Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries

May 4 – 8, 2026 | La Paz, Mexico

PICES ICES CIEM Food and Agriculture Organization of the United Nations

Endorsed by 2021 2030 United Nations Decade of Ocean Science for Sustainable Development

La Paz , May 2026

Nature scientific reports

Climate change impacts on small pelagic fish distribution in Northwest Africa: Trends, shifts, and risk for food security /Regional initiatives to tackle the impacts ?

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Importance of Small Pelagics in North West Africa (NWA)

- NWA → **Pelagic resources** are one of the most **abundant** in the word.
  High productivity → attributed to the coastal **upwelling** (permanent/saisonal)

- Small pelagic fish are a major component in the region **for food security** (Ba et al. 2017).

Small pelagic resources in North West Africa

Tropical species……

Round sardinella

Sardinella aurita/ Sardinelle ronde

Flat sardinella

Sardinella maderensis/ Sardinelle plate

Cunene horse mackerel

Trachurus trecae
Chinchard noir

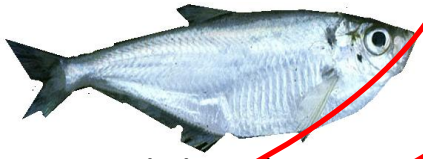
False scad

Decapterus rhonchus
Chinchard jaune

bonga shad

Ethmalosa fimbriata
Bonga

West African Ilisha



Ilisha africana
Alose rasoir

Temperate species ……..

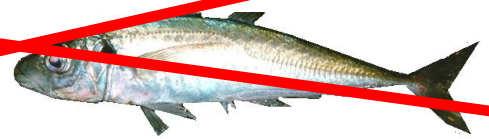
Sardine

Sardina pilchardus
Sardine

Chub mackerel

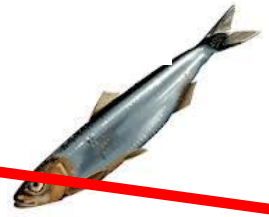
Scomber colias
Maquereau

Atlantic horse mackerel



Trachurus trachurus
Chinchard commun

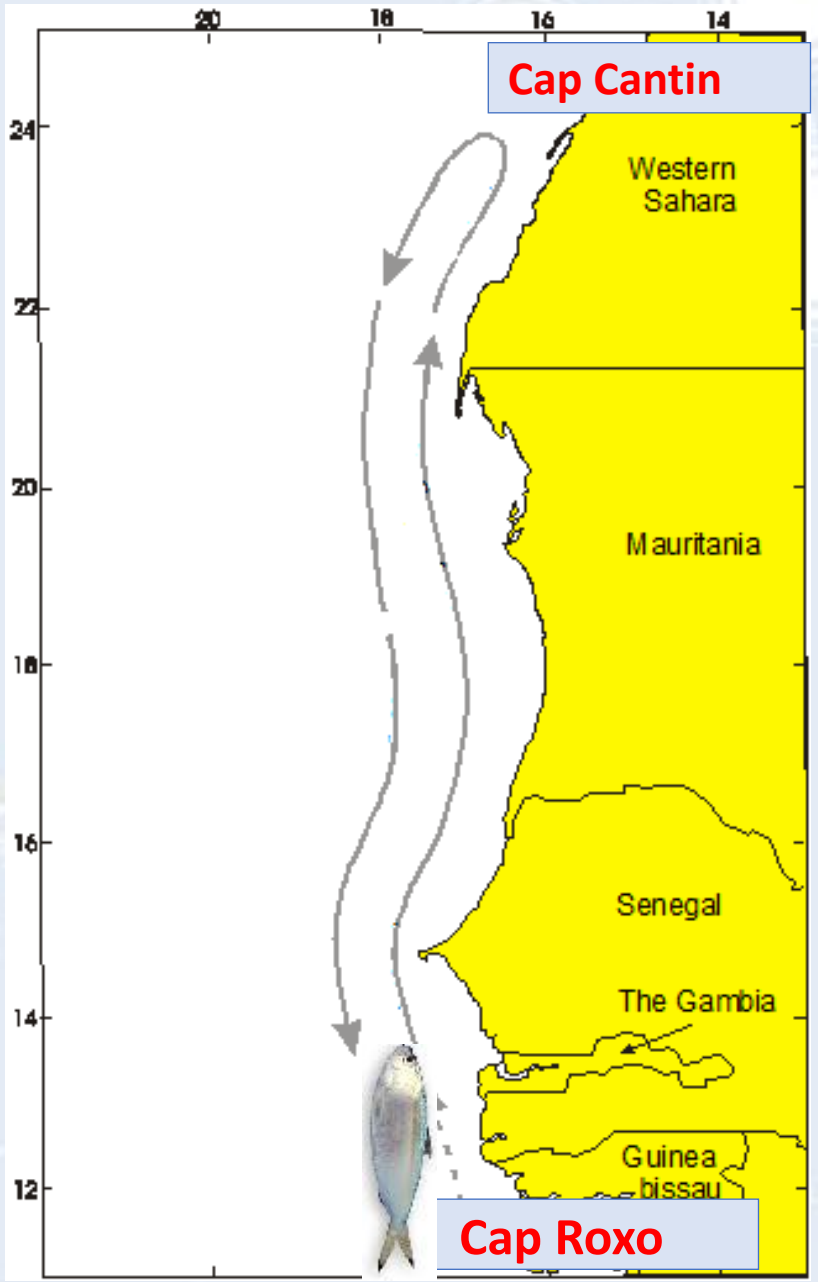
Anchovy



Engraulis encrasicolus
Anchois

Shared resources…

Among several different countries of (CCLME) between Cap Roxo (Senegal) and Cap Cantin (Morocco)

