

FISHERIES & AQUACULTURE

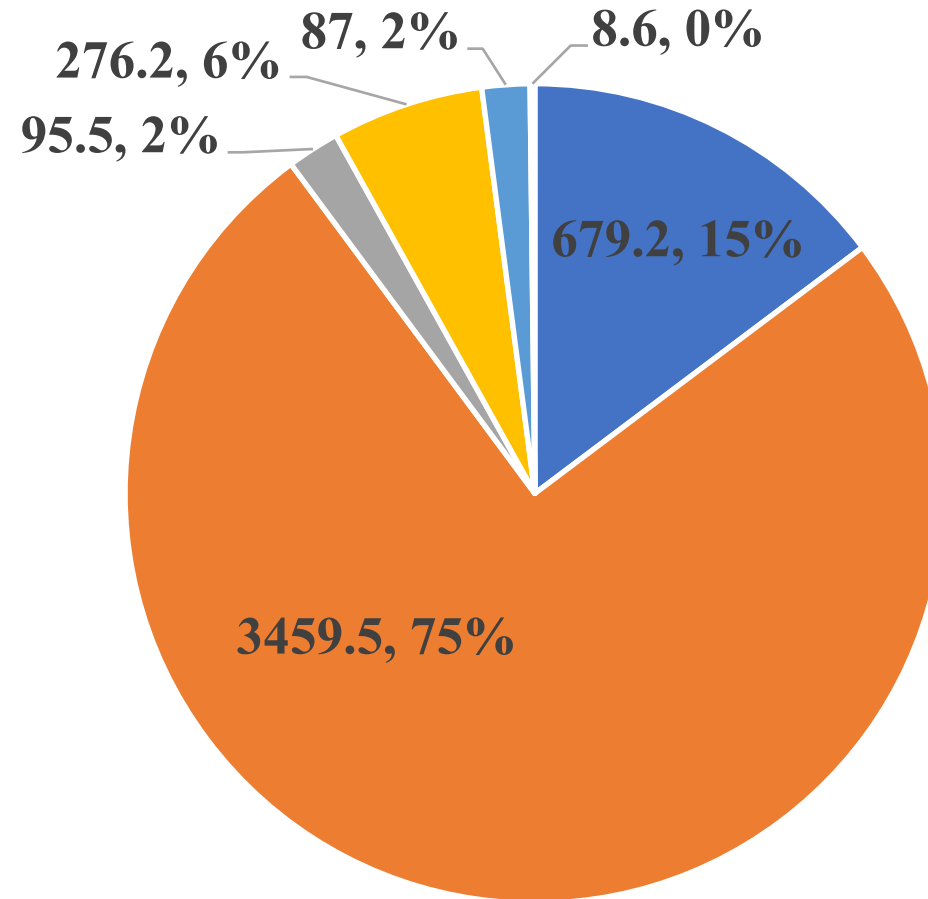
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Coastal Ocean Environment Summer School, Ghana 2018

UNIVERSITY OF GHANA, LEGON.

3RD AUGUST, 2018.

PERCENTAGE CONTRIBUTION (FLEETS)



■ AFRICA

■ ASIA

■ EUROPE

■ LATIN AMERICA

■ NORTH AMERICA

■ OCEANIA

CURRENT STATUS OF THE MARINE FISHERIES RESOURCES IN GHANA



GHANA



- Located in the **Western GoG**; Africa
 - 750 km north off the equator
 - Latitudes 4° to 12° N
 - Longitudes 3° W and 1° E.
- A coastline of **550 km** and a total continental shelf area of approximately **24,300 km²**.
 - relatively narrow continental shelf to a depth of around 75 –120 m. Trawlable area 169,000km²
- Fishing industry is based on resources from both **marine** and **inland** waters including coastal lagoons and aquaculture.

