International Symposium Drivers of dynamics of small pelagic fish resources
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More than 15 years of collaboration on the assessment of small pelagic fish off Northwest Africa:

Lessons learned and future perspectives.

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Introduction

- Marine waters off Northwest Africa, are among the richest in the world

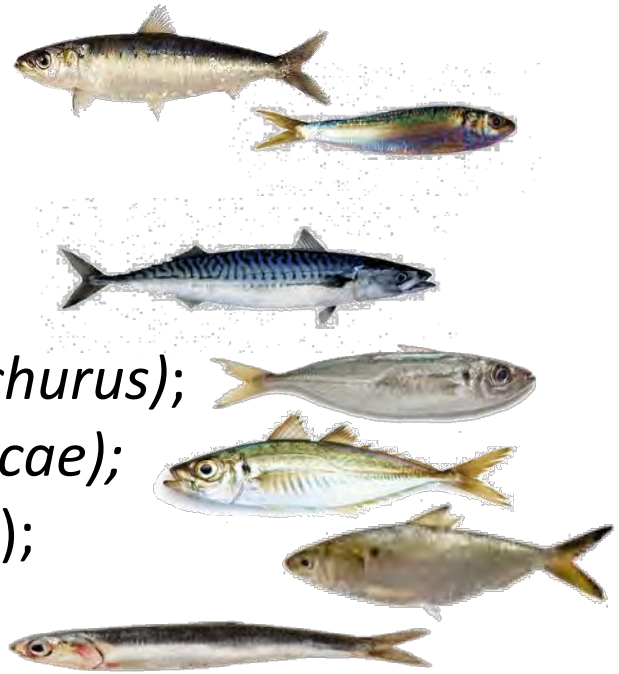
- Small pelagic fish represent approximately 70 percent of the total marine fish landings.

- Fisheries have an important social and economic role in the countries of the region, contributing to food, employment and income.

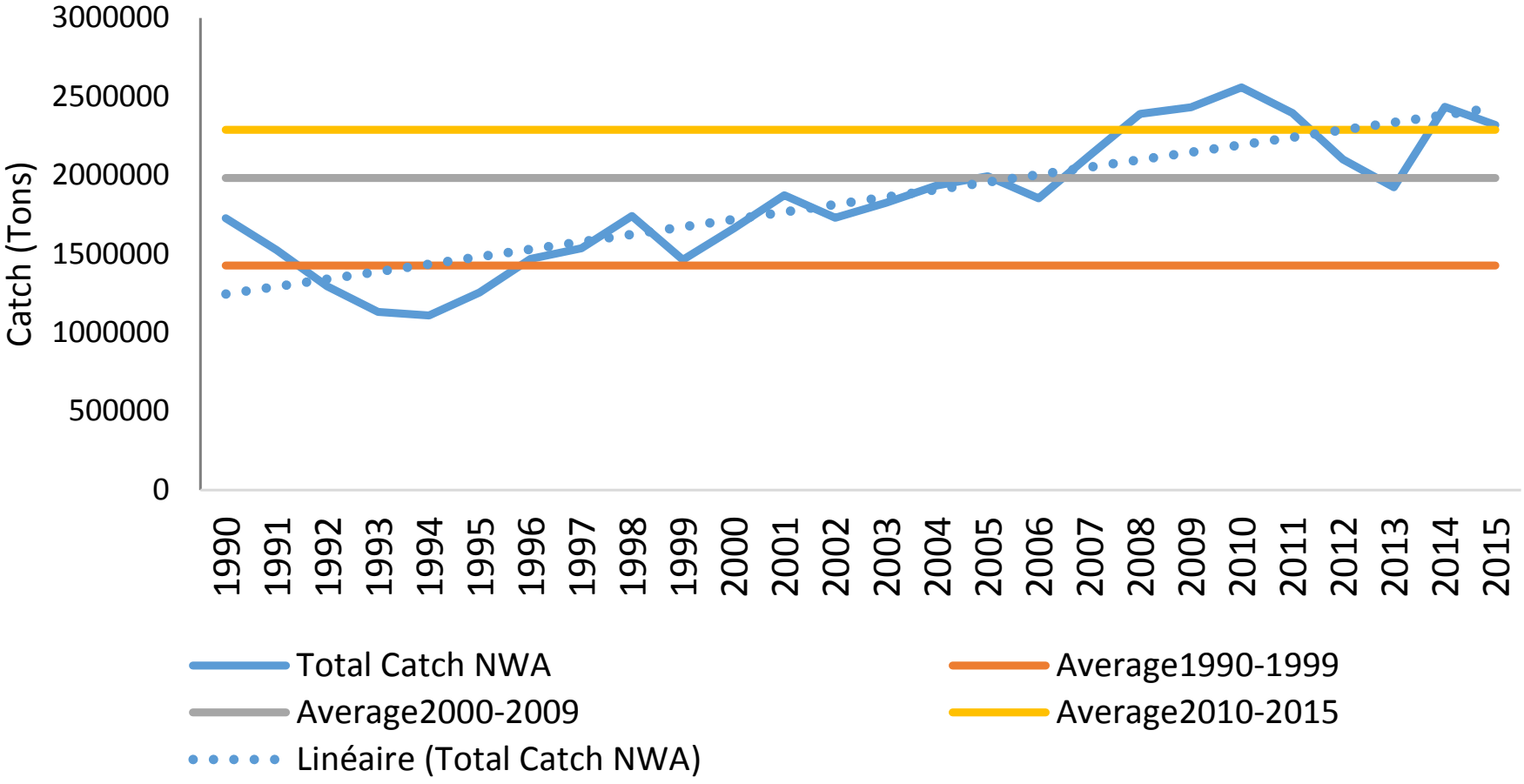
- Diverse fisheries and a range of fishing fleets and techniques
  - small scale dug-out canoes
  - larger motorized canoes
  - coastal fleets
  - large industrial vessels.

