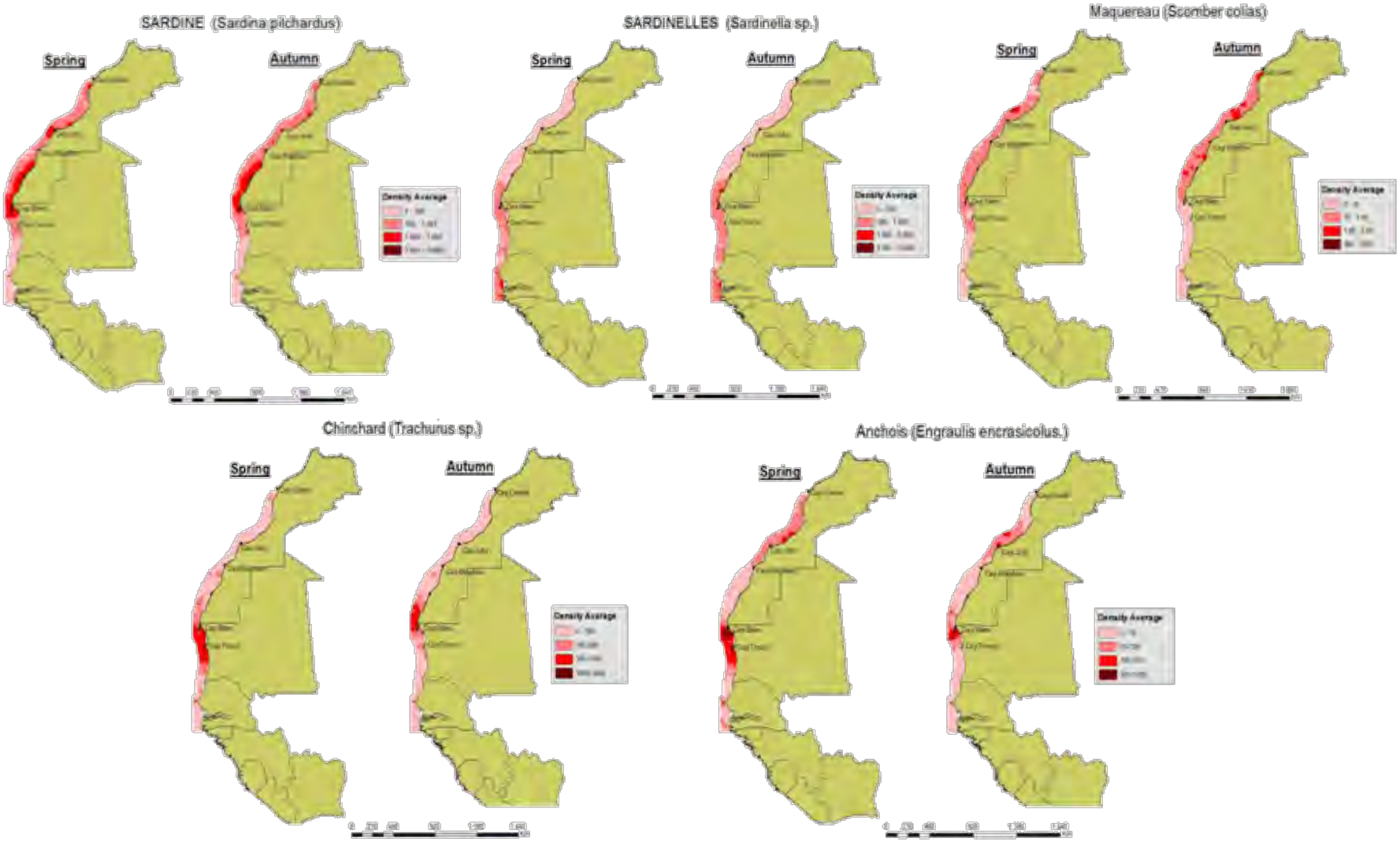
Itaf Deme

1995-2006; 2015

Dr Fridtjof Nansen



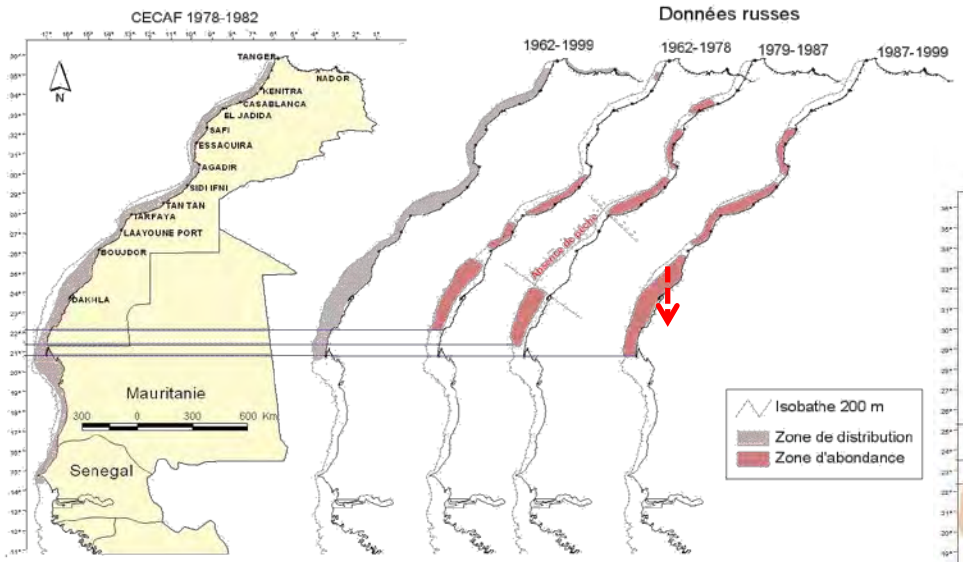
Spatial distribution of small pelagic species in NWA



Mean SPF distribution in the period 2000_2006

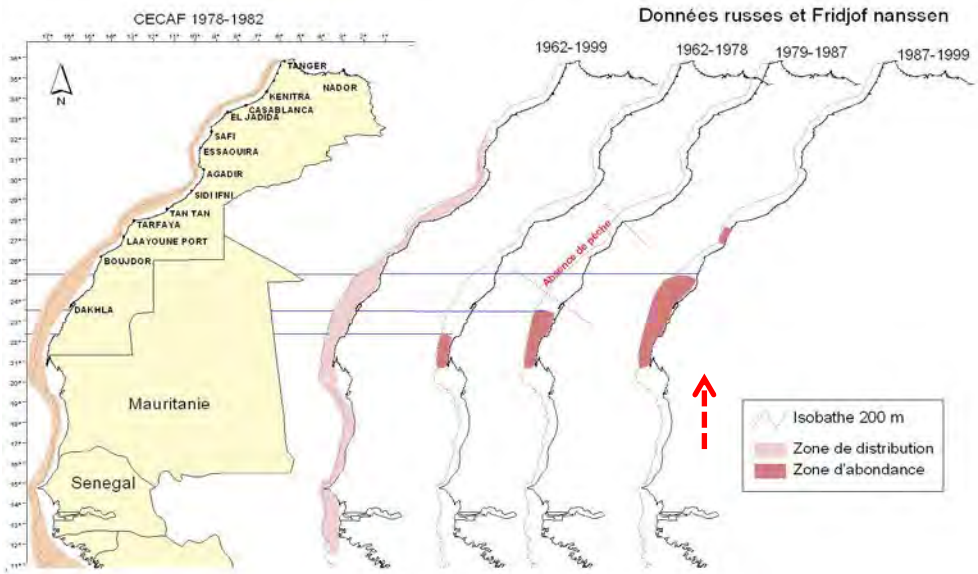
Long term context: Change in distribution areas of SPF in NWA

❑ Latitudinal trend of small pelagic stocks (North Cape Blanc)



La sardine (Sardina pilchardus)

Abundance area of sardine in 1962-1999.