Ghana's Fisheries Sector

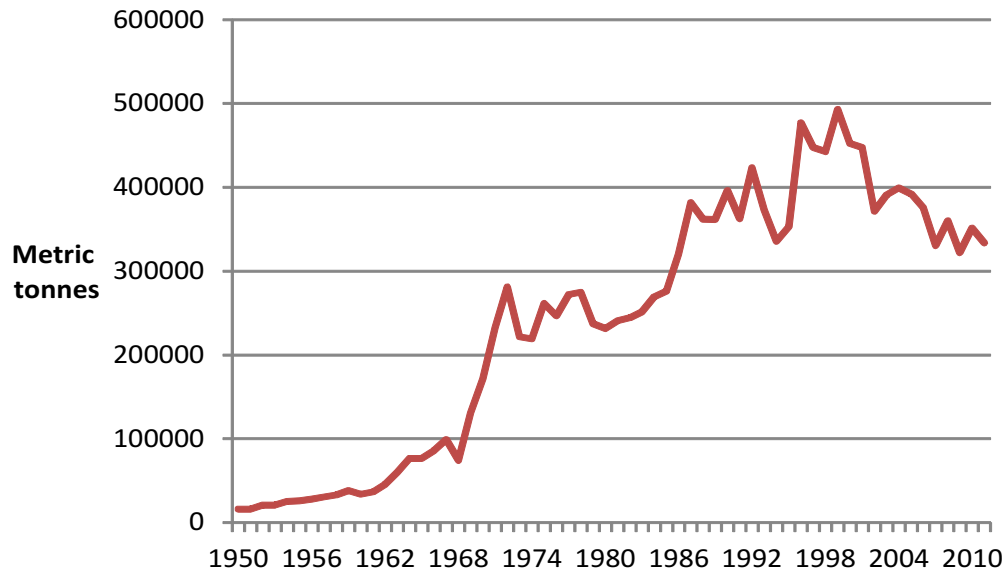


- Fisheries resources are obtained from the capture and culture environment.
- Capture fisheries comprises fish from the wild including sea, lagoons, lakes, rivers, dams and reservoirs and
- constitutes 90% of the fish production
- culture fisheries which includes farming or growing fish, in ponds, tanks and cages, makes up the remaining 10% -----
Aquaculture
- The sector is expanding due to the significant progress in aquaculture

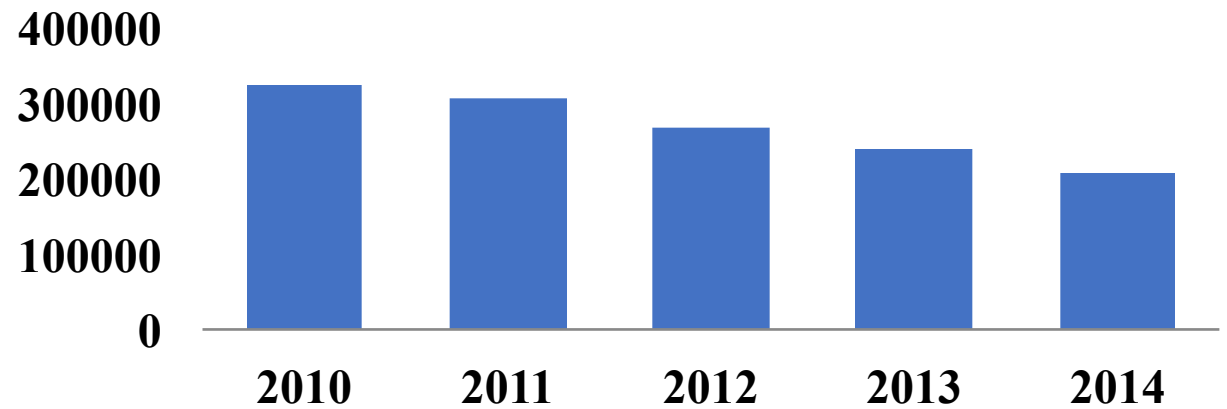
Ghana's Fisheries Sector (cont'd)

- The Fisheries sector accounts for about 5 % of the country's Agric. GDP.
- Fish contributes 60 % of annual protein intake of Ghanaians.
- In addition to food security, the marine fisheries sector is estimated to generate approximately US \$1 billion in total revenue each year.
- Formerly, the sector represented around 1.9% of Ghana's GDP (due to rebasing in 2007 –impact of oil & gas find).
- The latest figures indicate that the sector represents around 2.6 % of Ghana's GDP (Fisheries and Aquaculture Development Plan 2011-2016 – *GOG 2011*).

Landings of fish resources from all fleet (marine and inland) 1950-2010 & 2010-2014