Main small pelagic species

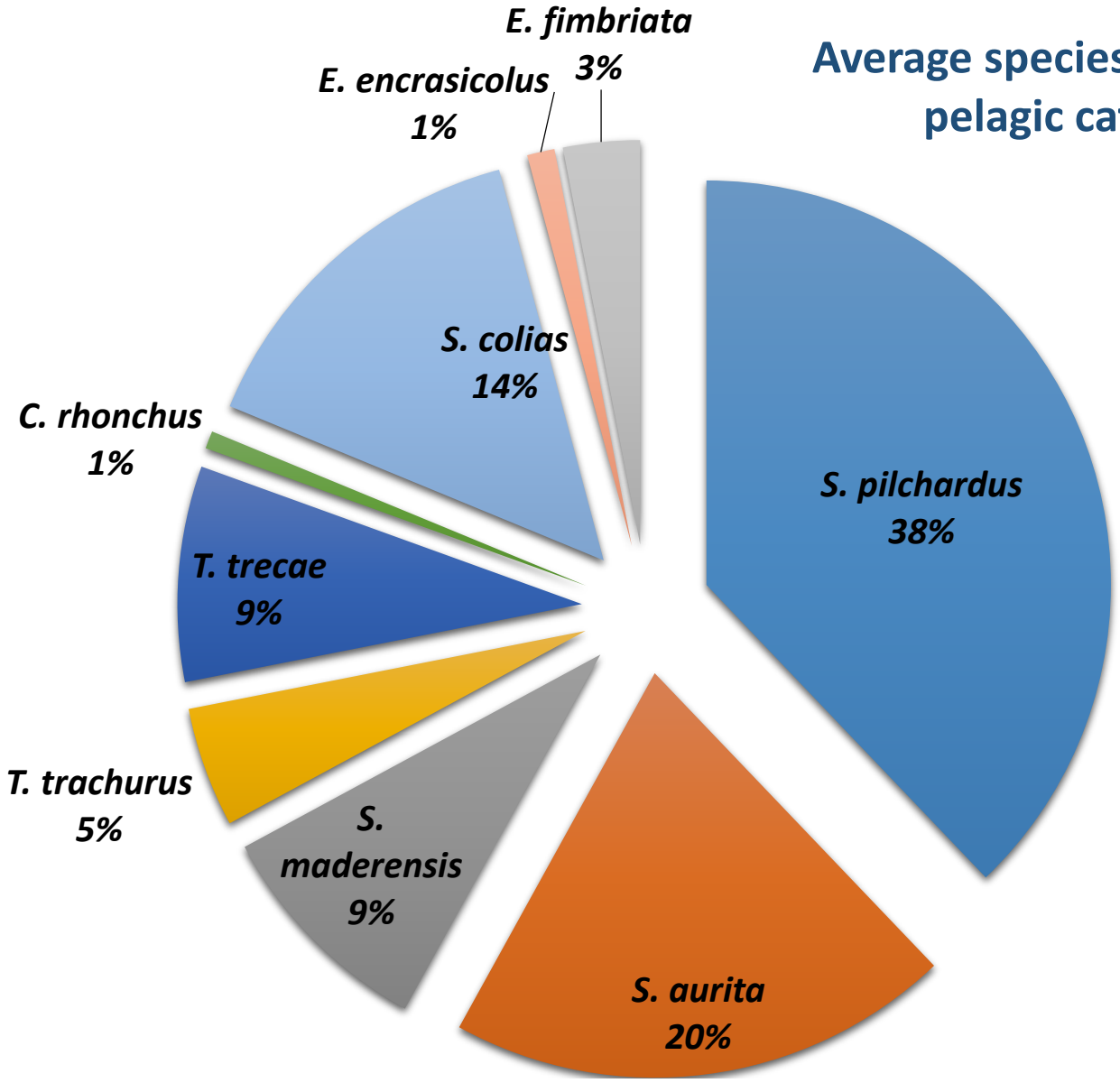
- Sardine (*Sardina pilchardus*);
- Round Sardinella (*Sardinella aurita*);
- Flat Sardinella *(Sardinella maderensis*);
- Chub mackerel (*Scomber colias*);
- Atlantic horse mackerels (*Trachurus trachurus)*;
- Cunene Horse mackerels *(Trachurus trecae);*
- Ethmalosa/Bonga (*Ethmalosa fimbriata*);
- Anchovy (*Engraulis encrasicolus*).