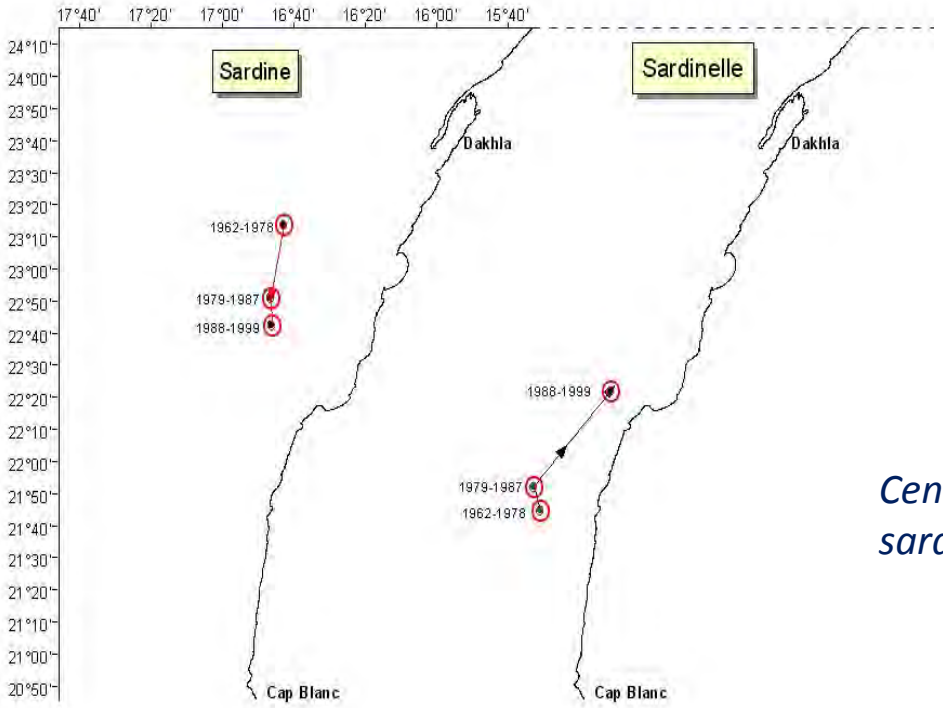


La sardinelle (Sardinella aurita)

Abundance area of Sardinella in 1962 - 1999.

Long term context: Change in distribution areas of SPF in NWA

❑ Latitudinal trend of small pelagic fish

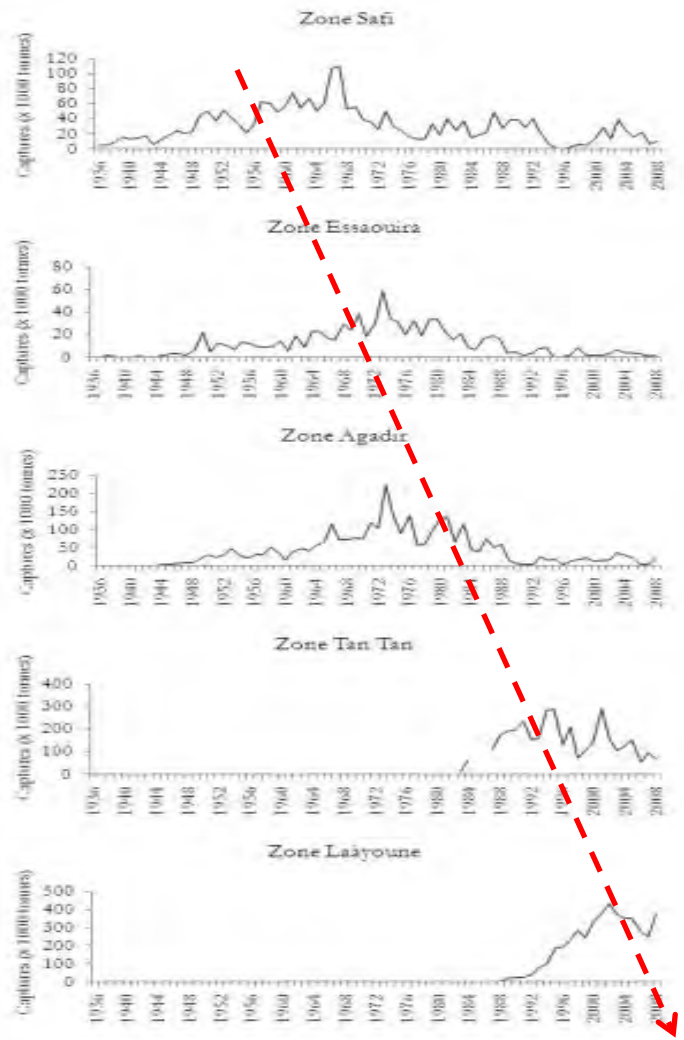


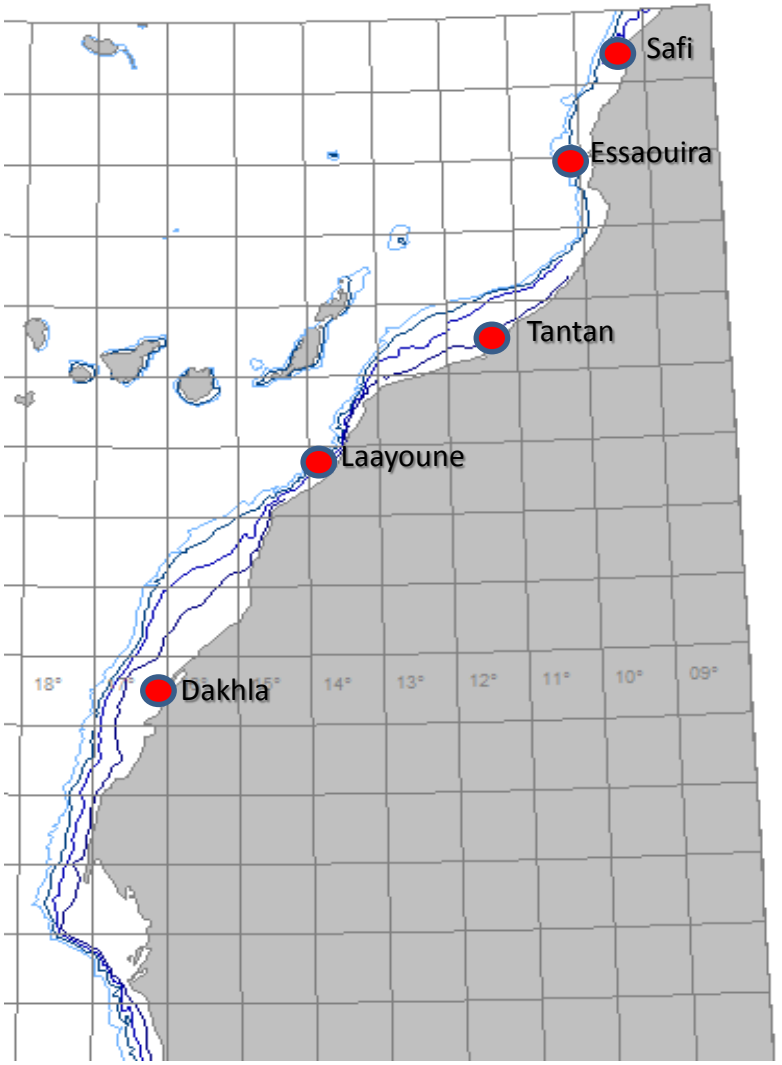
Centroids of Sardine and sardinella 1962-1999

A long term trend in the abundance areas: southward for the septentrional fish (sardine) and northward for the meridional fish (sardinella).

Long term context: Change in distribution areas of SPF in NWA

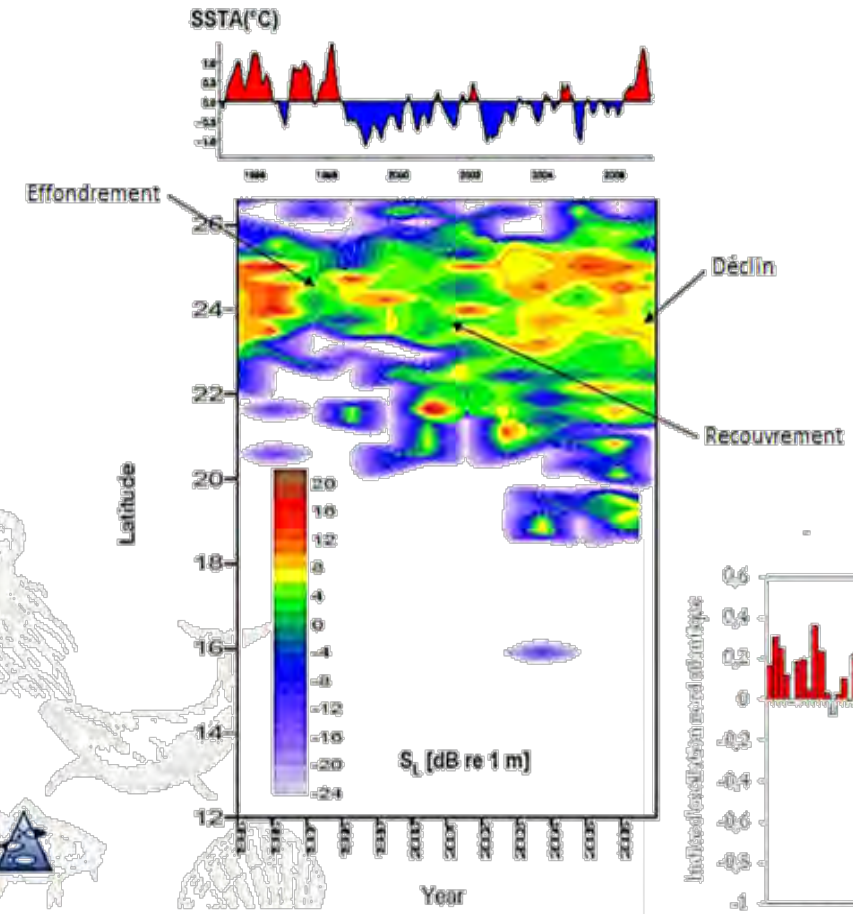
- **Latitudinal moving of small pelagic fish**