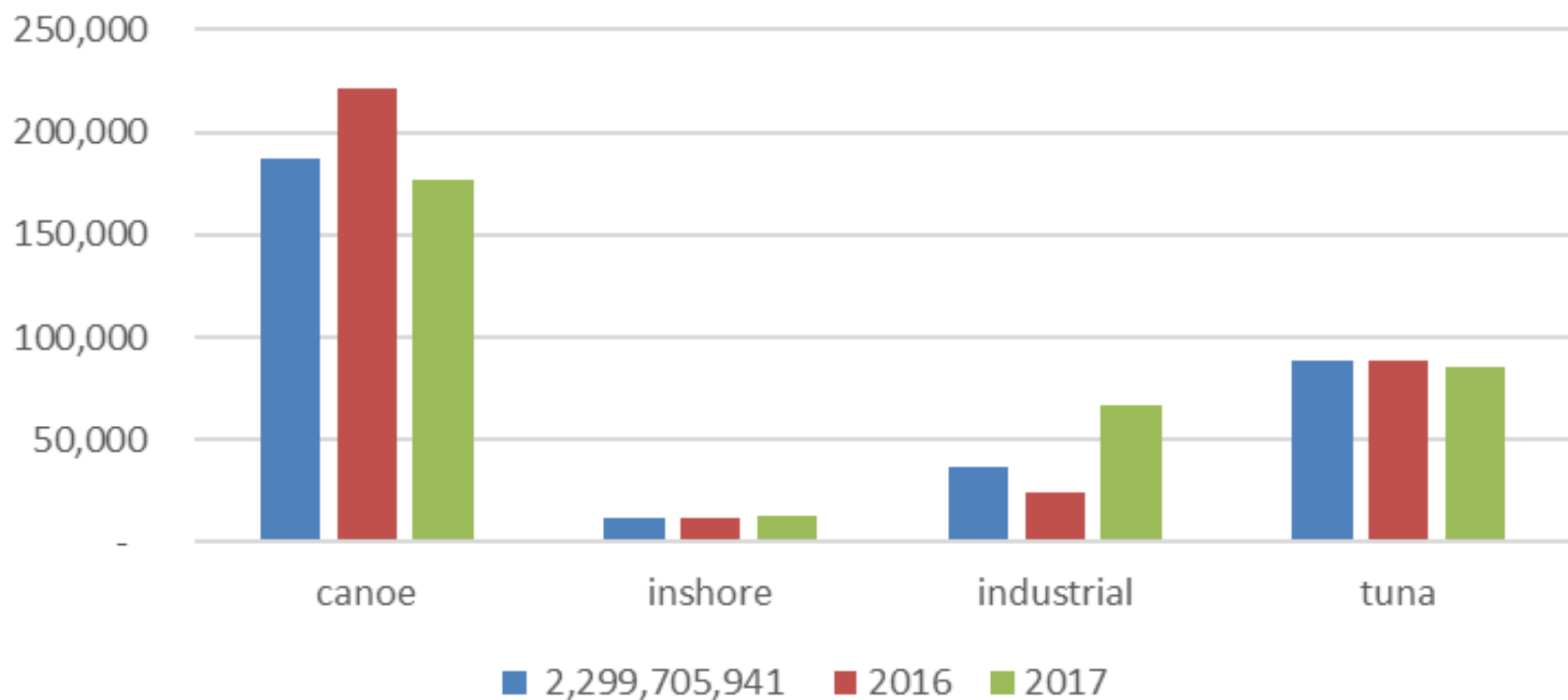


Total landings 2010-2014 (mt)