Total catch of small pelagic species in NWA region

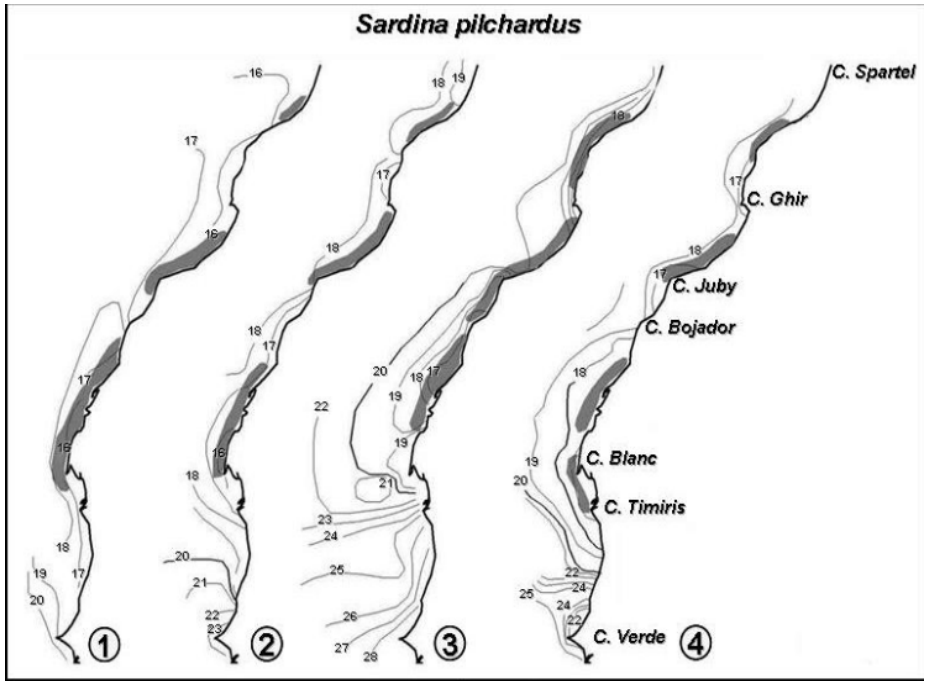


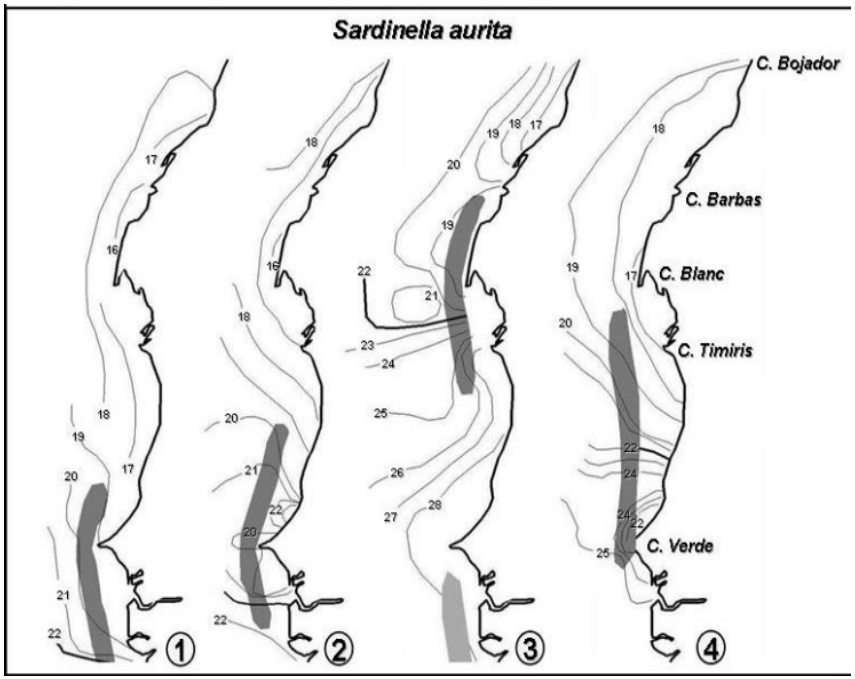
Average species composition of small pelagic catches 2011-2015



Distribution of small pelagic species

- Many of the main small pelagic resources migrate and stocks are shared bilaterally or even by sub-region





- Importance of a more regional approach to research and management
- The FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa was established in 2001; since WG has met annually.

Overall objective of the WG

- To contribute to the improved assessment of small pelagic resources in Northwest Africa.
- To analyse fisheries management and exploitation options aimed at ensuring optimal and sustainable use of small pelagic fish resources for the benefit of coastal countries.
- Provide research recommendations

Nouadhibou 2001, First meeting

Members: Coastal states and fishing nations

Focus on data quality and analysis of trends in basic data

Aim for this process is to establish a reliable database

Time series analyses

Several problems in estimating total catches in some countries of the region:

- Combined catch (e.g *Trachurus*)
- No official statistics available for some fleets (e.g. artisanal fishery….)

Standardization of sampling methods

- Sampling intensity reviewed for some fisheries and surveys
- Recommendations for biological sampling
- Standard matrix for biological parameters

Exchange of Otoliths

Age Workshops for sardine & sardinella

- Discrepancies in assigning ages and lack of criteria
- Standardize age-reading methodologies,
- Establish age-reading criteria & ensure common interpretation.

Setting up common survey standards & routines

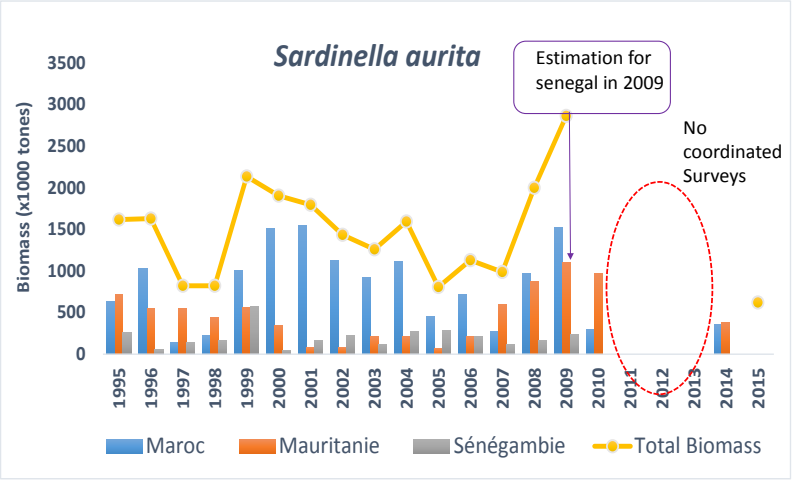
- Planning Group
- Improve consistency of time series by national vessels
- Coordination & intercalibration btw countries
- Training in acoustics

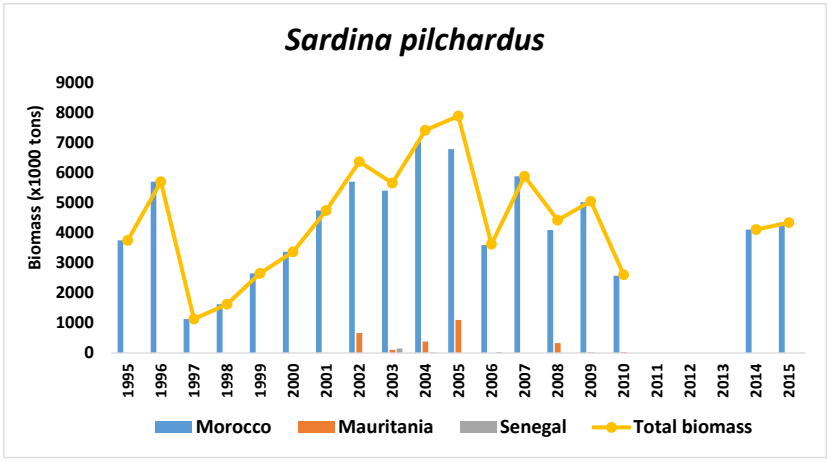
Regional Acoustic Surveys

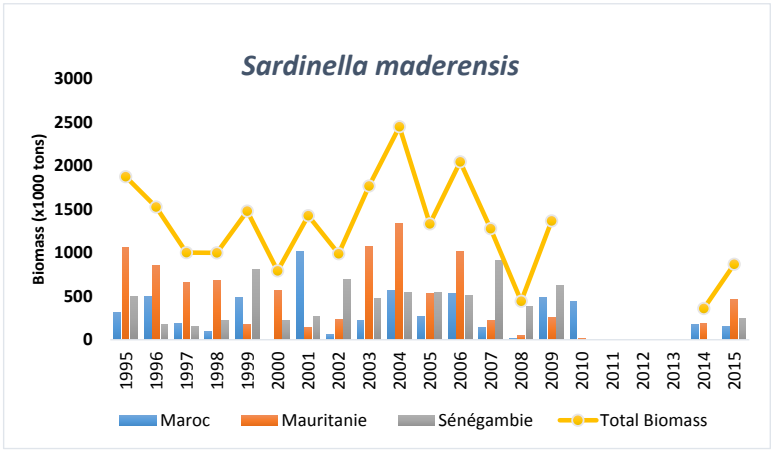
- **Nansen conducted surveys in the region regularly from 1995-2006;**
  - Series backbone of SP assessments in WG
  - Regional survey time series to be taken up and maintained by national R/Vs