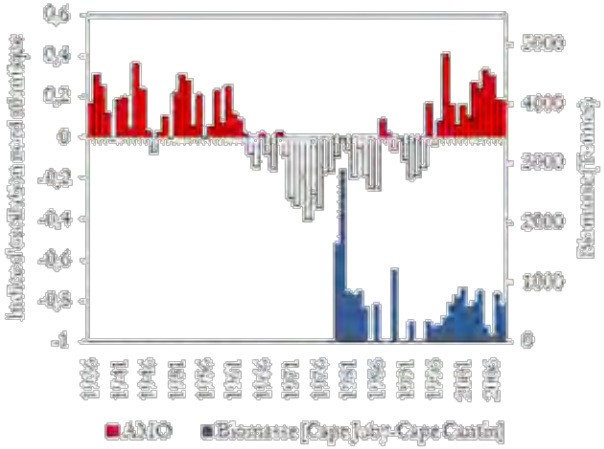


Long term context: Change in distribution areas of SPF in NWA

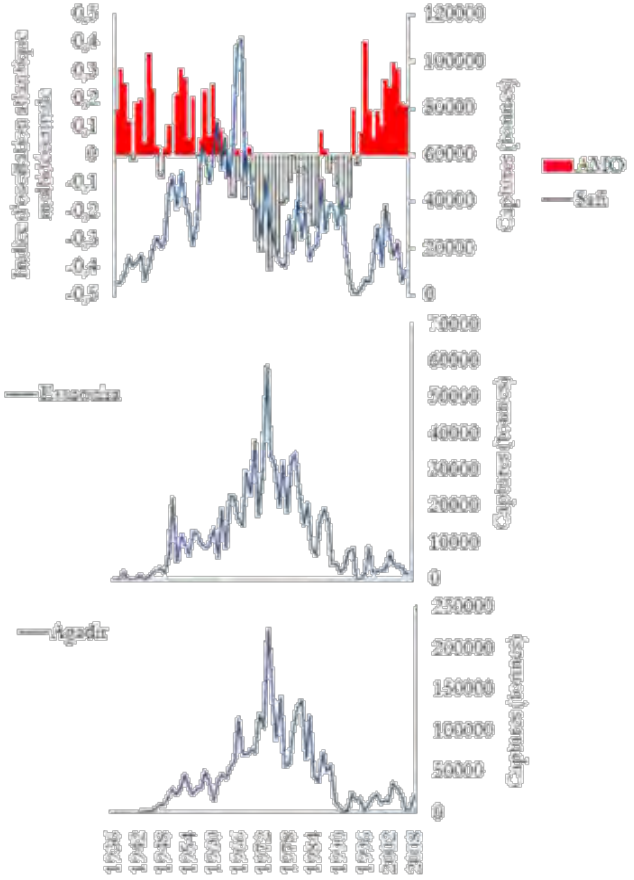
❑Sardine biomass and Atlantic Multi-Decadale Oscillation (AMO indice)



[Ostrowski et al, 2008]



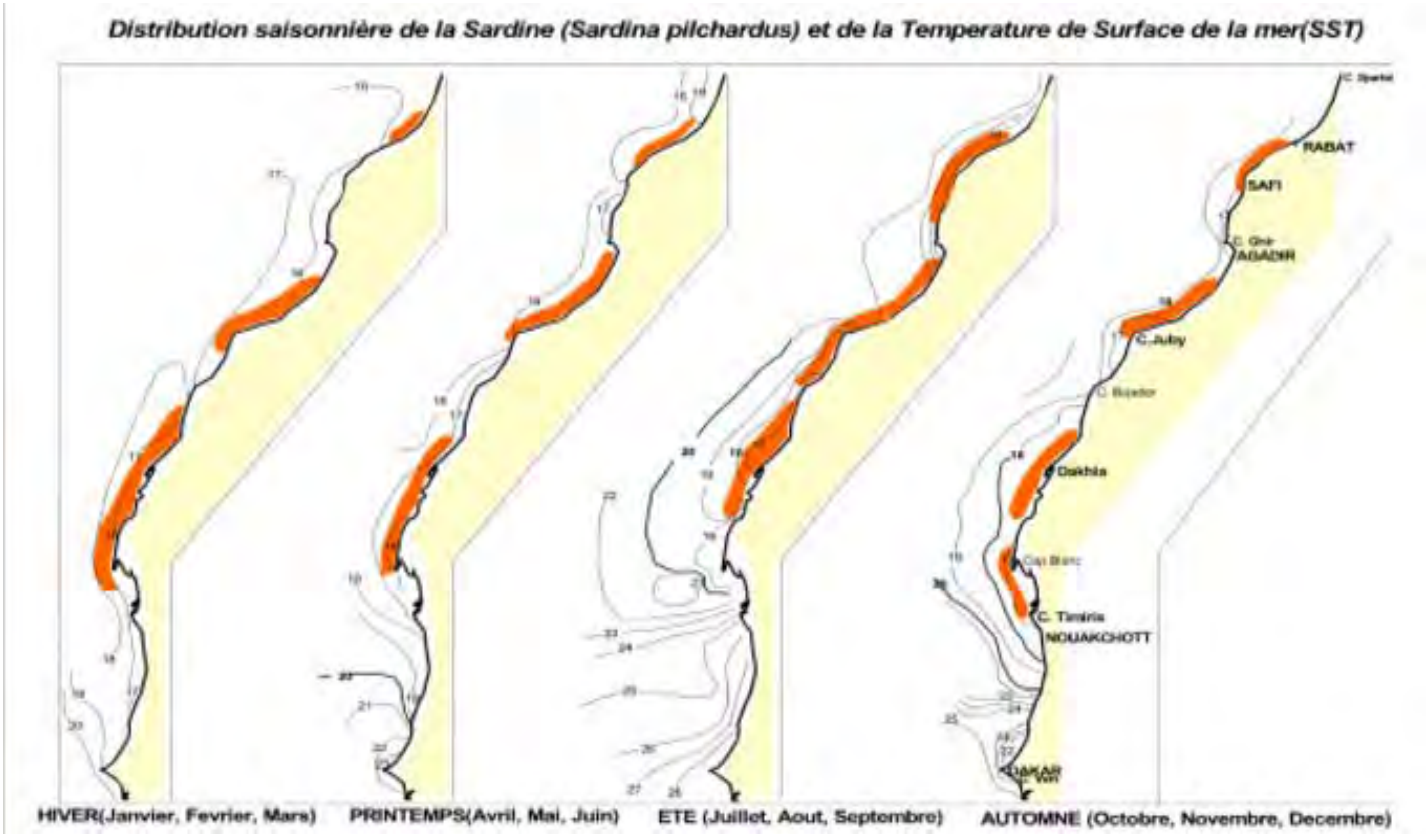
Cape Cantin –Cape Boujdor-



[Kifani et al]