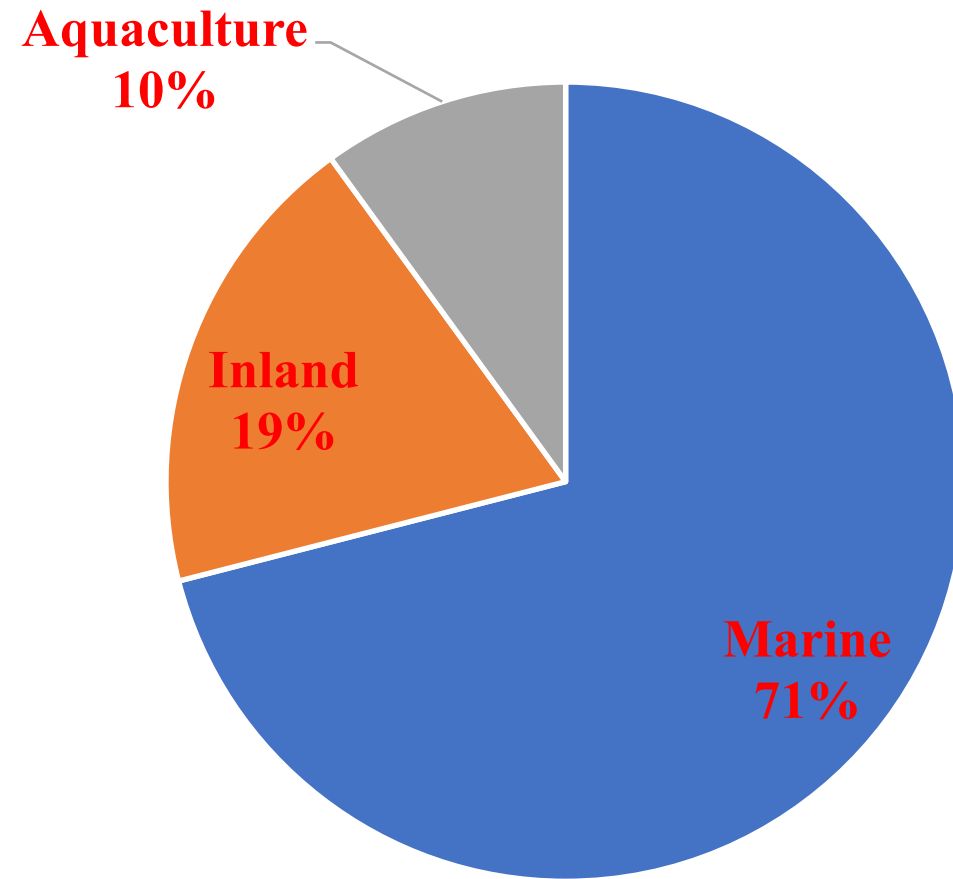


Marine landings by the various sectorsal

*2017 provisional



% Contribution of the various sub-sectors to total fish landings

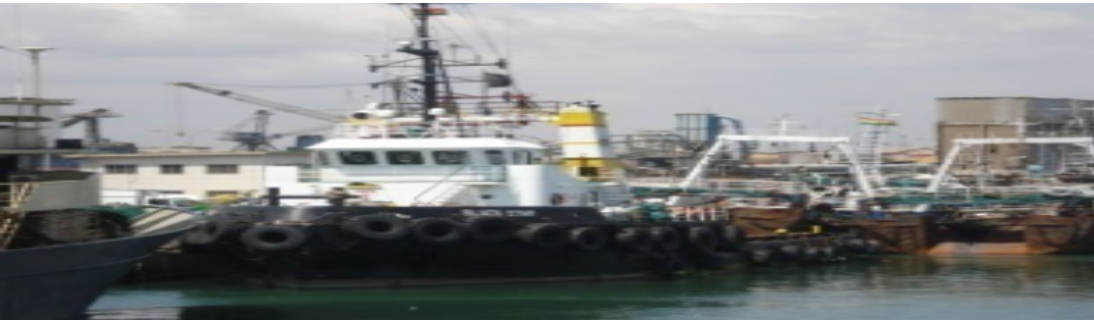


The marine sector of Ghana's fishery



Artisanal fishery – Canoe fishery using a variety of gears including the beach seine. Over 10,500 canoes (*2014 register*) 12728 in frame survey

Inshore fishery– operated from crafts with inboard engines with wooden hull (403 registered in 2014 (*2014*))



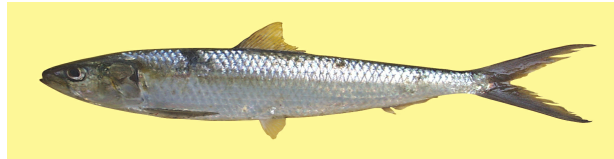
Industrial comprising the 107 bottom trawlers 2 shrimpers and 37 tuna vessels *2016*