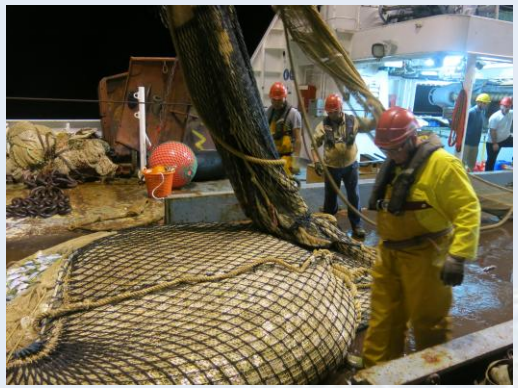


Data used / Données utilisées dans l'étude

Fridtjof Nansen Database (Acoust surveys since 1995) → **consistent** sampling protocol

Acoustic: 170 000 km
Biologic: 2 263 chaluts

Acoustic data → Biomasses of both sardinella (in NASC)



Fishing data → 8 species of interest en NWA

Satellites → Méridian wind, Chlorophylle *a* , SST
1982 to 2015

Processing :

Traitements effectués :

❖ ***Barycentre of biomasses***

Le barycentre des biomasses

❖ ***Northernmost limit of presence***

La présence extrême nord

Analyses annuelles

Environnemental data

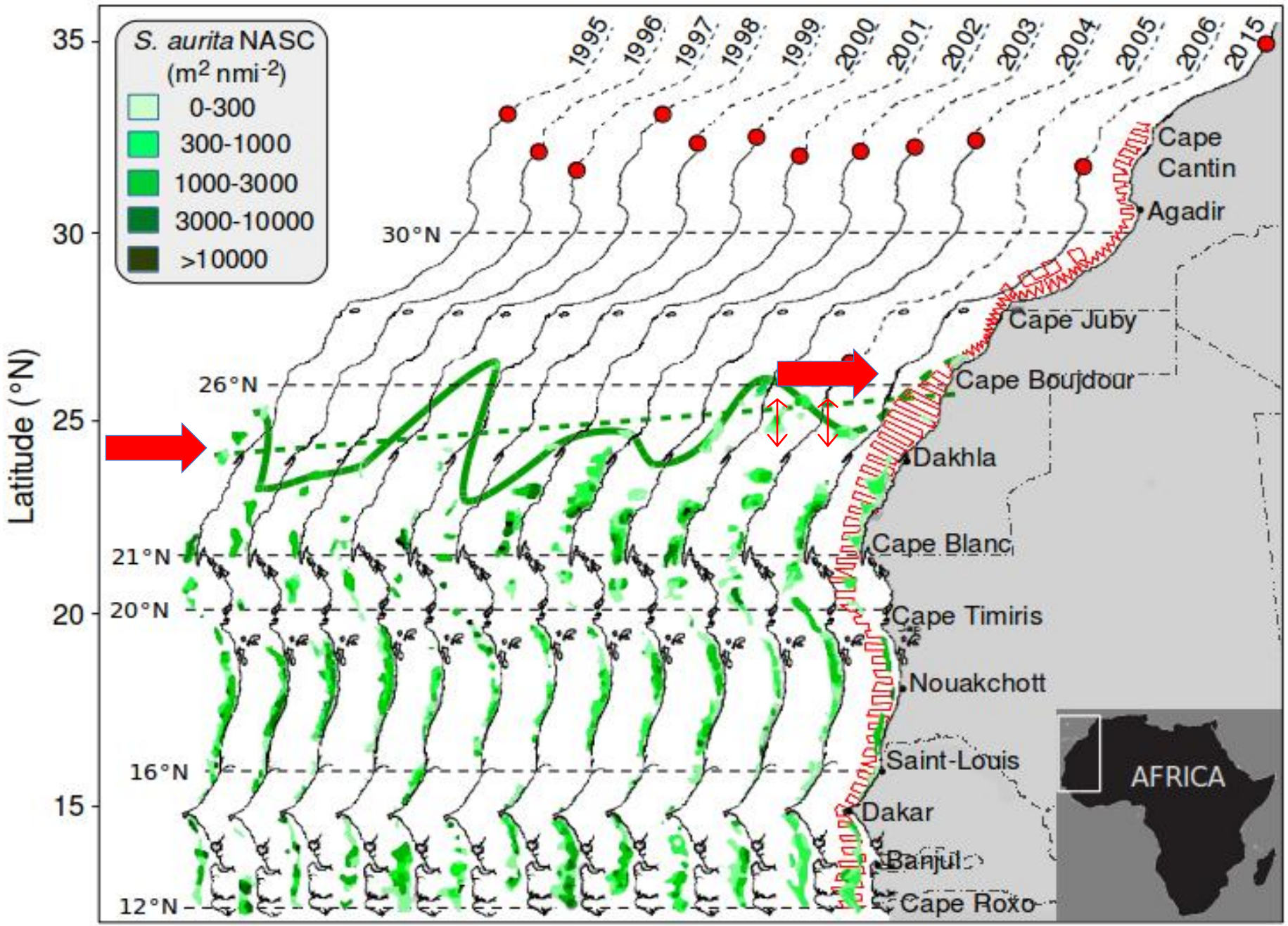
3 key environmental parameters were followed to address our issue:

Trois paramètres environnementaux clés, dont la couverture est synoptique pour aborder notre problématique :

- *Equatorial wind* /Le vent méridional
- *Chlorophyll*-a /*Chlorophyll*-a,Primary production
- Sea surface temperature / *SST*