Short term context: Seasonnal migrations of SPF

❑ Seasonnal distribution of sardine in NWA

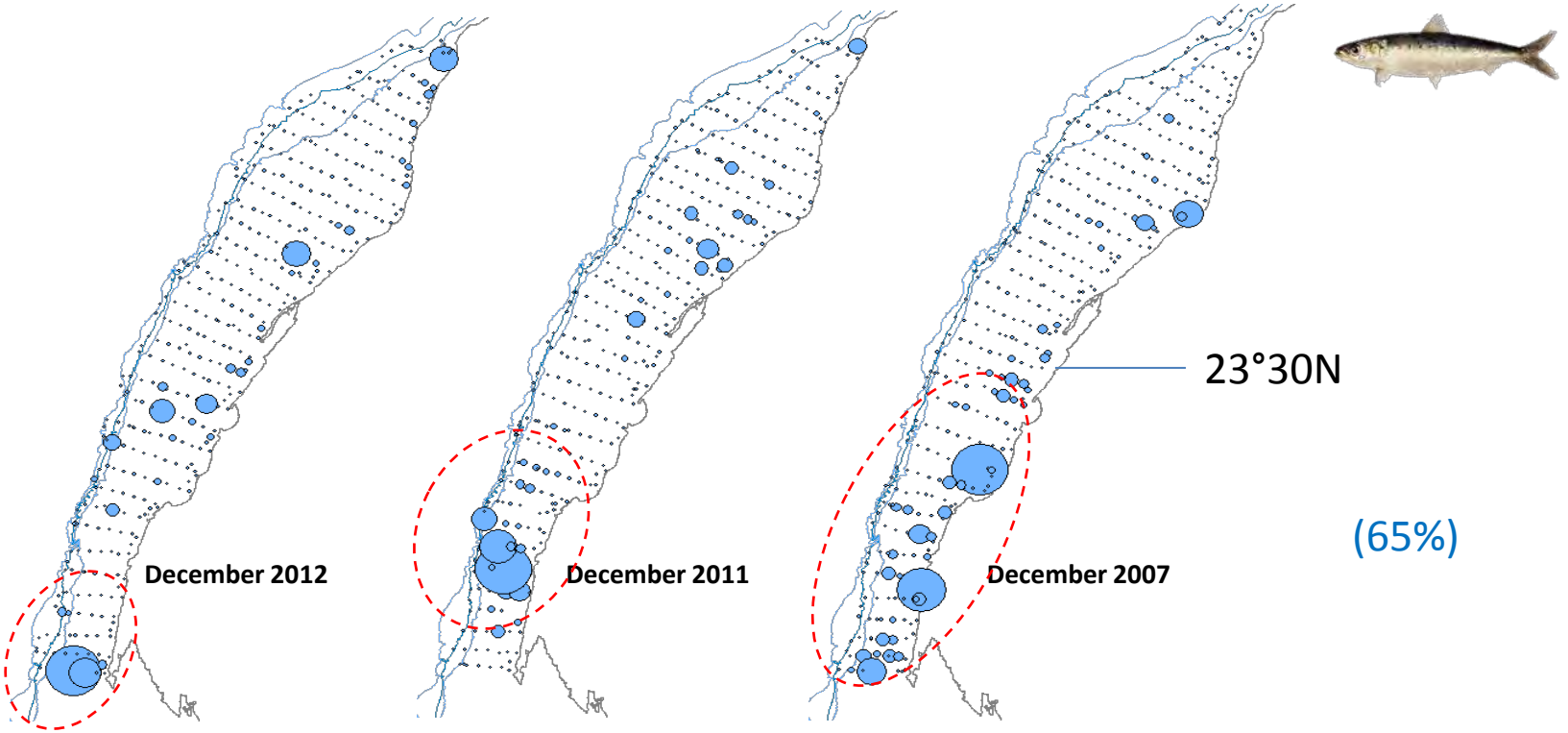


Winter ***Spring*** ***Summer*** ***Autumn***

Moustahfid, 2002

Short term context: Seasonnal migrations of SPF

❑ Seasonal distribution pattern of small pelagic fish: Typical examples of winter situation

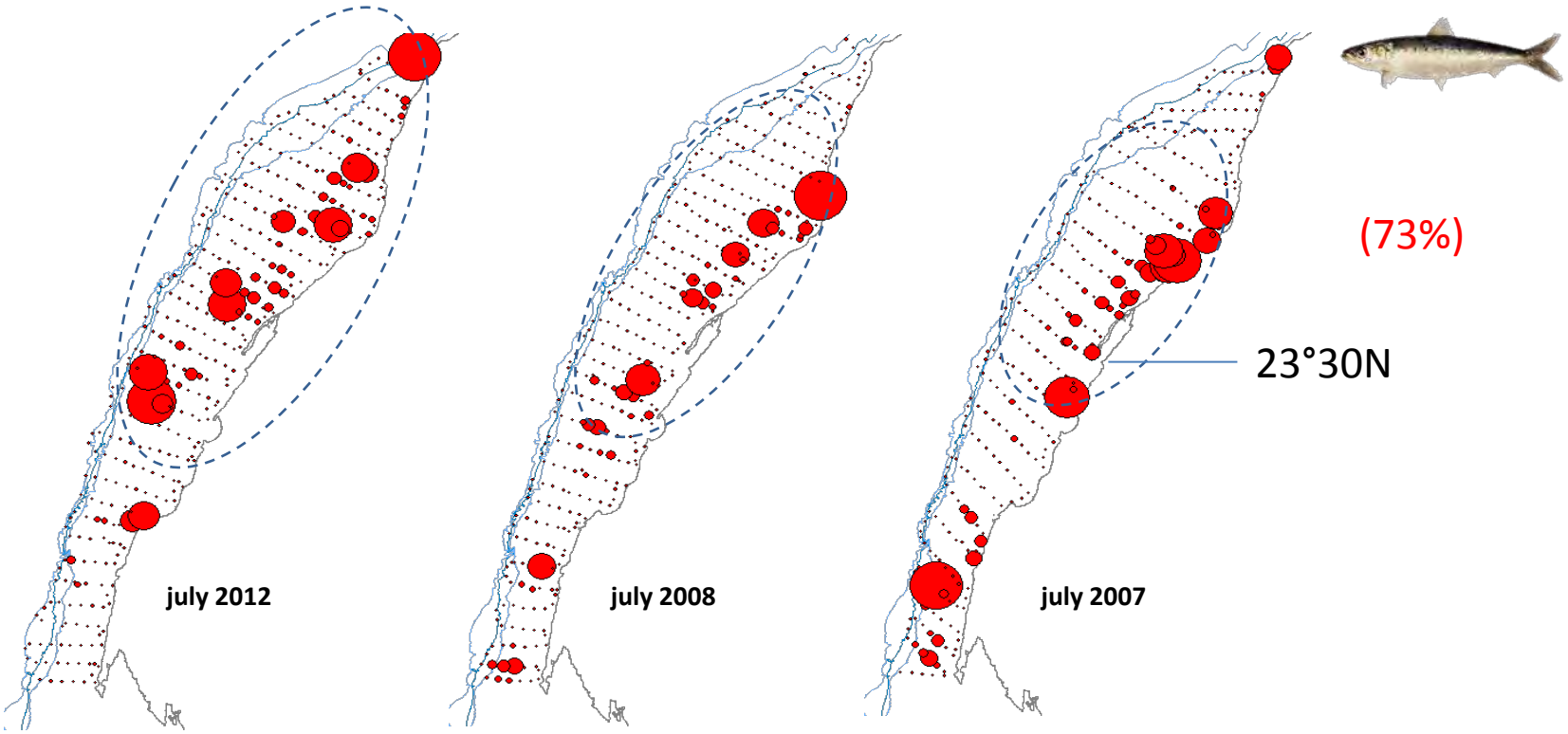


Dynamics are likely driven by the hydrographic features in the area

- ✓ Winter situation: fish is more prevalent in the southern part (south Dakhla (23°30N)). due to the dominance of the northern currents Bordering the area to its southern parts, and which are more favorable for pilchards.
- ✓ Fish are more aggregated and the distribution ranges are narrower at breeding period

Short term context: Seasonnal migrations of SPF

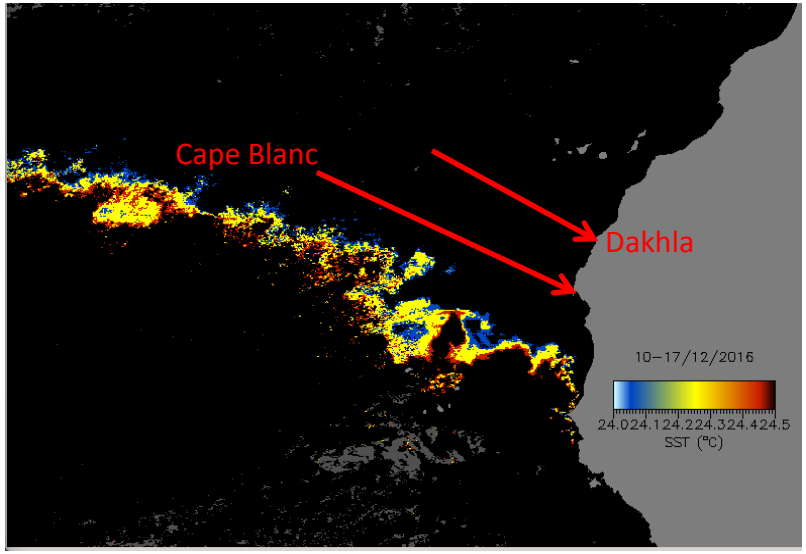
❑ Seasonal distribution pattern of sardine: Typical examples of summer situation