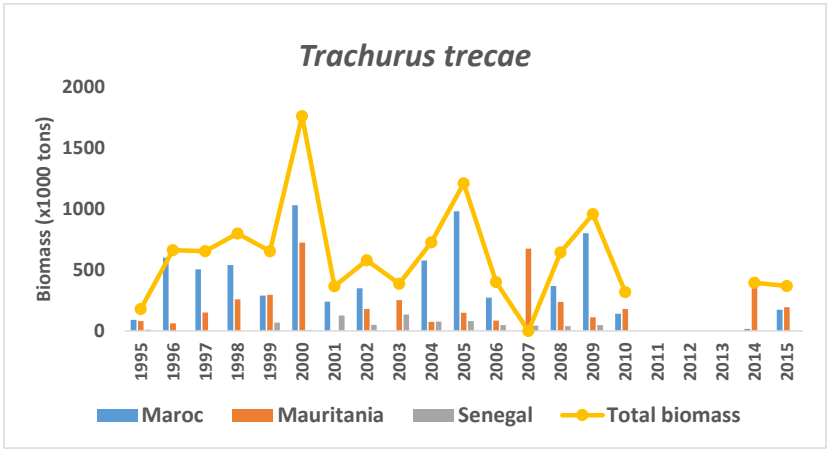
- **Regional Guidelines developped**.
- **Planning group established in 2002.**
  - ➢Coordination and intercalibration
- **National vessels carry out national surveys**

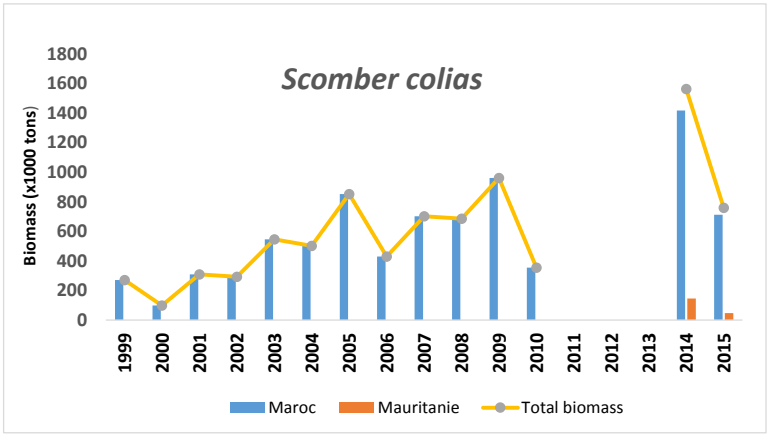
Challenge to maintain regional series

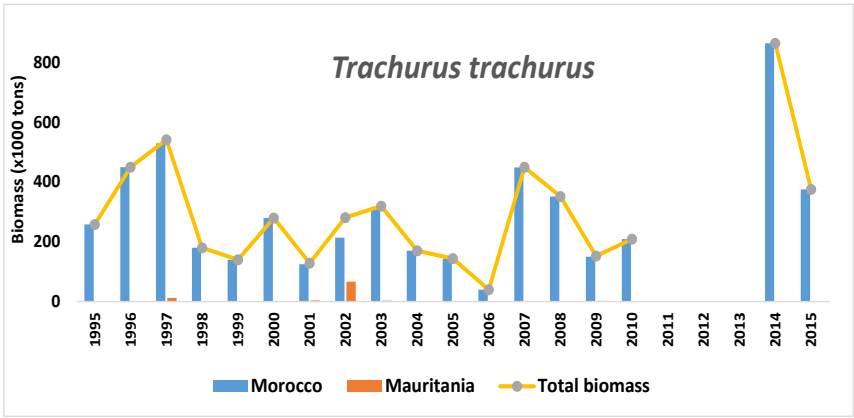

Sardinella aurita
Estimation for senegal in 2009
No coordinated Surveys
Biomass (x1000 tones)
Maroc
Mauritanie
Sénégambie
Total Biomass


Sardina pilchardus
Biomass (x1000 tons)
Morocco
Mauritania
Senegal
Total biomass


Sardinella maderensis
Biomass (x1000 tons)
Maroc
Mauritanie
Sénégambie
Total Biomass