Results

Sarré *et al.*, 2024

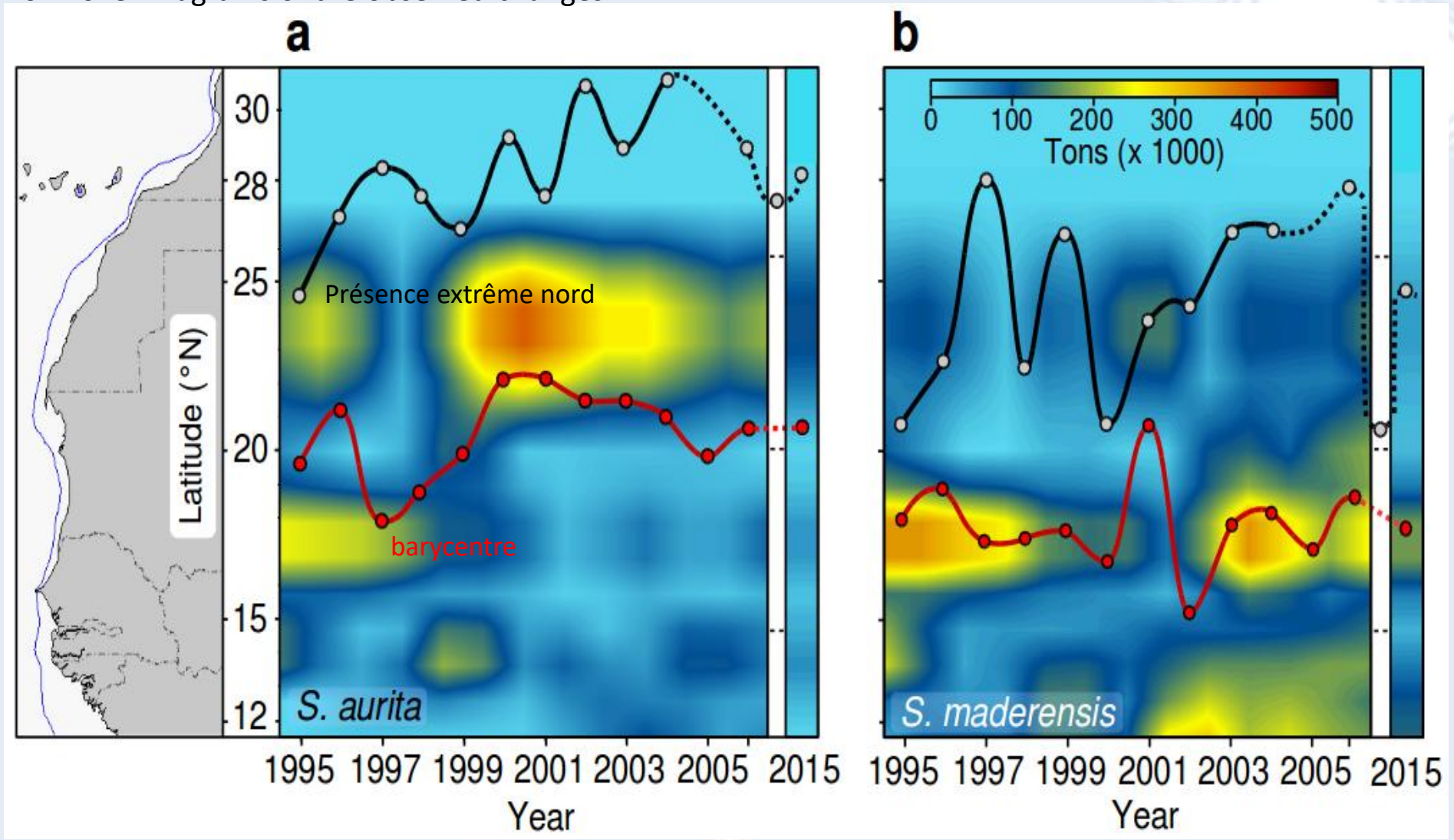


Fish density is shown by different intensities of green

Results

The barycentre of the biomasses and latitudinal extreme presence

Hovmoller Diagrams of the observed changes