Artisanal fishery characterised by the small pelagic species

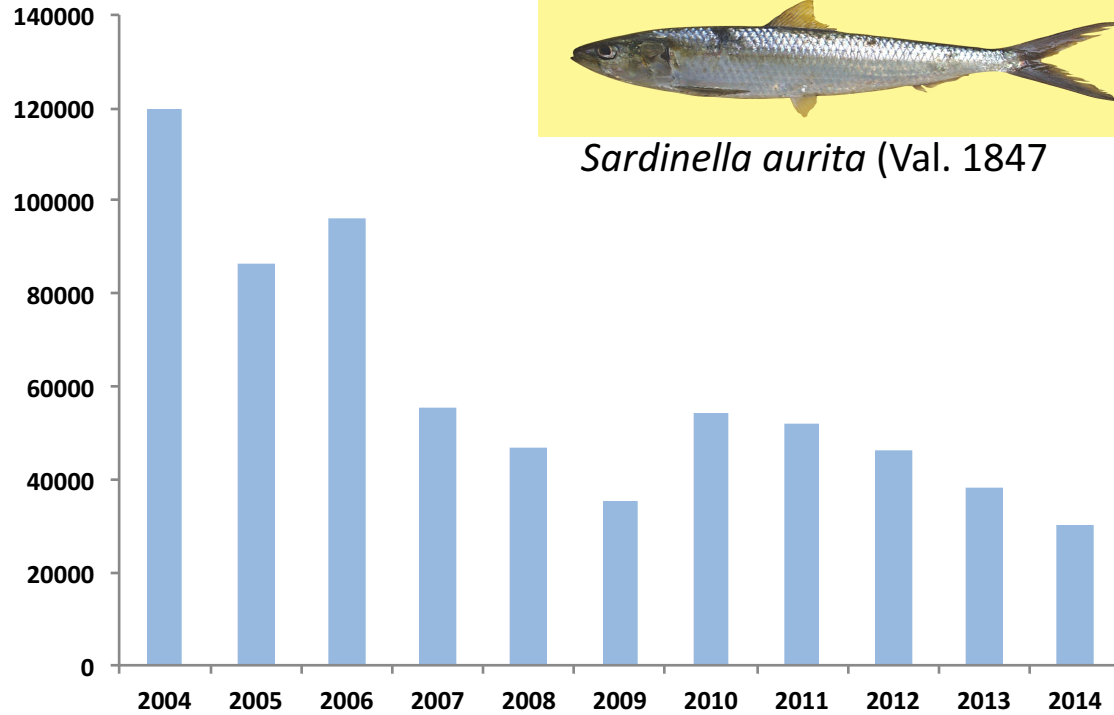
- Sardinellas form at least 50% of Ghana's annual marine catch (FSSD reports) and the backbone of the artisanal fisheries;
- The Sardinella fishery is seasonal with the *Sardinella aurita* more abundant between July and September than the *Sardinella maderensis*.



Sardinella maderensis (Lowe 1841)