Trachurus trecae
Biomass (x1000 tons)
Maroc
Mauritania
Senegal
Total biomass

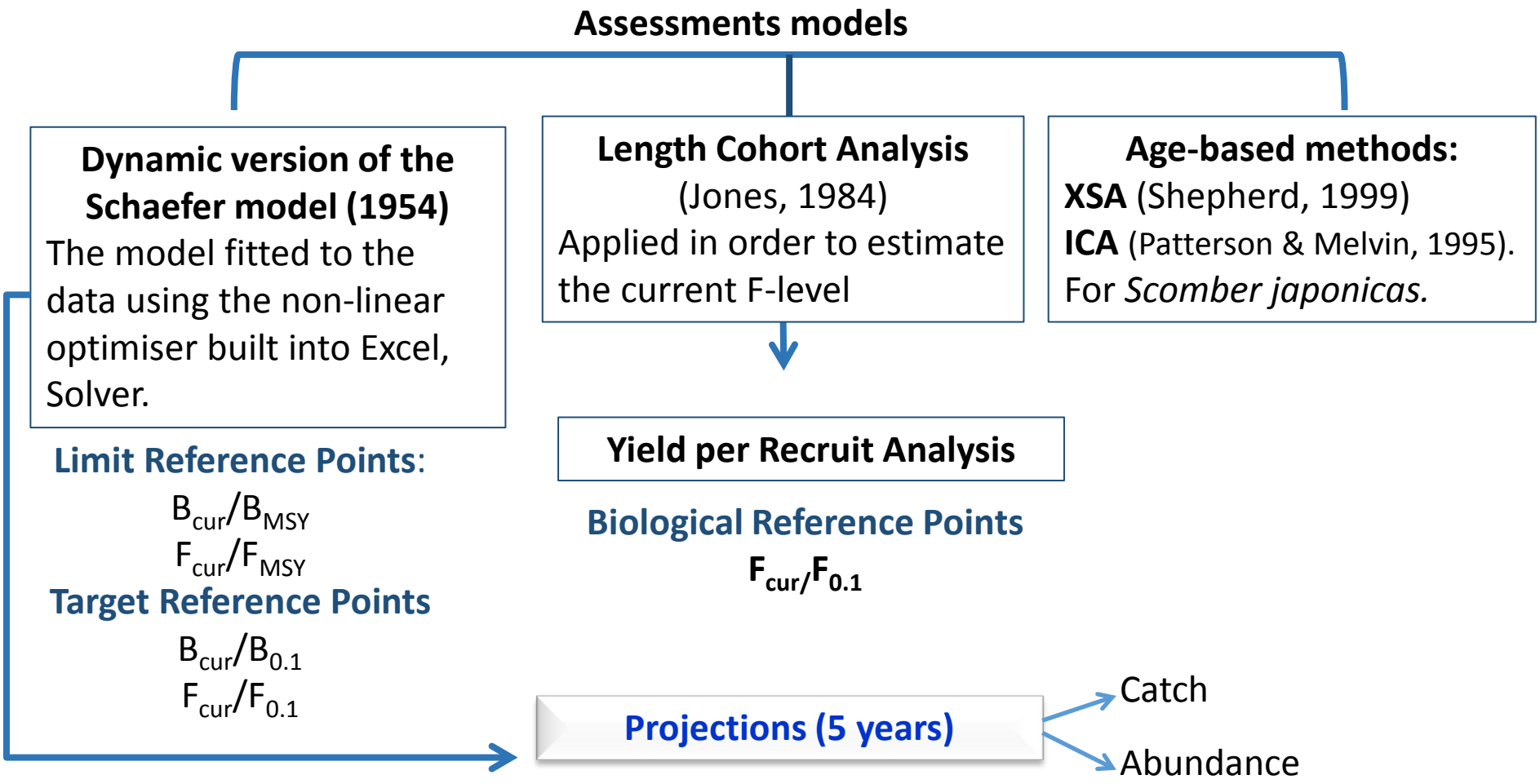

Scomber colias
Biomass (x1000 tons)
Maroc
Mauritanie
Total biomass


Trachurus trachurus
Biomass (x1000 tons)
Morocco
Mauritania
Total biomass

WG focused on developing and improving assessment methods

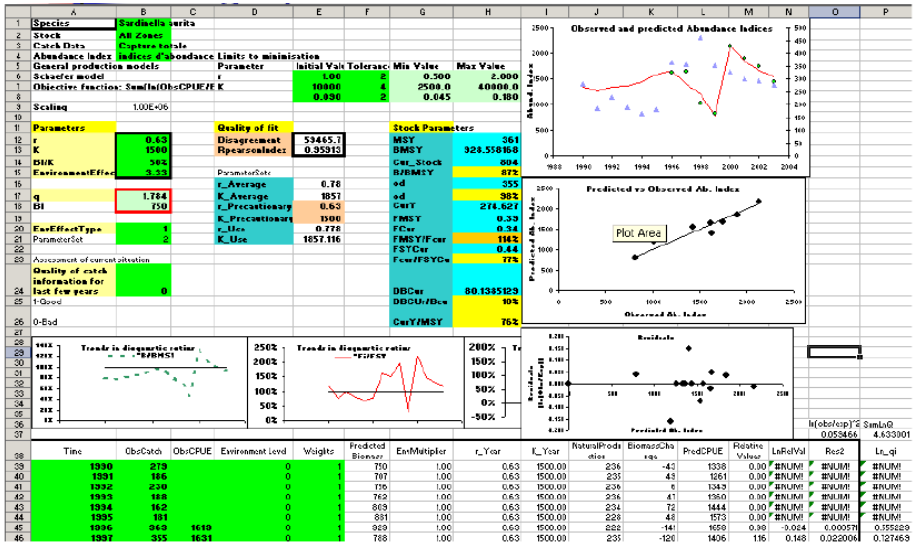
Modelling approaches

Differents models used to assess de state of small pelagic stocks in the NWA region

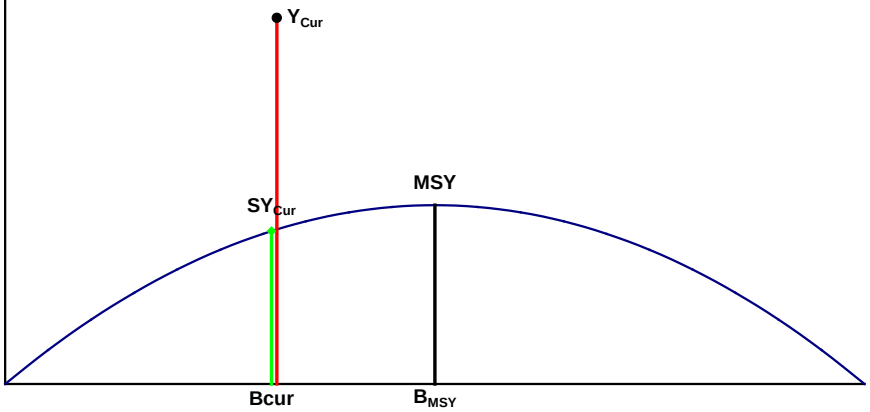


Dynamic version of the Schaefer model

- A spredsheet implemented in Excel was developed to run the model with the observation error estimator method (Haddon, 2001)
- Model fitted to the observed data using the non-linear optimizer of Excel (Solver).



Biological Reference Points



Diagnostics of fit:

- ✓Objective function
- ✓Correlation between Observed and Expected CPUE's
- ✓Graphs Observed and Estimated CPUE

Current Fishing mortality, Biomass and catches relative to target and limit BRP

Assign Stock Status

Environmental parameters

Linear effect

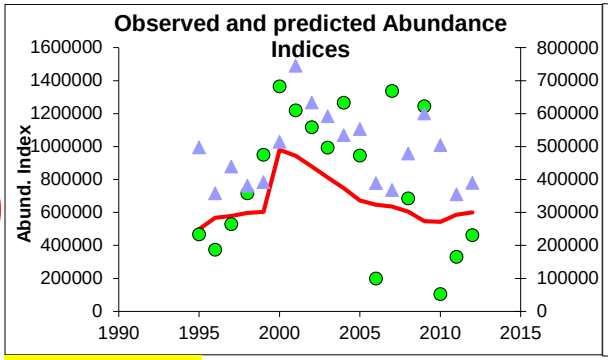
$$\begin{cases} r_i = r \times \left(1 + \alpha \left|E_i\right|^{\mathrm{sgn}(E_i)}\right) \\ K_i = K \times \left(1 + \alpha \left|E_i\right|^{\mathrm{sgn}(E_i)}\right) \end{cases}$$

Exponential effect

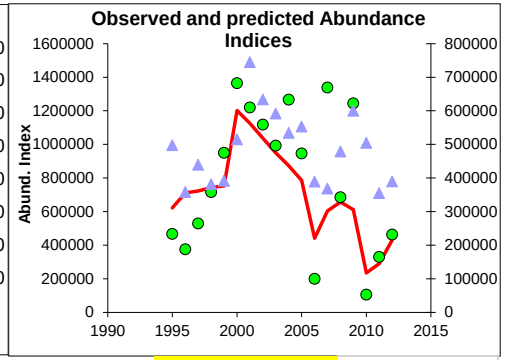
$$\begin{cases} r_i = r \times e^{\alpha \times E_i} \\ K_i = K \times e^{\alpha \times E_i} \end{cases}$$