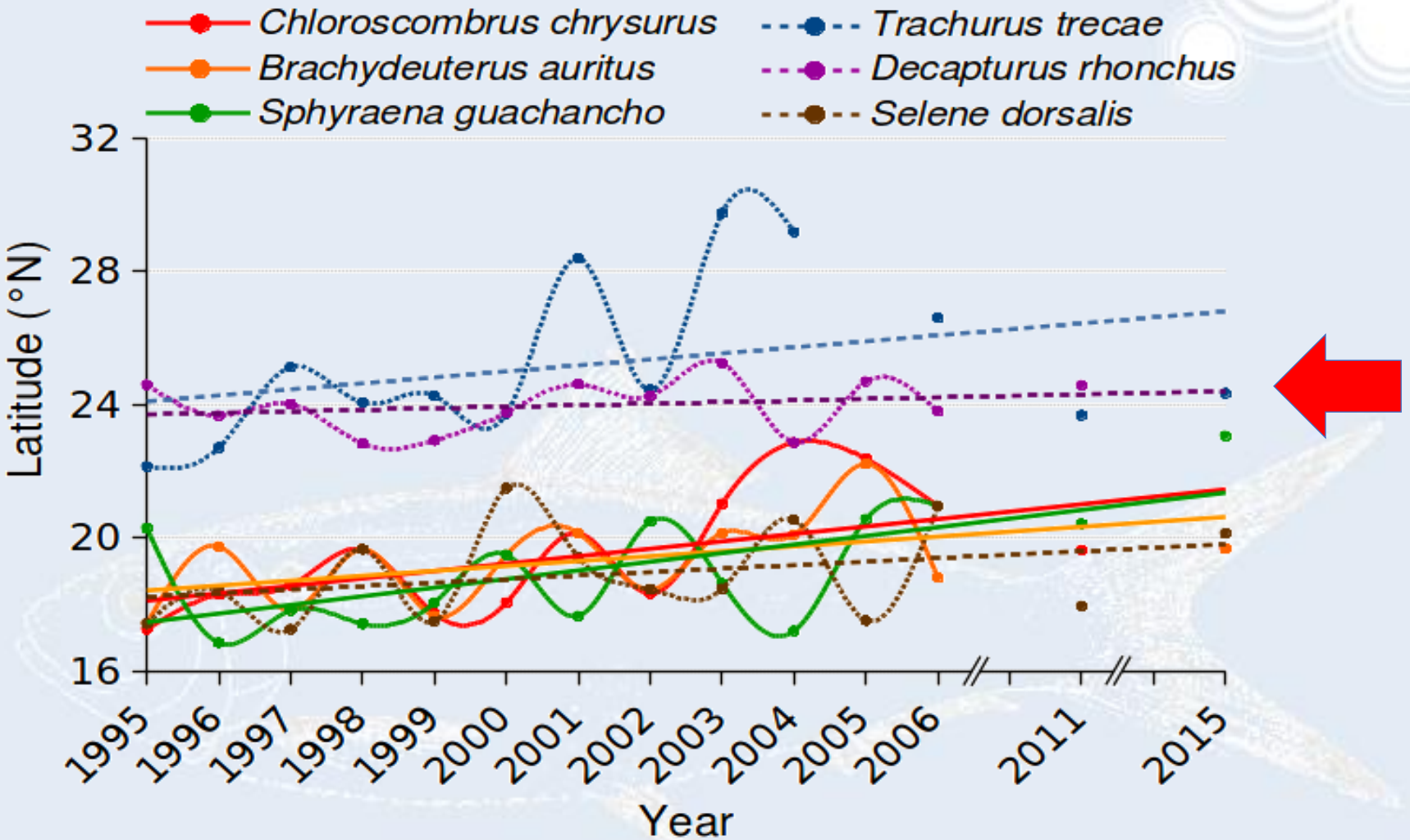


Sarré *et al.*, 2024

Résults

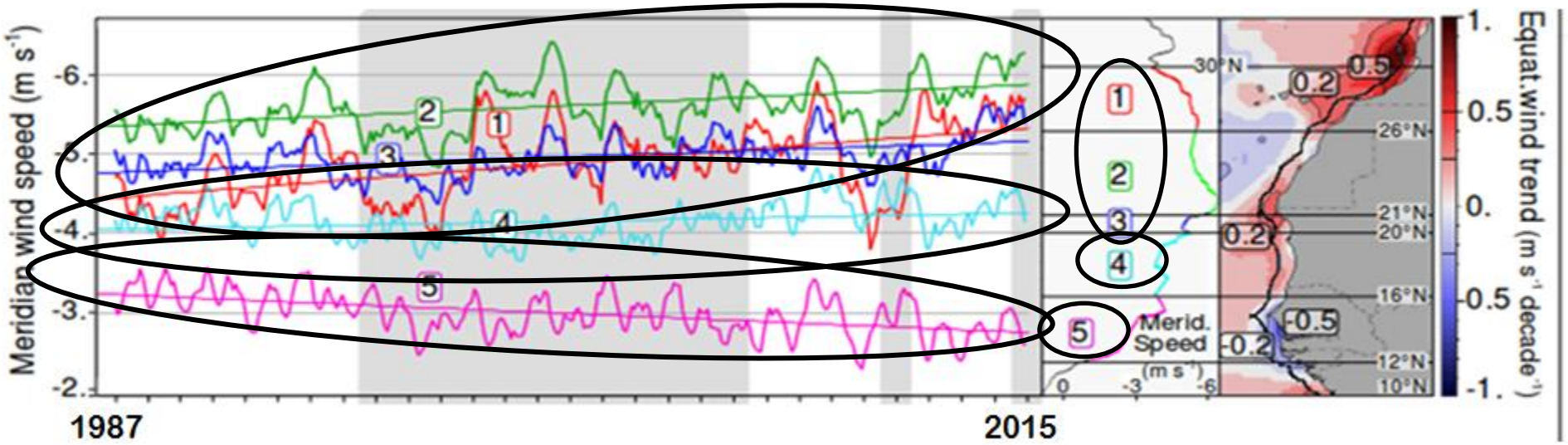
Like S. aurita, other small pelagic fish species showed northward trends in their distribution

Comme *S.aurita*, d'autres espèces ont montré les mêmes signes :