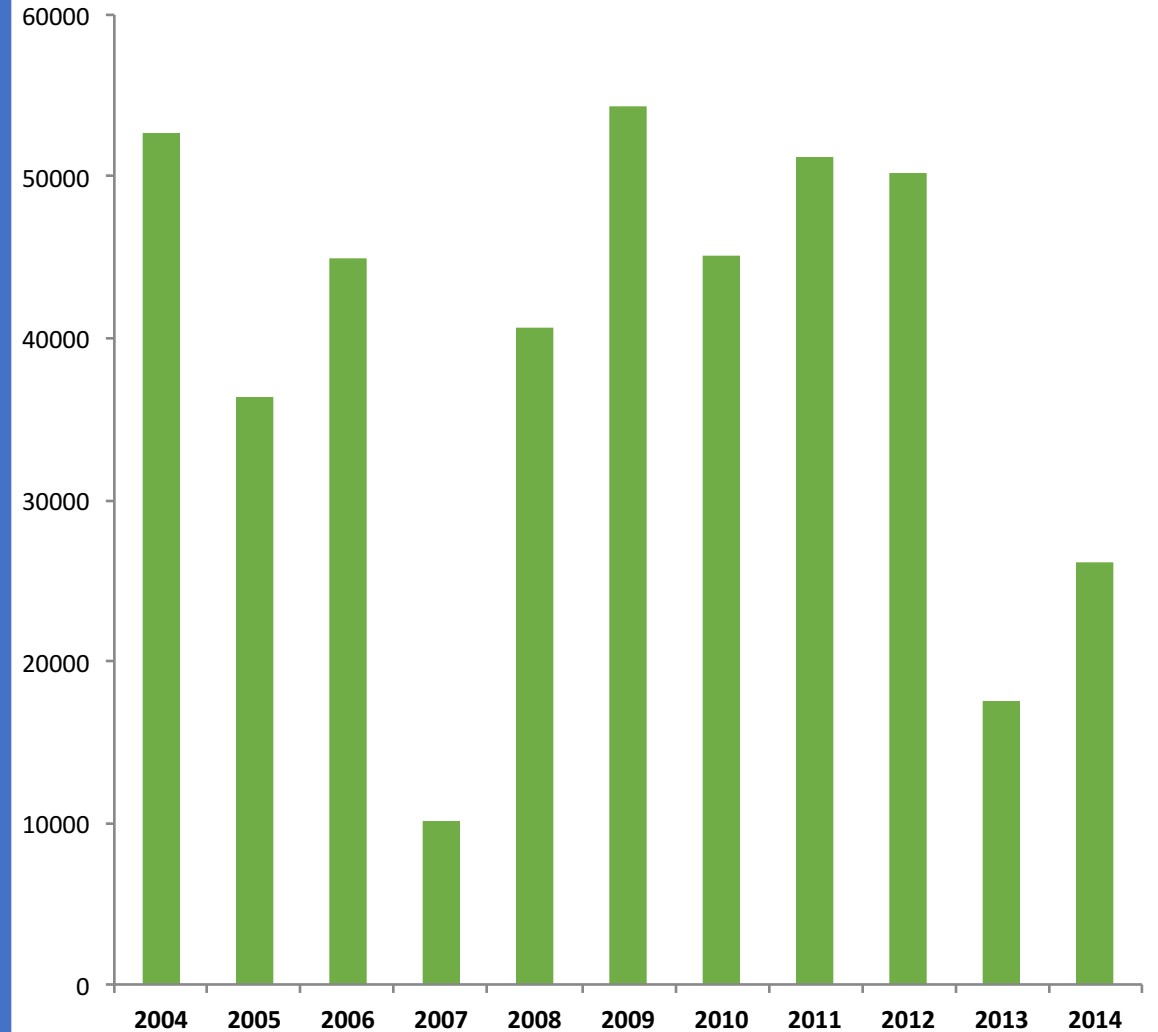


Sardinella aurita (Val. 1847)

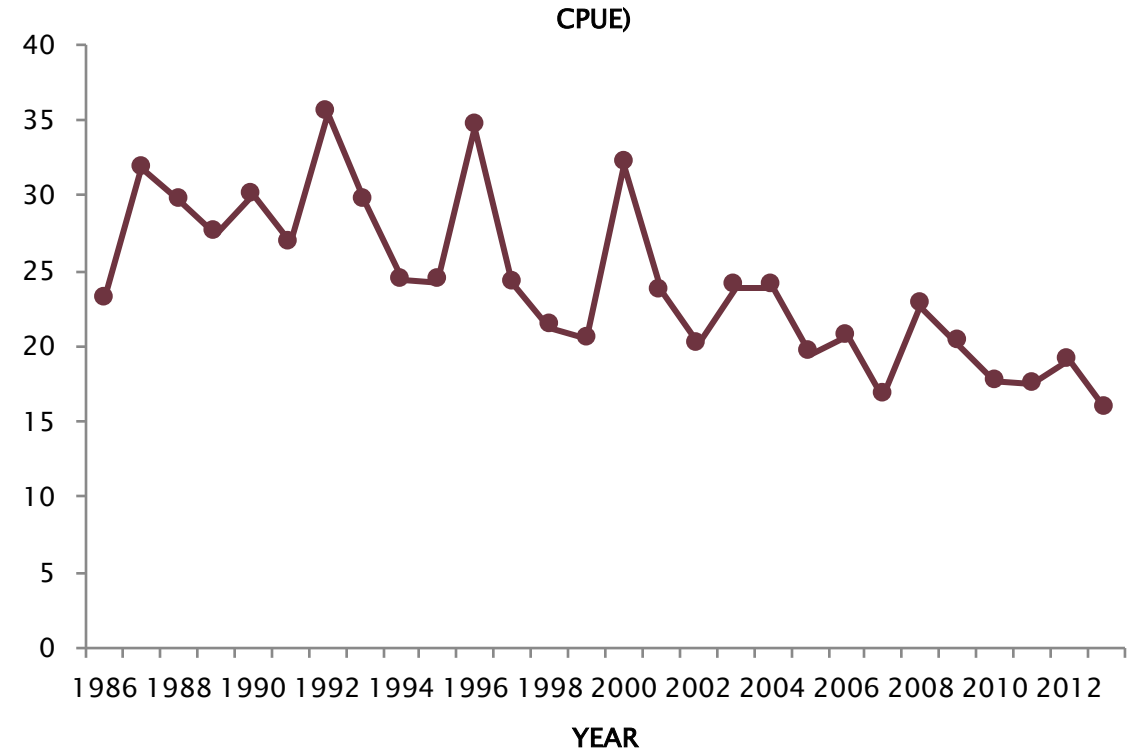
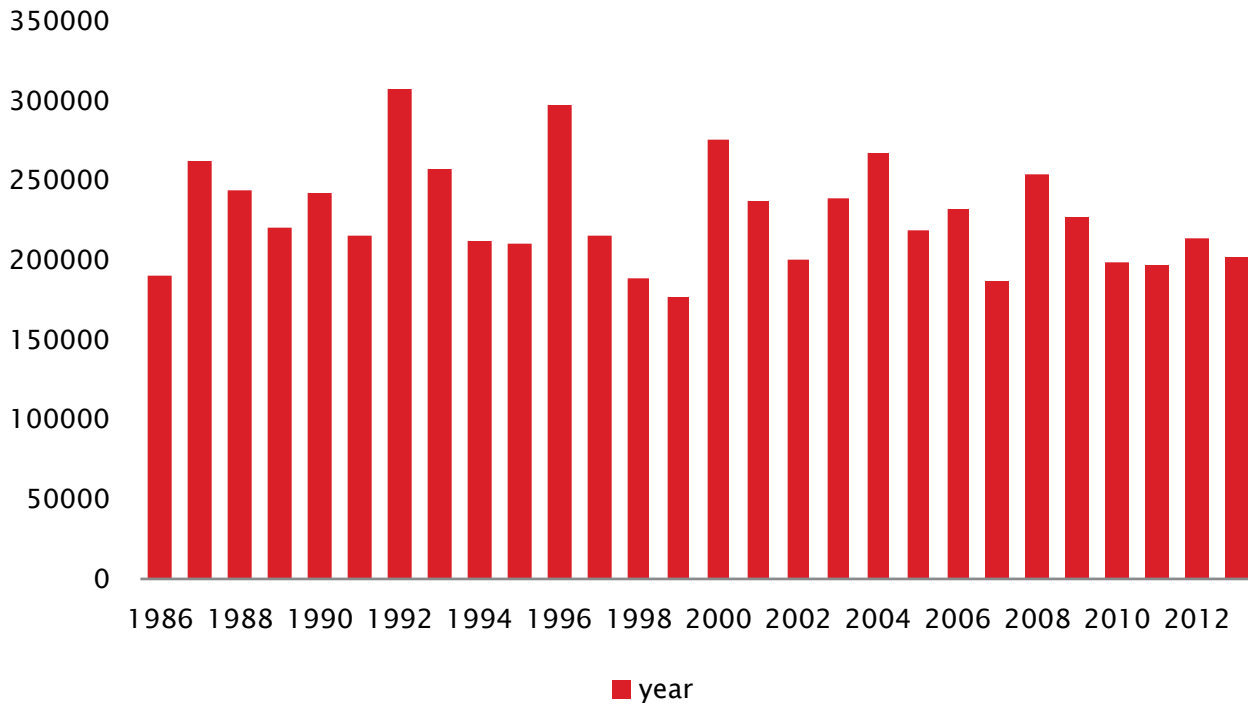