Schaefer model		
Objective function: Sum(ln(ObsAbIndex/ExpAbIndex))		
Scaling	1,00E+06	
Parameters		
r	0,91	
K	3790883	
BI/K	88%	
EnvironmentEffect	1,02	
q_fixed	0,80	
Model Control		
EnvEffectType	EXP	EXP
EnvEffect-r	YES	YES
EnvEffect-K	YES	YES
UseMidYearBRef	StartYear	StartYear
ParameterSet	Precautionary	Precautiona
Quality of catch info last years	Good	Good
q_Estimation	Estimate	Estimate
Derived Parameters		
q_use	1,079	
BI	3340167	
q_estimated	1,079	

- Model fitting often difficult and lead to uninspected results due to the instability of SP resources and there abundance indices generally known by large fluctuations
- A qualitative environmental index has been introduced in the implemented production models.



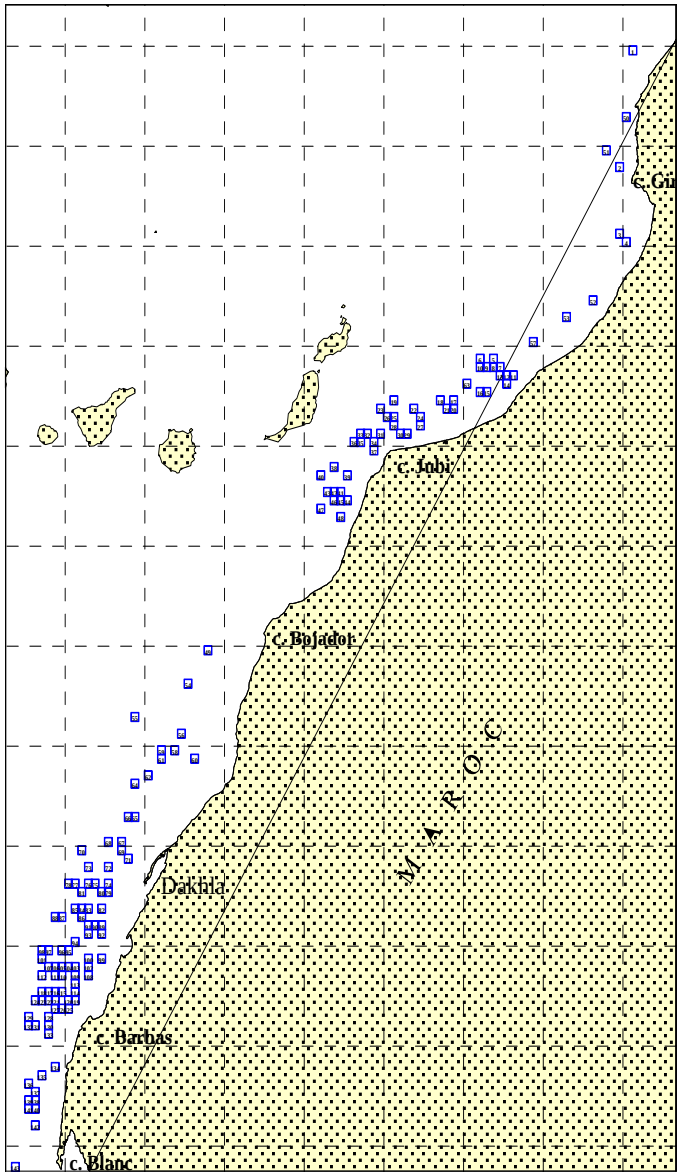
Quality of fit	
Disagreement	6865397,154
RpearsonIndex	0,589483804



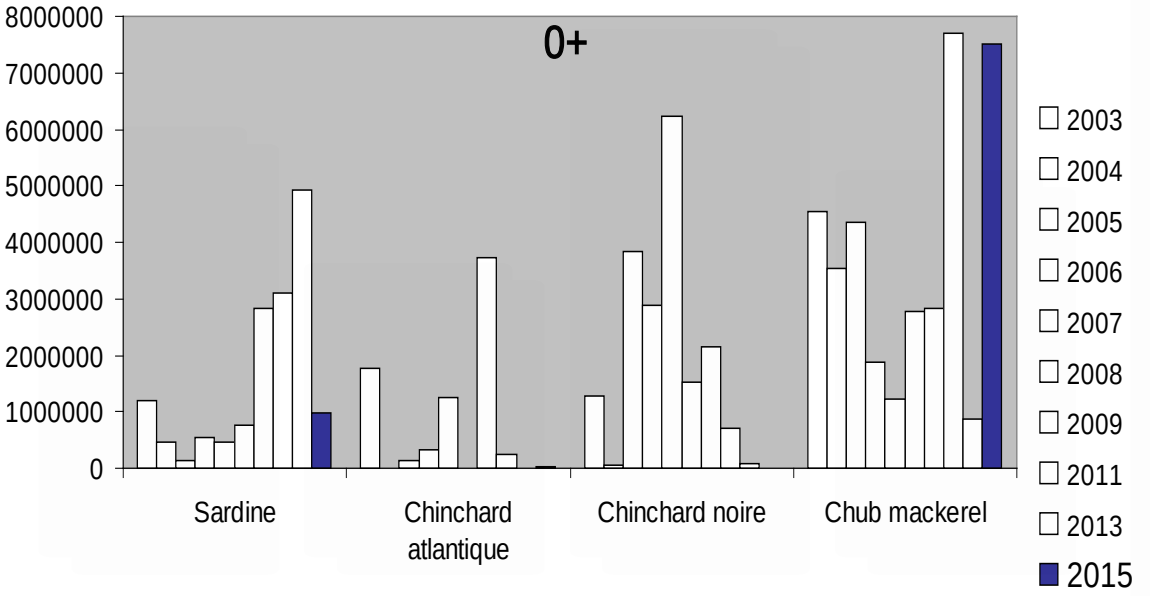
Quality of fit	
Disagreement	3269571,223
RpearsonIndex	0,749088216