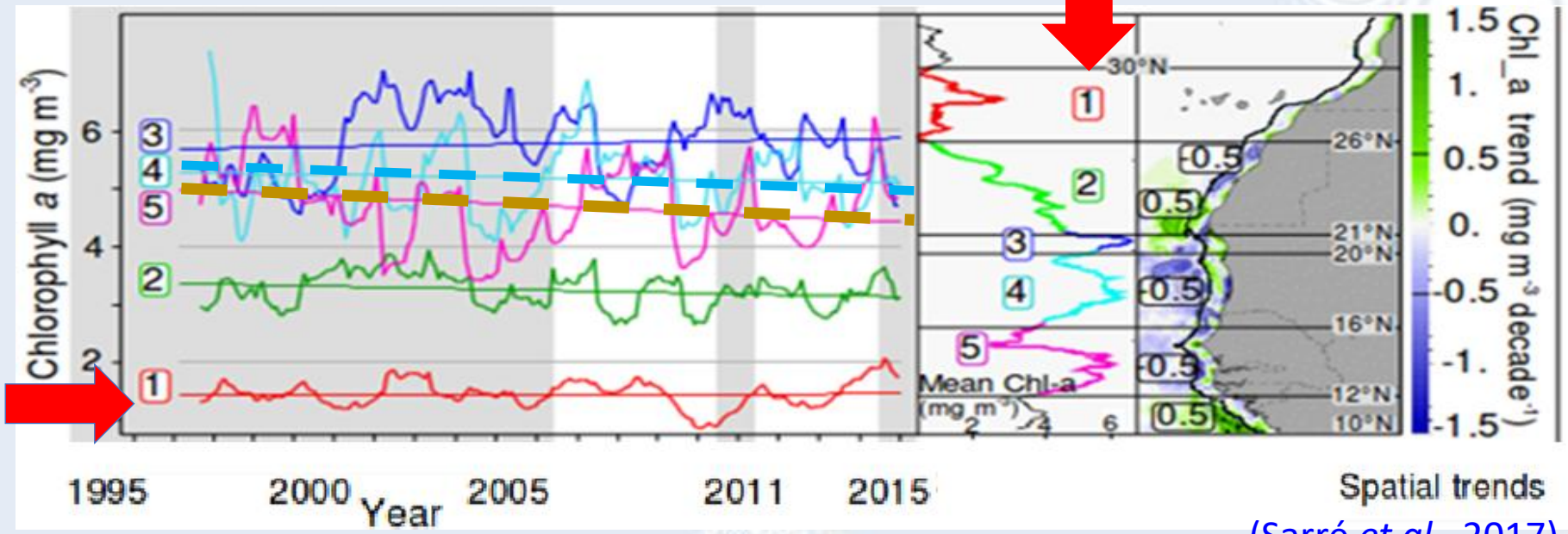
Sarré *et al.*, 2024

Results --- **Meridian component of the sea surface wind**



Sarré *et al.*, 2024

Primary production



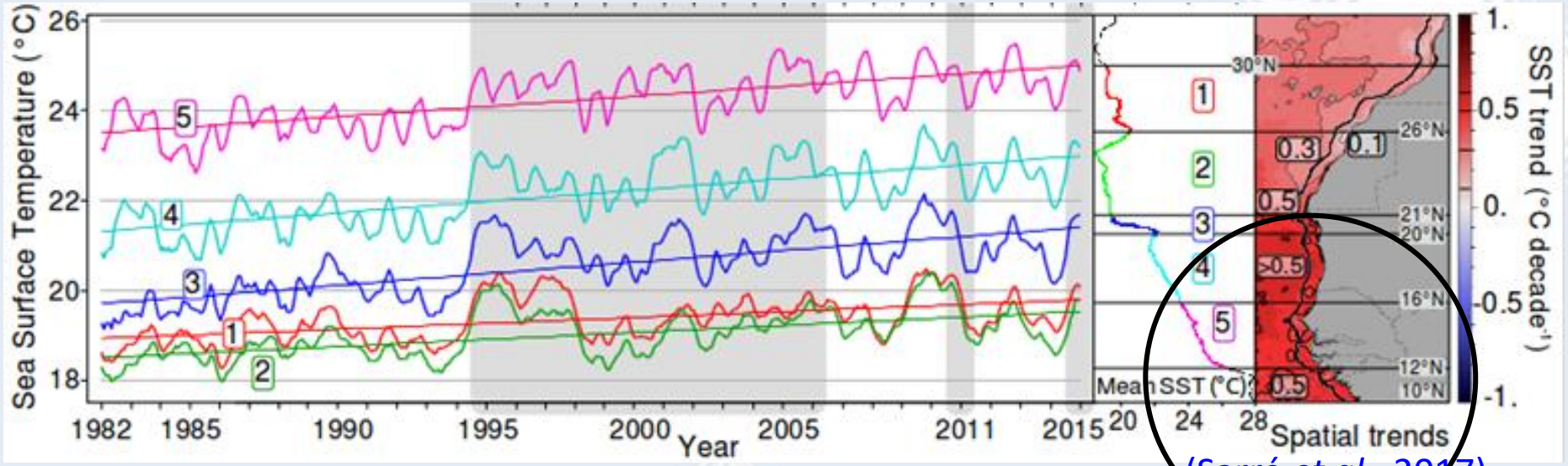
(Sarré *et al.*, 2017)

Slight decrease (not significant) in Senegal and Mauritania

Contrast in area 1 (26–30 °N)

Sarré *et al.*, 2024

Sea surface température (SST)