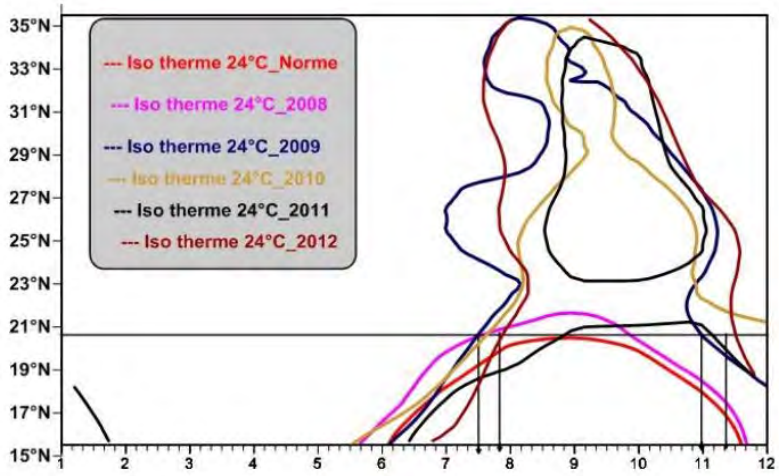


- ✓ Summer situation: fish are more scattered in the recruitment period. Detections are more important in northern part of Bay Cintra (23°00N), due to intrusions of tropical waters through Cape Blanc.
- ✓ More other pelagic species with tropical affinity are found south Bay Cintra

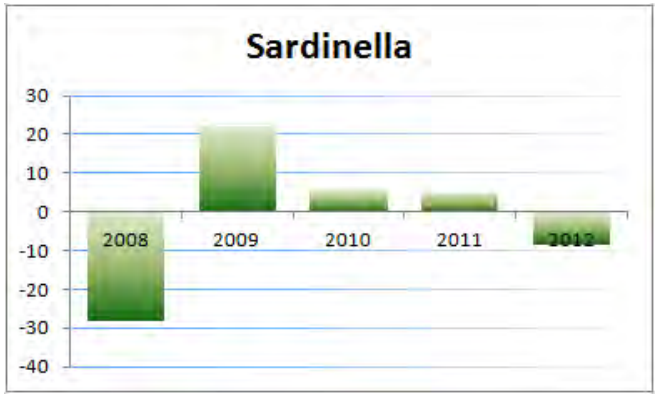
Short term context: Seasonnal migrations of SPF

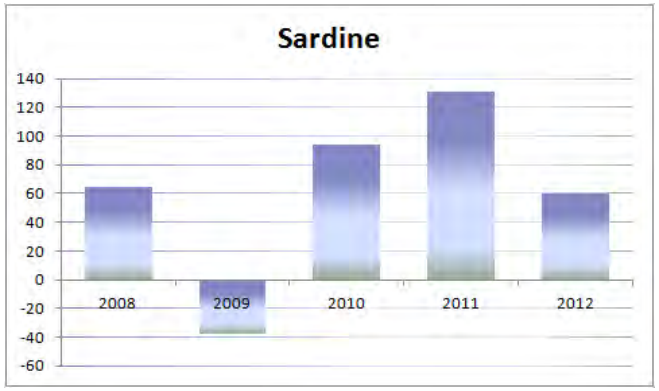
❑ Seasonnal dynamic with SST trend





Catchs anomaly at Dakhla port





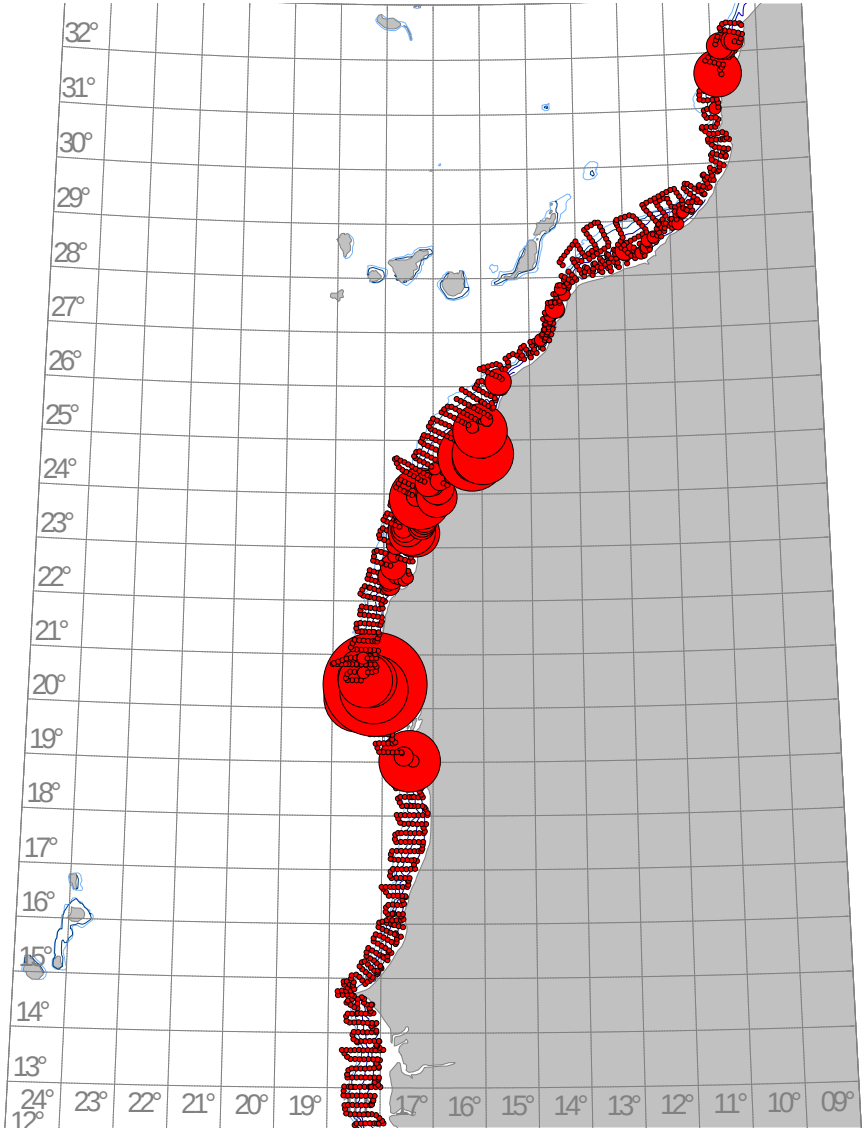
Source :IMROP reports (Mauritania)

Characterizing associations of SPF and correlations with the environment

Nansen Data: 1995-2006

- ✓Fish Data: Acoustic densities (NASC) of Sardine, sardinella, horse mackrel, Chub mackrel and anchovy

- ✓Data CTD transects:
  - ✓Sea surface temperature (SST)
  - ✓Sea surface salinity (SSAL)
  - ✓Sea surface oxygen (SO2)
  - ✓Mean oxygen (MeanO2)



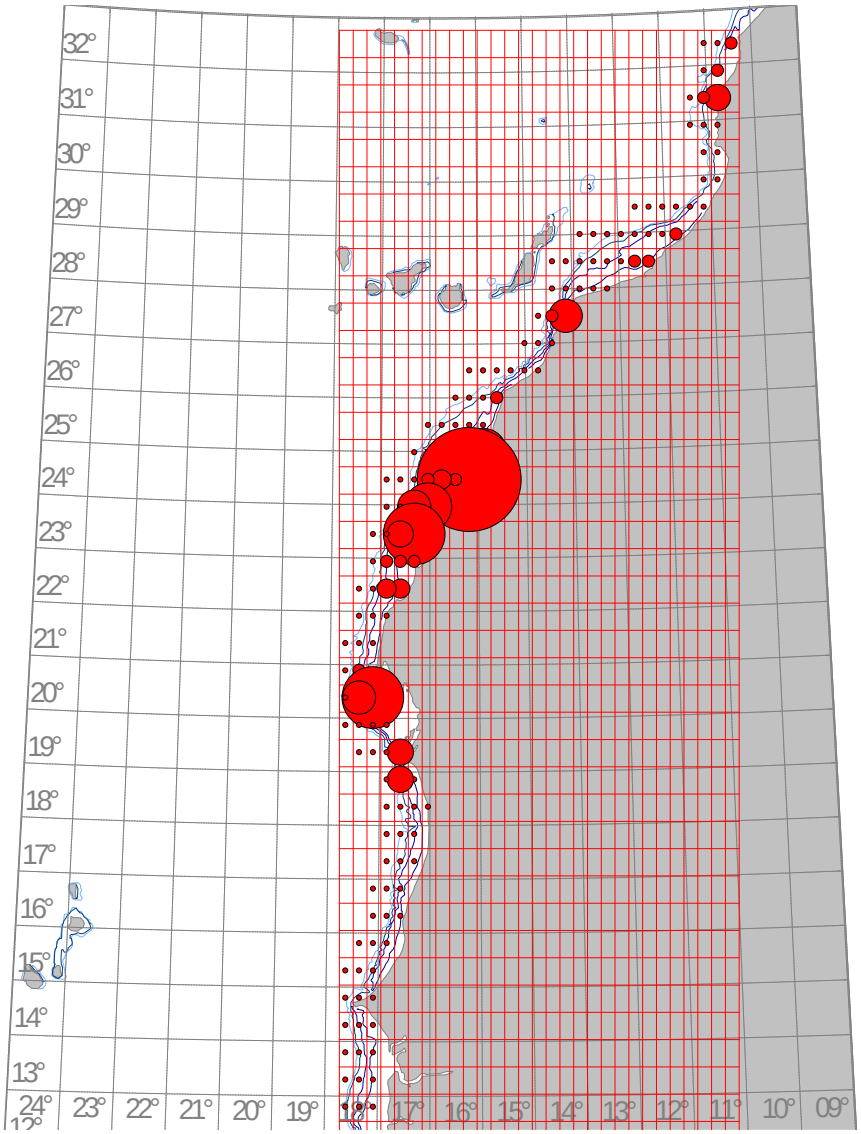
Characterizing associations of SPF and correlations with the environment