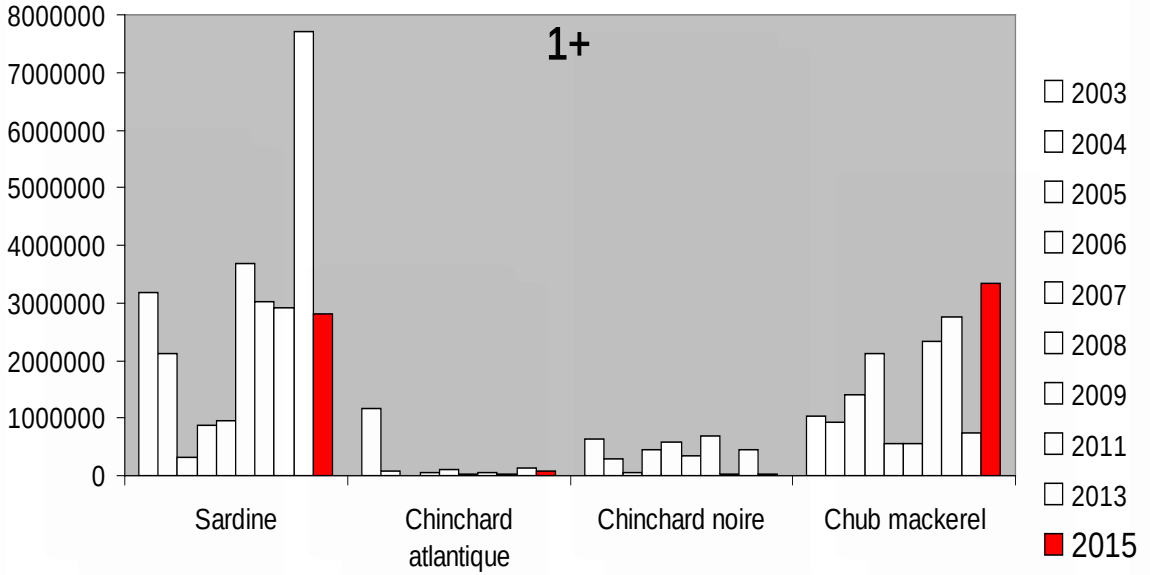
Fitting model improved

R/V ATLANTIDA – **RECRUITMENT**



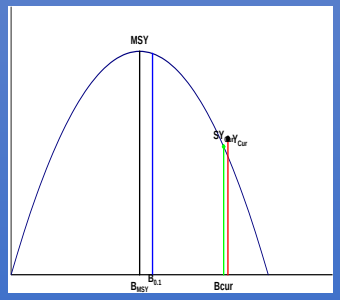
Abundance of Juveniles





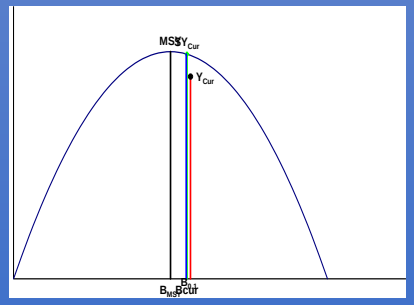
Overview of state of the different stocks, 2016 WG results