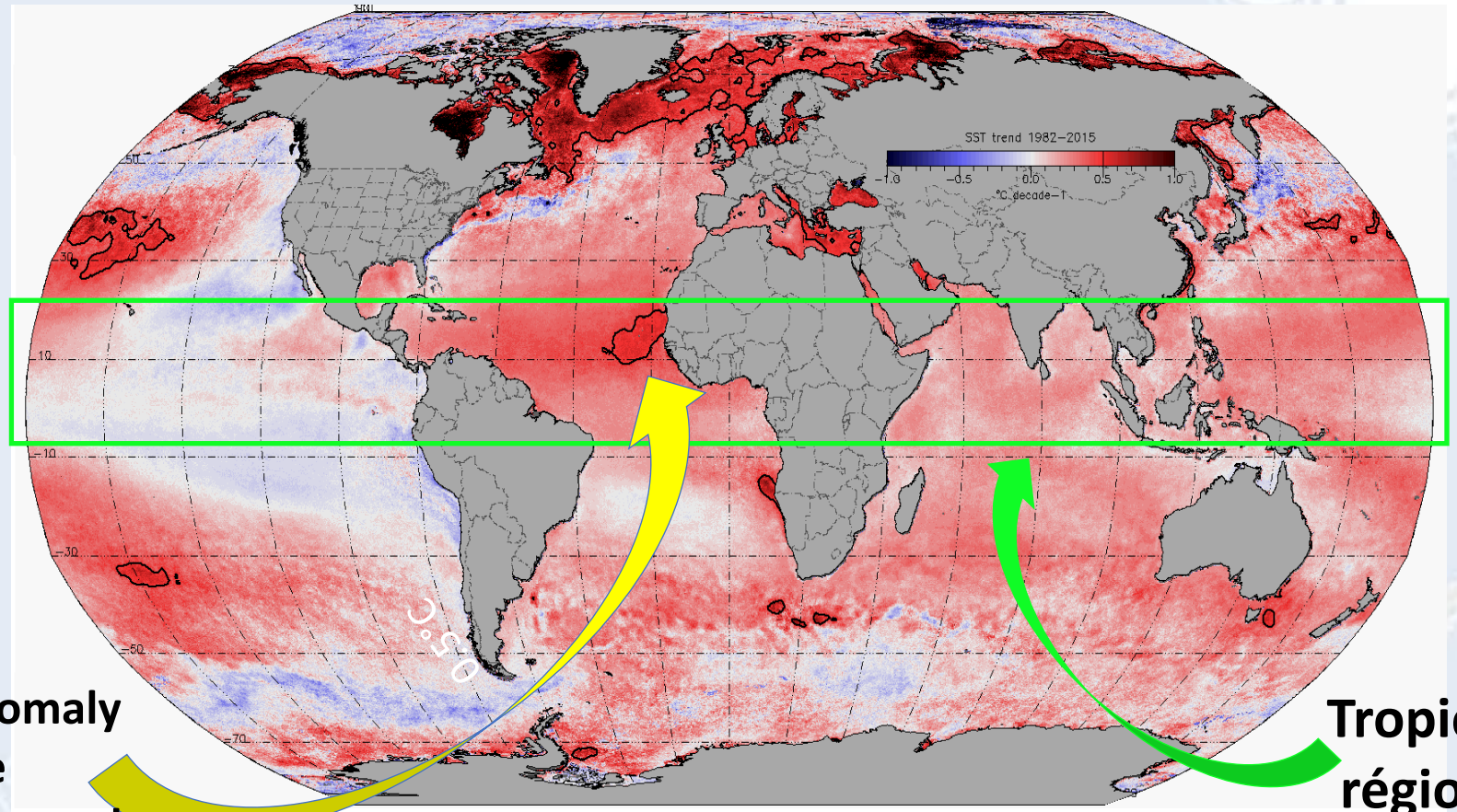
(Sarré *et al.*, 2017)

• SST displays a regular and homogeneous **intense warming** trend ~~throughout~~ **the whole region**

• especially **south of Cape Blanc** (areas 3 to 5) with cumulative **increases of between 0.5 °C and 1.5 °C** in the past 34 years

Temperature anomaly SST in NWA region/ période 1982-2015

At global level…



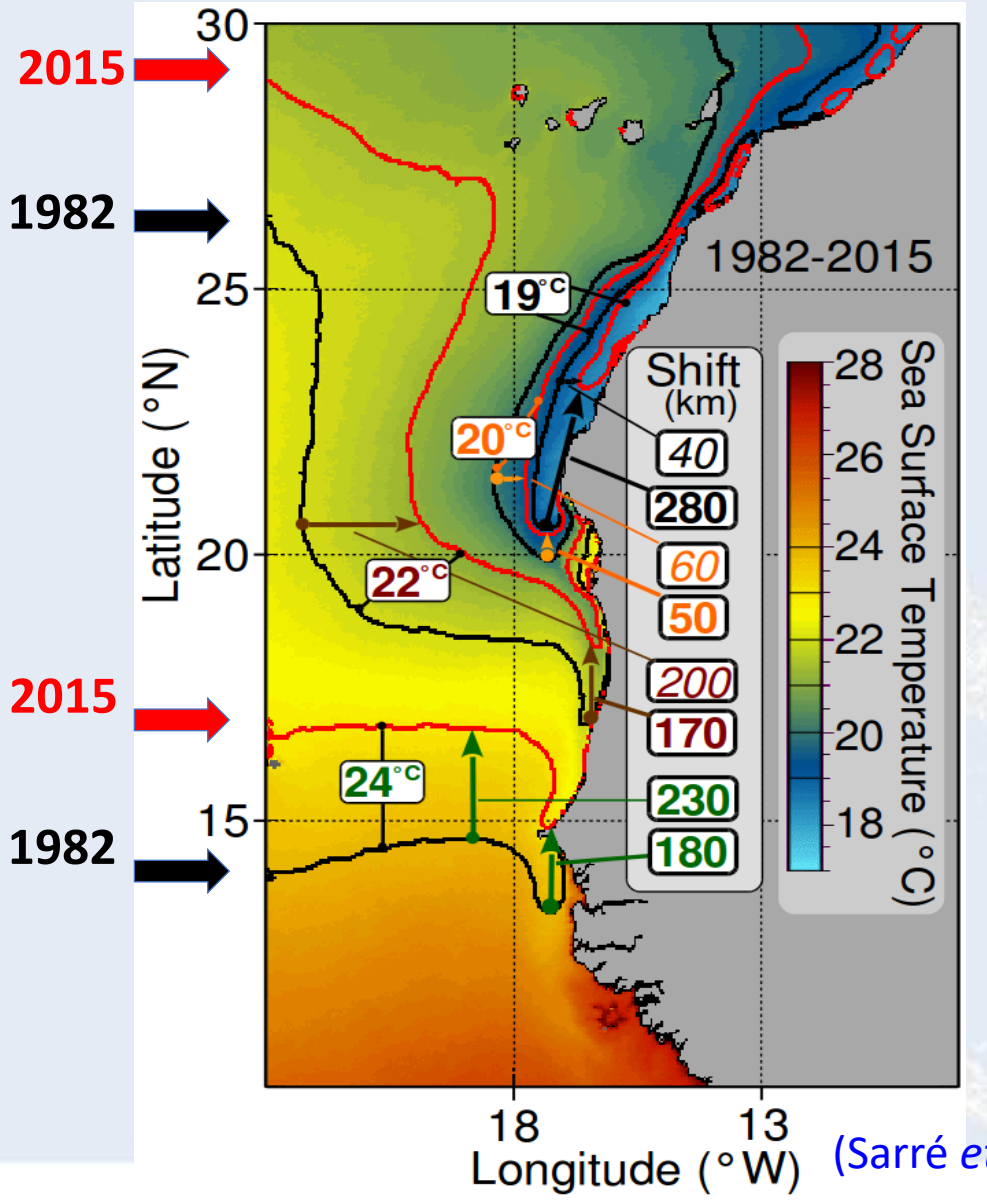
NWA is experiencing the **highest warming among all tropical regions worldwide**