Nansen Data: 1995-2006

✓Import Data into a grid cells (15x30 nm^2)

✓Factorial Analysis on fish correspondance: PCA + Clustering on factorial axis

✓Factorial Analysis on fish-hydroparameters correspondance: MFA + Clusturing on factorial axis



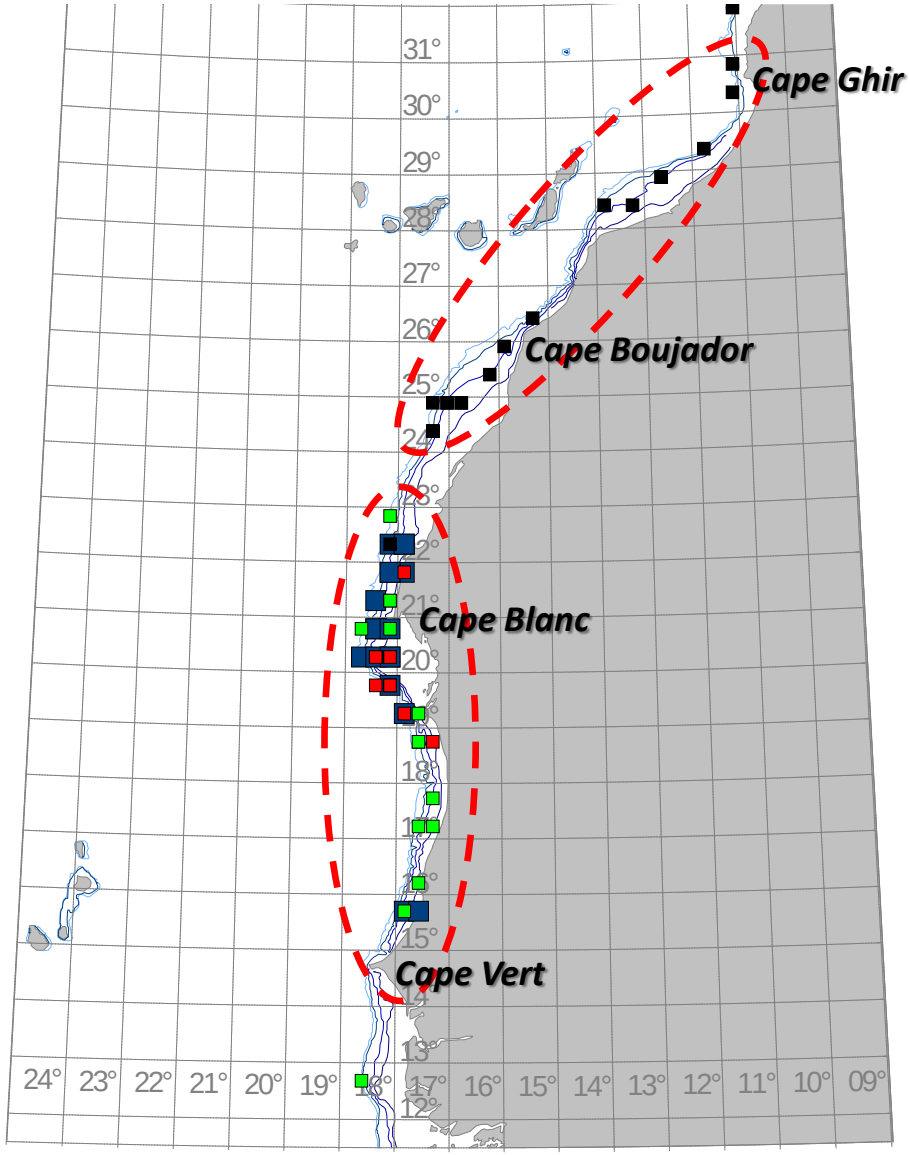
SPF spatial associations in NWA: Species profiles

1. *Sardinella: Associated to Horse mackrel*

2. *Horse mackrel: Associated to sardinella and Anchovy*

3. *Anchovy: Associated to . Horse mackrel sardinella.*

4. *Sardine: Associated to Chub mackrel*



SPF and environment correlations

Coordinates of active variables						
	Variables	axe 1	axe 2	axe 3	axe 4	axe 5
Groupe 1	Pilch	23,6537	7,0945	27,3247	13,8757	2,4657
	Sard	24,5591	21,1310	5,5474	4,5616	19,2200
	Horse	0,6009	58,8892	4,1931	3,9574	1,8758
	Scomb	0,3382	0,0440	0,9599	0,1479	0,0276
	Anch	0,3850	0,0660	0,0251	18,7915	53,0744
	All	49,5368	87,2247	38,0502	41,3341	76,6634
Groupe 2	Mean02	7,9084	10,0221	24,6583	3,0987	2,6771
	SST	15,8688	0,2353	0,0176	30,0009	3,7818
	SSO2	11,2530	0,4565	36,5991	7,2097	0,0216
	Ssal	15,4331	2,0615	0,6748	18,3566	16,8560
	All	50,4633	12,7754	61,9498	58,6659	23,3365

Classe 1 / 5 (Poids = 25.00 Effectif = 25)

Variables caractéristiques	Moyenne dans la classe	Moyenne générale	Ecart-type dans la classe	Ecart-type général	Valeur-Test	Probabilité
SST	28,989	21,003	0,663	3,447	12,08	0,000
Sard	0,560	0,218	0,262	0,292	6,11	0,000
Axe factoriel 2	0,742	0,000	1,040	1,017	3,81	0,000

Classe 2 / 5 (Poids = 75.00 Effectif = 75)

Variables caractéristiques	Moyenne dans la classe	Moyenne générale	Ecart-type dans la classe	Ecart-type général	Valeur-Test	Probabilité
Sard	0,598	0,218	0,148	0,292	13,03	0,000
Axe factoriel 5	0,392	0,000	0,212	0,487	8,05	0,000
Axe factoriel 2	0,661	0,000	0,466	1,017	6,49	0,000
Axe factoriel 4	0,380	0,000	0,375	0,597	6,35	0,000
SST	21,805	21,003	2,859	3,447	2,32	0,010

Sardinella ----> Temperature and Salinity

SPF and environment correlations

Classe 3 / 5 (Poids = 86.00 Effectif = 86)

Variables caractéristiques	Moyenne dans la classe	Moyenne générale	Ecart-type dans la classe	Ecart-type général	Valeur-Test	Probabilité
Horse	0,638	0,240	0,085	0,283	15,46	0,000
Ssal	36,192	36,030	0,391	0,731	2,43	0,008

Horse mackrel -----> Salinity

Classe 4 / 5 (Poids = 26.00 Effectif = 26)

Variables caractéristiques	Moyenne dans la classe	Moyenne générale	Ecart-type dans la classe	Ecart-type général	Valeur-Test	Probabilité
Anch	0,534	0,057	0,135	0,159	16,04	0,000
Axe factoriel 4	1,081	0,000	0,314	0,597	9,64	0,000
Axe factoriel 1	0,488	0,000	0,673	1,277	2,04	0,021