The Sardinella fishery is seasonal with the *Sardinella aurita* more abundant between July and September than the *Sardinella maderensis*

Anchovy



Landings (mt) and CPUE (mt/canoe/trip) for the artisanal fleet



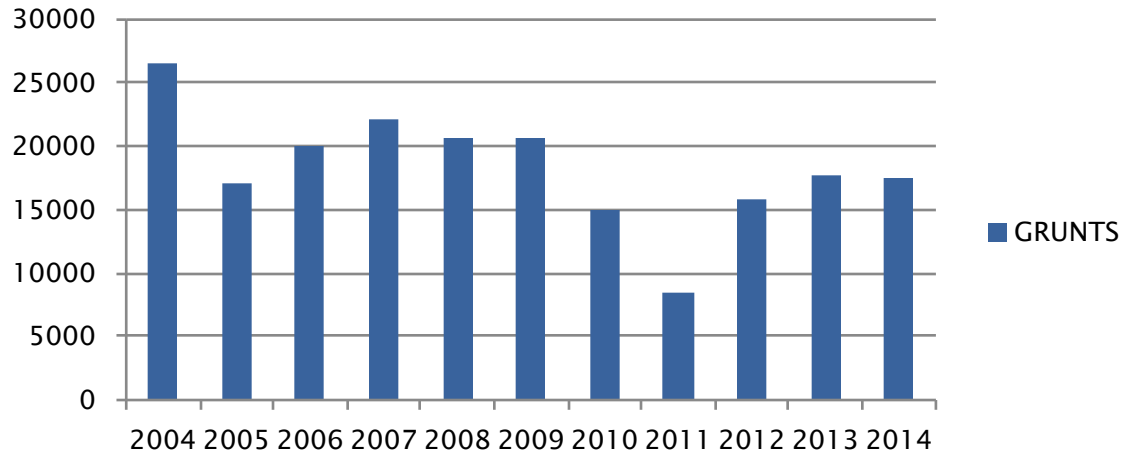
CPUE declining over the decades

Semi-industrial (inshore) fishery

- ▶ Operated from crafts with inboard engines with wooden hull
- ▶ Dual purposed often pursing during the major season and trawling off the season
- ▶ Target species are mainly the sardinellas and other demersal or semi-pelagic species