0.5°C anomaly / decade iso-contoured

Tropical régions

Anomalies de températures SST au niveau mondial sur la période 1982-2015 (1982-2011: AVHRR, 2012-2015: MODIS) avec la valeur 0.5°C décennie

Sea surface Temperature (SST)



- **The increase in SST was evaluated in terms of northward displacement of isotherms** by comparing the past 17-year period (1982-1998 **in black**) with the recent one (1999-2015 **in red**).

- 24 °C Isotherm (Dakar)

  Observed displacement: 230 km

(Sarré *et al.*, 2017)

Results

Displacement **key small pelagic species** from1995 to2015 // Displacement of **isotherms**

a)

Species	Mean latitudinal North limit (°N) 1995	2015	Shift distance (in km)
Sardinella aurita	26,77	29,17	267
Sphyraena guachancho	17,24	20,61	375
Trachurus trecae	23,59	26,61	335
Chloroscombrus chrysurus	17,75	20,73	332
Brachydeuterus auritus	18,28	19,94	184
Selene dorsalis	17,98	19,93	217
Decapterus rhonchus	23,72	24,14	48
Sardinella maderensis	24,10	24,95	94

b)

Isotherm (°C) / Period	19	20	21	22	23	24
1982-1998	20.5	20.0	18.5	16.9	15.0	13.3
1999-2015	23.0	20.5	19.9	18.4	17.5	14.9
Shift 1982-2015	280	50	150	170	170	180
Shift 1995-2015	>200	30	-	50	20	40

Note: the distances that migratory pelagic fish have moved were of the **same order of magnitude** as those observed for the isotherms in the region (150–300 km) since 1995.

Conclusions

		Pearson	
		r	p-value
WIND	Area 1	**0.54**	**0.003**
	Area 2	**0.48**	**0.010**
	Area 3	0.41	0.030
	Area 4	0.21	0.280
	Area 5	**-0.53**	**0.004**
CHL_a	Area 1	0.07	0.779
	Area 2	-0.18	0.476
	Area 3	0.01	0.978
	Area 4	-0.24	0.340
	Area 5	-0.18	0.484
SST	Area 1	**0.56**	**6.00E-04**
	Area 2	**0.61**	**1.18E-04**
	Area 3	**0.74**	**4.91E-07**
	Area 4	**0.73**	**8.03E-07**
	Area 5	**0.77**	**7.47E-08**

Effet de la température

- ***It is likely that SST is the most significant environmental parameter explaining the movements of S. aurita****, even though combination of physical and ecological factors contribute to this phenomenon*

- *The observed variation in meridian wind cannot explain the gradual northward shift of the S. aurita population.*

Conclusions

- **The observed northwards shifts of the *S. aurita* stock** as well several tropical pelagic species **may significantly** affect **(decrease) their abundance in the Southern part of the system**, *i.e.*, South of Cape Blanc

•The specific shift of ***S. aurita*** has to be underlined as it **constitutes a key source of proteins for the regional populations**

Consequently, any shift in the distribution of this stock might affect the food security in the region

What regional initiatives in North West Africa to tackle the impacts of climate Change …

Summary of relevant work in North West Africa in response to climate change

In these regional works, one can mention the initiatives to....

- **Mitigate** coastal erosion through **reforestation**
- **Update** the **National Adaptation Plans** to Climate Change
- **Strengthen** resilience tools in the face of resource reduction:

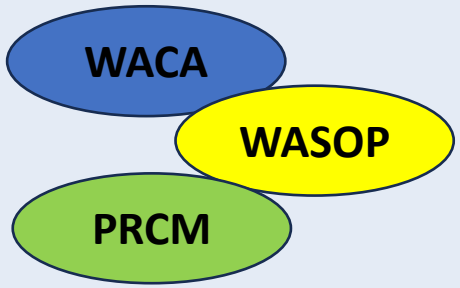
  Marine Protected Areas, artificial reefs, aquaculture development …

- **Contribute** more significantly to **regional and international programmes** tackling climate change Etc….