Anchovy -----> Temrerature and salinity

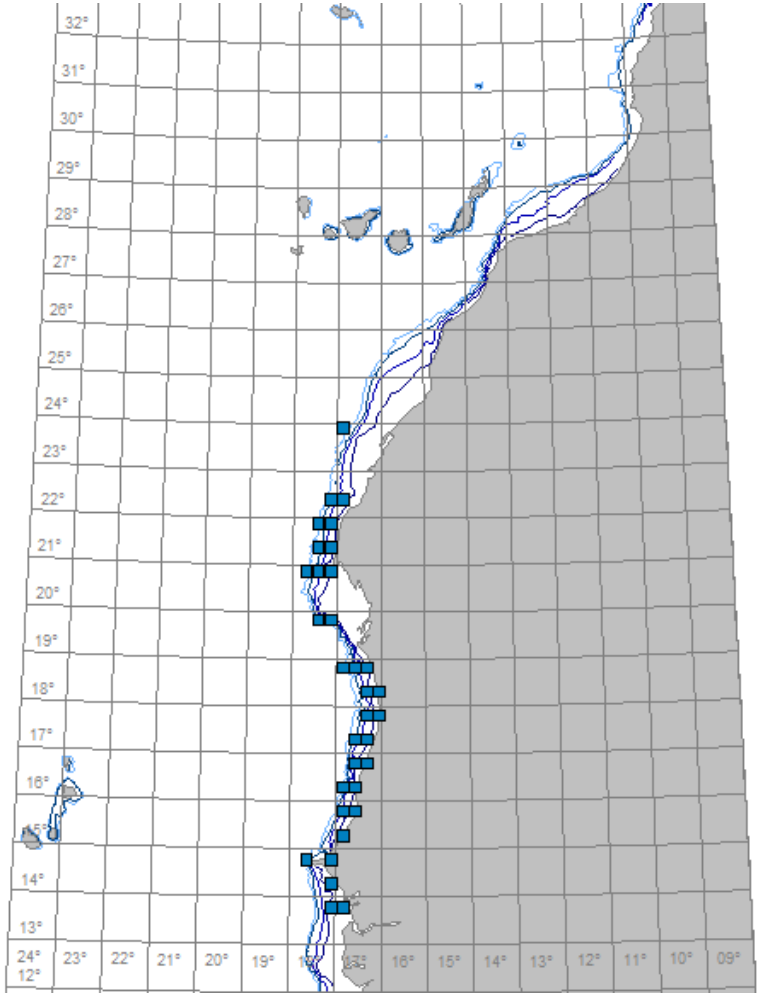
Classe 5 / 5 (Poids = 87.00 Effectif = 87)

Variables caractéristiques	Moyenne dans la classe	Moyenne générale	Ecart-type dans la classe	Ecart-type général	Valeur-Test	Probabilité
Pilch	0,600	0,195	0,108	0,274	16,33	0,000
Axe factoriel 1	1,471	0,000	0,367	1,277	12,74	0,000
Mean02	4,861	4,071	0,987	1,186	7,37	0,000
SSO2	5,553	5,086	0,621	0,771	6,69	0,000
Ssal	36,454	36,030	0,196	0,731	6,41	0,000
Axe factoriel 3	0,359	0,000	0,567	0,623	6,37	0,000
Axe factoriel 2	0,551	0,000	0,287	1,017	5,99	0,000
Scomb	0,061	0,028	0,128	0,097	3,76	0,000
Axe factoriel 5	0,096	0,000	0,168	0,487	2,18	0,015

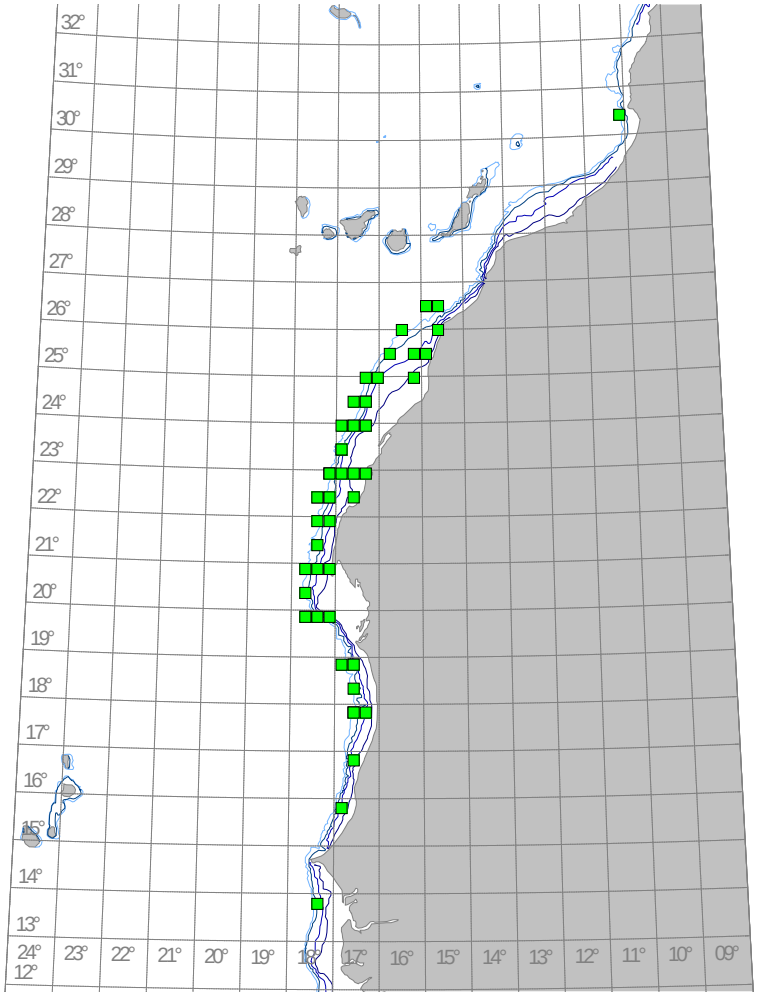
Sardine+ Scomber ----> Oxygen and salinity