Sardina pilchardus



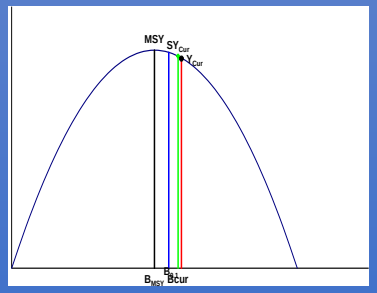
Not fully exploited

Scomber colias



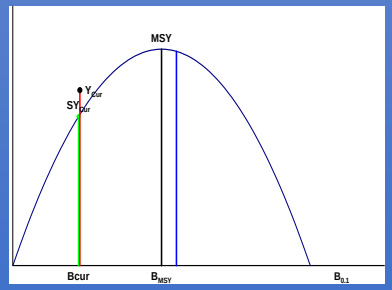
Fully exploited

Trachurus trachurus



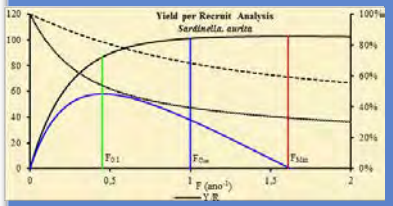
Fully exploited

Trachurus trachurus trecae



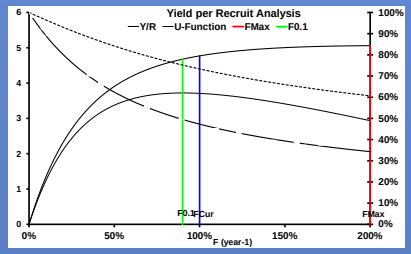
Overexploited

Sardinella aurita



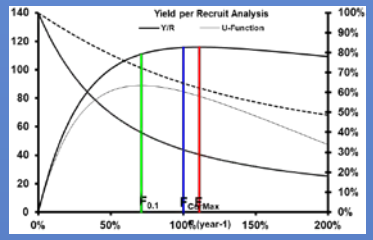
Overexploited

Engraulis encrasicolus



Overexploited

Ethmalosa fimbriata

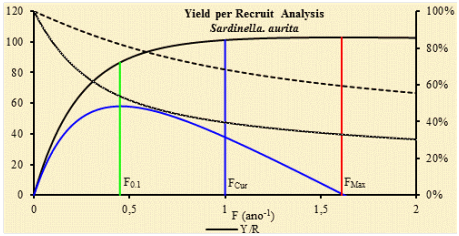


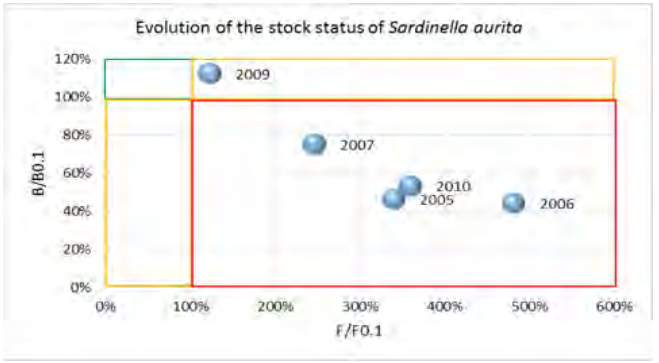
Overexploited

Changing data availability- creating issues with assessments

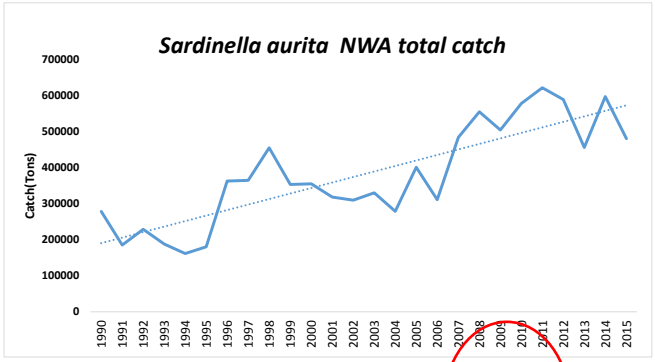
Example: *Sardinella aurita*

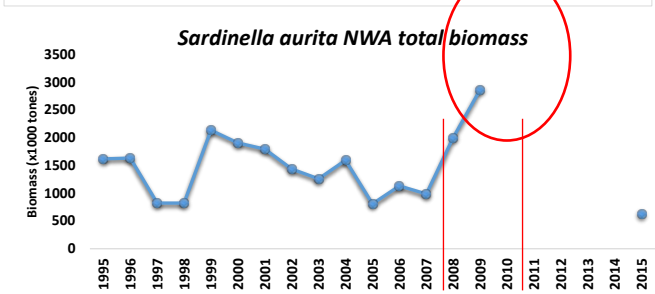
- Assessed as overexploited since 2006





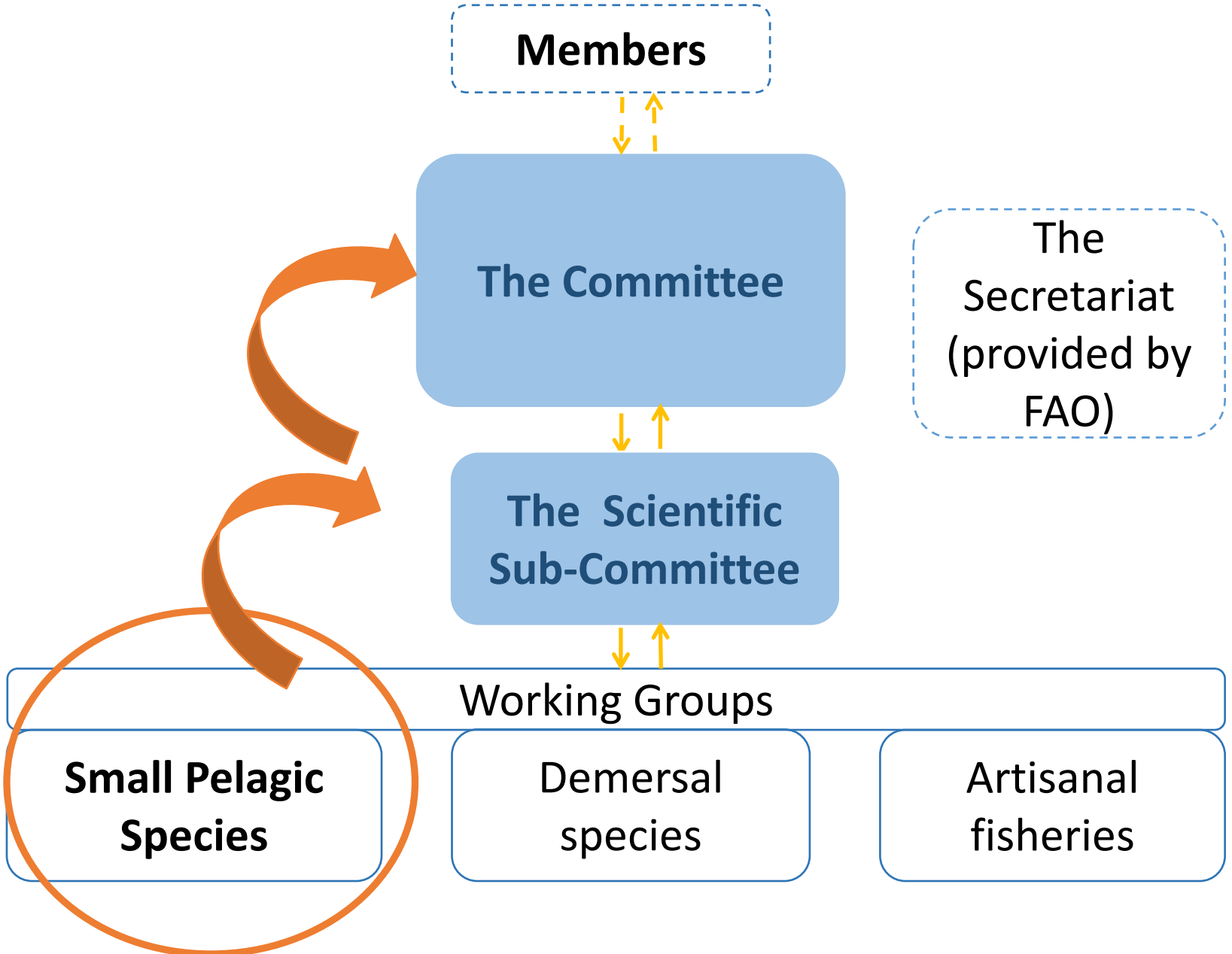
- Catch remains high, and exceeds recommended level
- Incomplete abundance series
  - First used survey series (2001-2008)
  - Then CPUE EU fleet in Mauritania (2008-2015)
  - Now lenght based model





- Variability of growth parameters and lack of basic biological data

Management advice process- CECAF



Uptake of scientific advice in management

- **Recommendations from the Working Groups are taken up in national processes to a different degree.**

- **Management plans for small pelagics**

  - Morroco: Plan operationnal
  - Mauritania: Plan developed
  - Senegal : Plan in preparation
  - Gambia: Plan to be initiated

- Daft framework for a regional management plan (Canary Current Large Marine Ecosystem Project with the Sub-regional Fisheries Commission and CECAF)

Discussion are ongoing

ACHIEVEMENTS

The Working Group has created a momentum for joint scientific work in the region and beyond, and has facilitated improved knowledge on small pelagic resources at a regional scale:

- More consistent series of catch and effort available for the North West Africa;
- Significant improvement was made in sampling intensity in the region, including in terms of Length-frequency;
- Distribution and estimated abundance indices of the main small pelagic fish species in the NWA region available;
- Estimates from the different surveys are available as numbers and biomass per length-group for the various species;
- Assessment and management advice system in place.

Future Perspectives

- Still need for improvement in the basic data: biological sampling including for length, continued effort to estimate age, maintain regional time series abundance and biomass

- How can environmental changes and recruitment be integrated in assessments?

- There is a need to review decision framework, including status descriptions, allocations and reference point frameworks

Some key questions:

- What are the stock units?
- How can recruitment be predicted?
- What is the degree of environmental influence?
- How can assessments be continued and advice provided in a consistent way, with shifts in basic data


Thanks for your attention