Overview of relevant work in West Africa in response to climate change

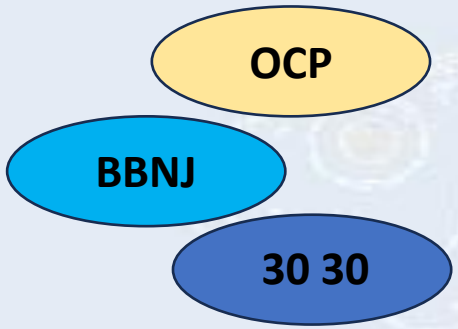
Ongoing regional and international programmes…

- **West Africa has regional initiatives**



- At the regional level, one can mention the **WACA initiative .** The West African Coastal Zone Management Programme (WACA) is a **regional initiative to tackle the impacts of climate Change in West African countries** improve the management of their coasts in the face of risks such as erosion and flooding, taking into account climate change.
- **WASOP** - West Africa Sustainable Ocean Programme (UE funded)
- **PRCM** - Regional Partnership for the Conservation of the coastal and marine area

- **And during the COPs NWA reaffirmed its alignment with international climate initiatives**



- **The Ocean & Climate Platform (OCP)** within the framework of the United Nations Framework Convention on Climate Change (UNFCCC)

- At the international level, the NWA is aligned with international initiatives such as the **Biodiversity Beyond National Jurisdiction (BBNJ)** and **the objective 30 30**

  (Les objectifs du BBNJ et du 30×30 : ***vers des AMPs Transfrontalières***)

Strengthening resilience tools

In response to CC impacts and since the COP 16 session, **several adaptation measures** are being implemented by West African countries.

- Among these resilience measures, one can mention **economic diversification**, through

fish farming **oyster farming** **ecotourism.**

Parc du Dioudi

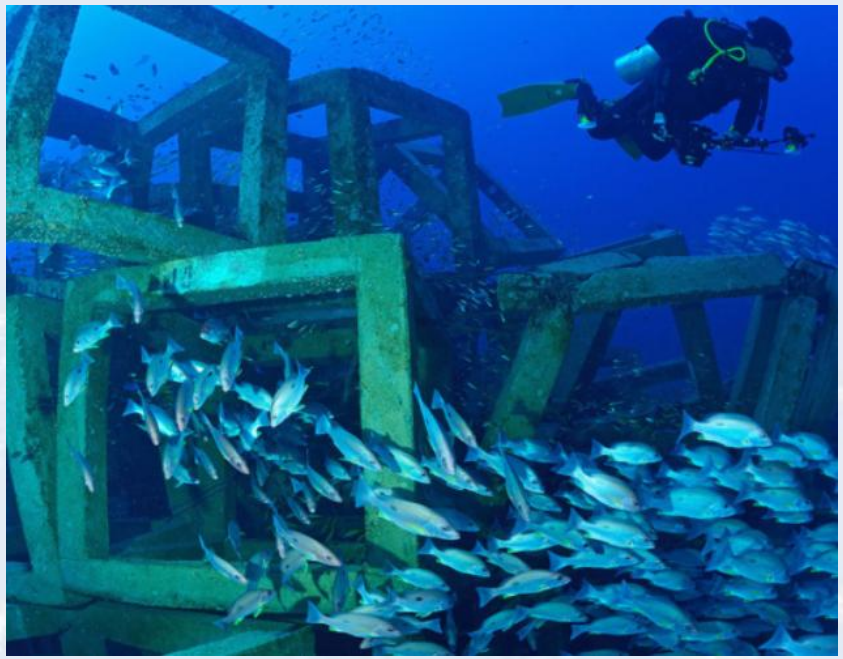
to provide additional income and reduce the pressure on local fisheries resources

Strengthening resilience tools

To adapt to climate change, **other initiatives are underway** in West Africa

Marine Protected Areas

Artificial Reefs



Restoration of mangrove areas

Strengthening resilience tools

Reforestation of the mangrove in Toubacouta in Senegal by women

Strengthening resilience tools

In Senegal…
SONATEL INITIATIVE

The planting of mangroves on the **community nature reserve of Palmarin** contributes to

- **strengthening coastal resilience,**
- **preserving the wealth of our marine biodiversity**
- **and actively participating in the fight against climate change challenges.**

Replanting by students

Gaps & challenges

- ***Little room for manoeuvre in Africa:*** ~~***Attenuation***~~ ***VS Adaptation***

Africa has little flexibilty in terms of **mitigating greenhouse gas emissions. This is the responsabilty of** the main polluters in the word, ie the major industrial powers, led by China, the United States and India according to the carbon footprint per capita. **Africa can only move towards adaptation measures.**

- ***Lack of funding:*** *an urgent need for conservation West Africa, underfunded for the conservation of its biodiversity,* ***urgently needs resources to sustainably manage*** *its key ecosystems, such as Marine Protected Areas, mangroves, artificial reefs etc.*
- **Lack of information on environmental data:** Strengthen data collection systems and research institutes in the region
- **Weak capacities of our monitoring institutes/agencies:** Strengthen the capacity of meteorological agencies in the countries of the region to develop, process and disseminate **weather and climate information services (WCIS)** in order to strengthen farmers' resilience, fishermen and breeders to climate change. This task has hitherto been carried out by the USAID's Feed the Future program in many African countries and must find another source of funding since the United States has suspended this funding in Africa.
- **Not enough integration of climate-related issues in public policies:** Our states should integrate the concept of **energy transition** as a governance option into public policies

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THANKS

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Special THANKS
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