Interactions analysis: Environnment – SPF

Sardinella ----> Temperature and salinity

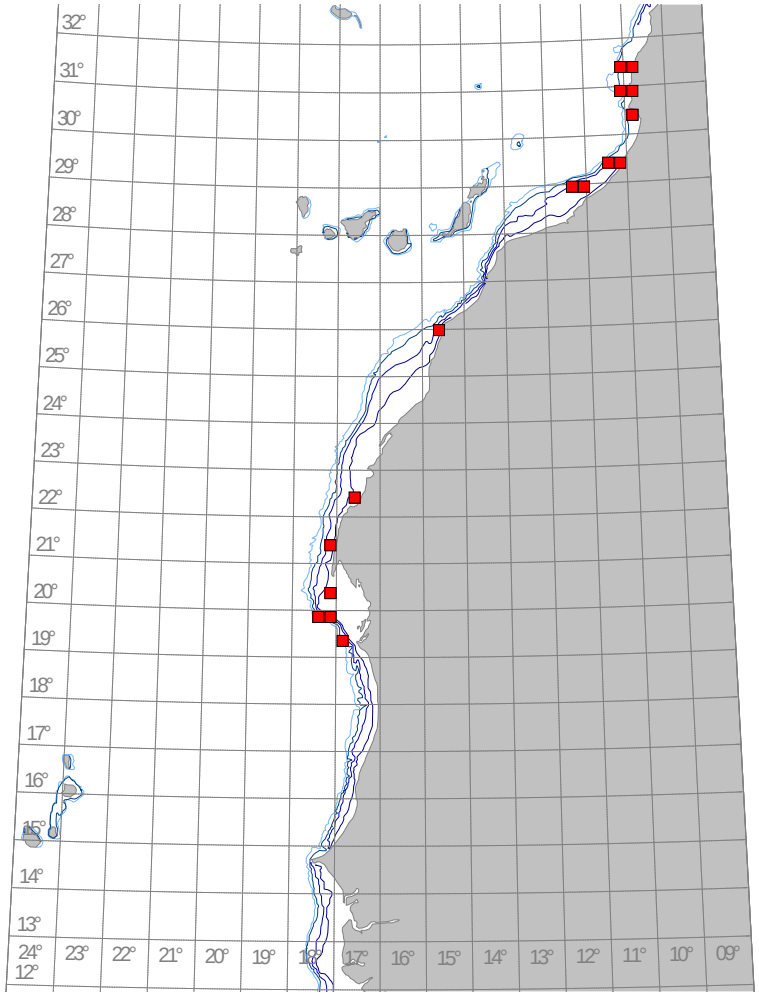


Horse mackrel -----> Salinity

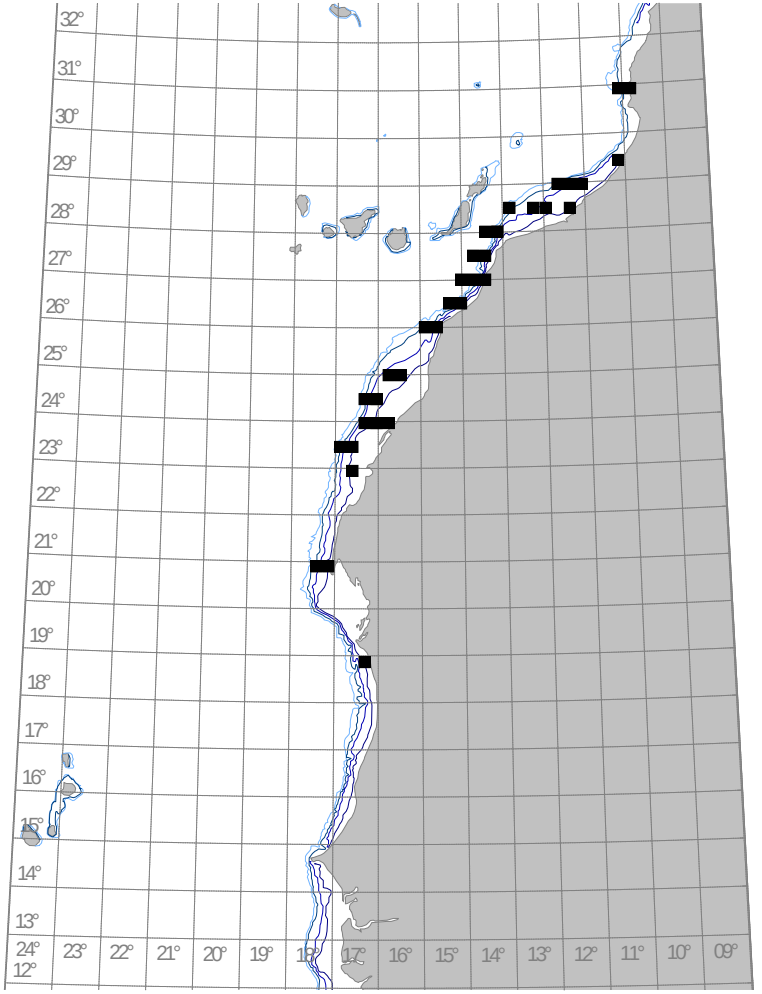


Interactions analysis: Environnment – SPF

Anchovy -----> Temperature and salinity

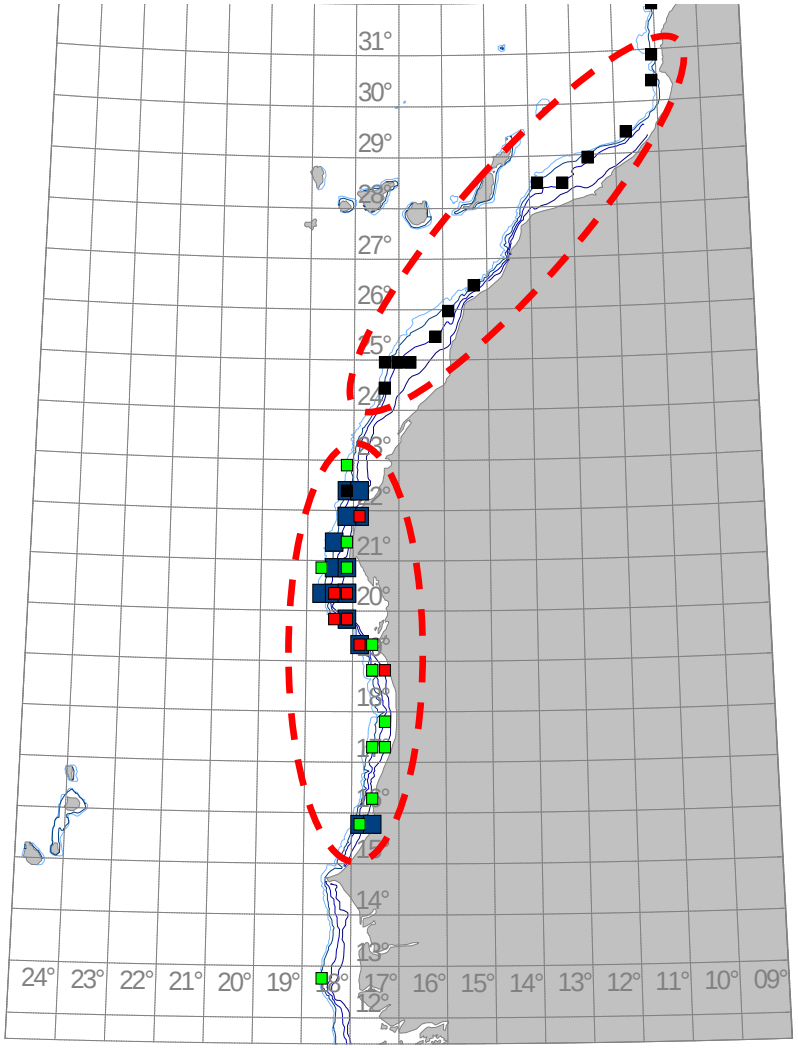


Sardine+ Scomber ----> Oxygen and salinity

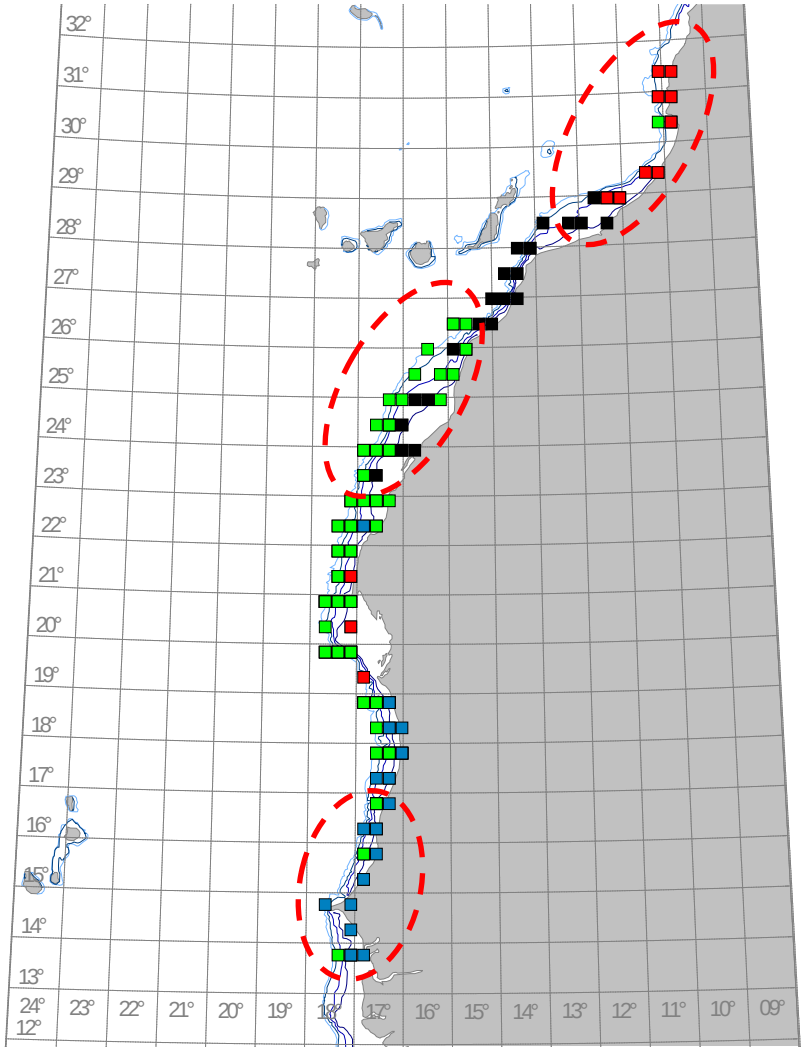


Interactions analysis: Environnment – SPF

SPF associations



SPF -environnment



Concluding remarks & Outlook

✓ Important fish spatial interactions are identified althought the high variability in the small pelagic stocks dynamic.

✓Associations seems to be more consistants at the adjoining area on both sides of Cape Blanc and Mauritania

✓ Some environnmental preferences are spatialy identified for the SPF species

In perspective

✓Conducting analyzis with more fish (trawl catchs) and environnment data (thermocline depth, oxycline, plankton north Cape Blanc…)

✓Extending database to recent surveys (after 2007)

✓Considering demography (juveniles/adults) in the analysis

Thanks to:

- ***CCLME project***
- ***FAO/ EAF-Nansen Program***

Thank you

Victoria, 06 – 11 March 2017