Common species exploited by the semi-industrial operators within the IEZ



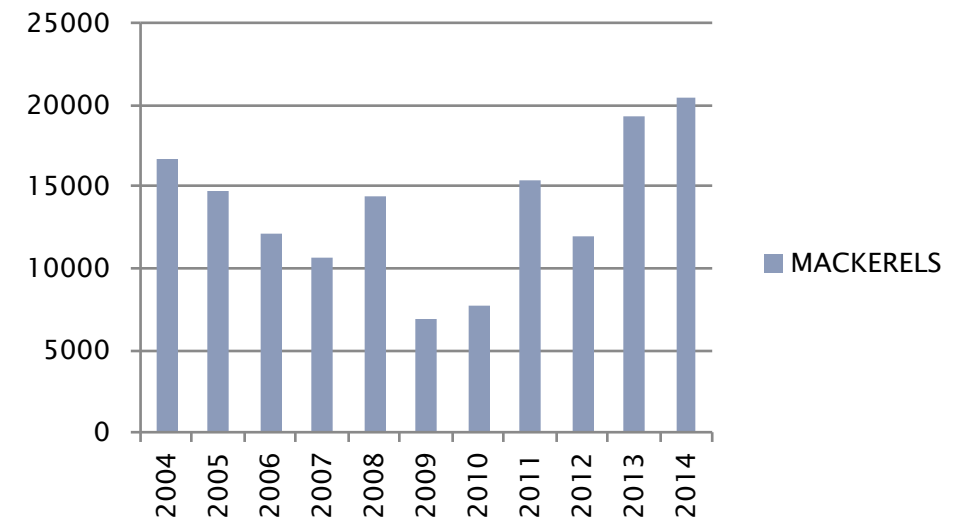
The burrito is one of the most abundant marine fish species caught in marine waters off the Gulf



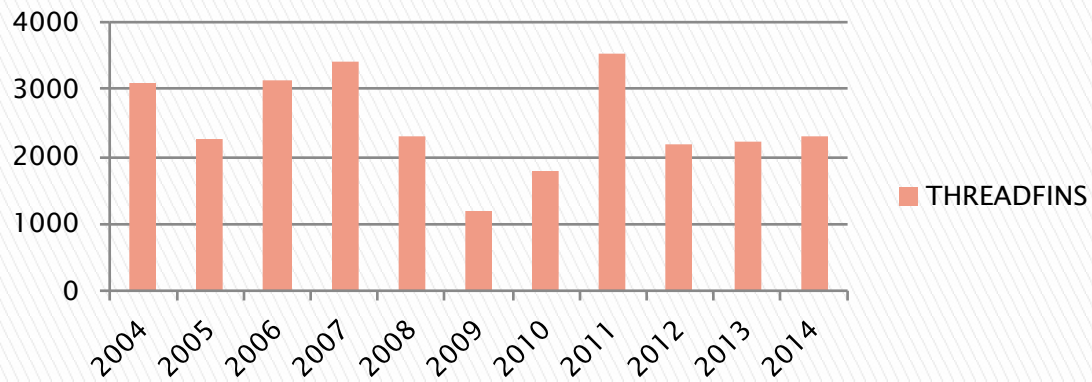
Scad mackerel



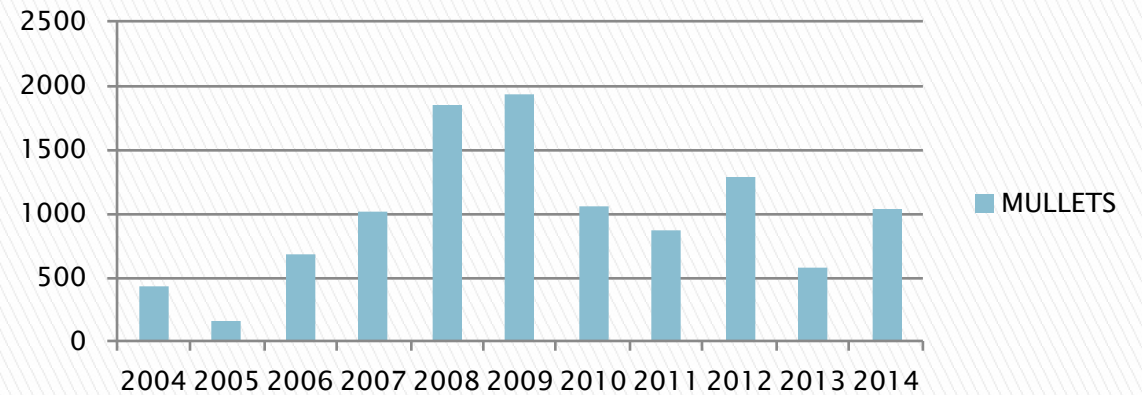
Horse mackerel



Inshore species Sardinellas mackerels hairtails inclusive of a variety including:

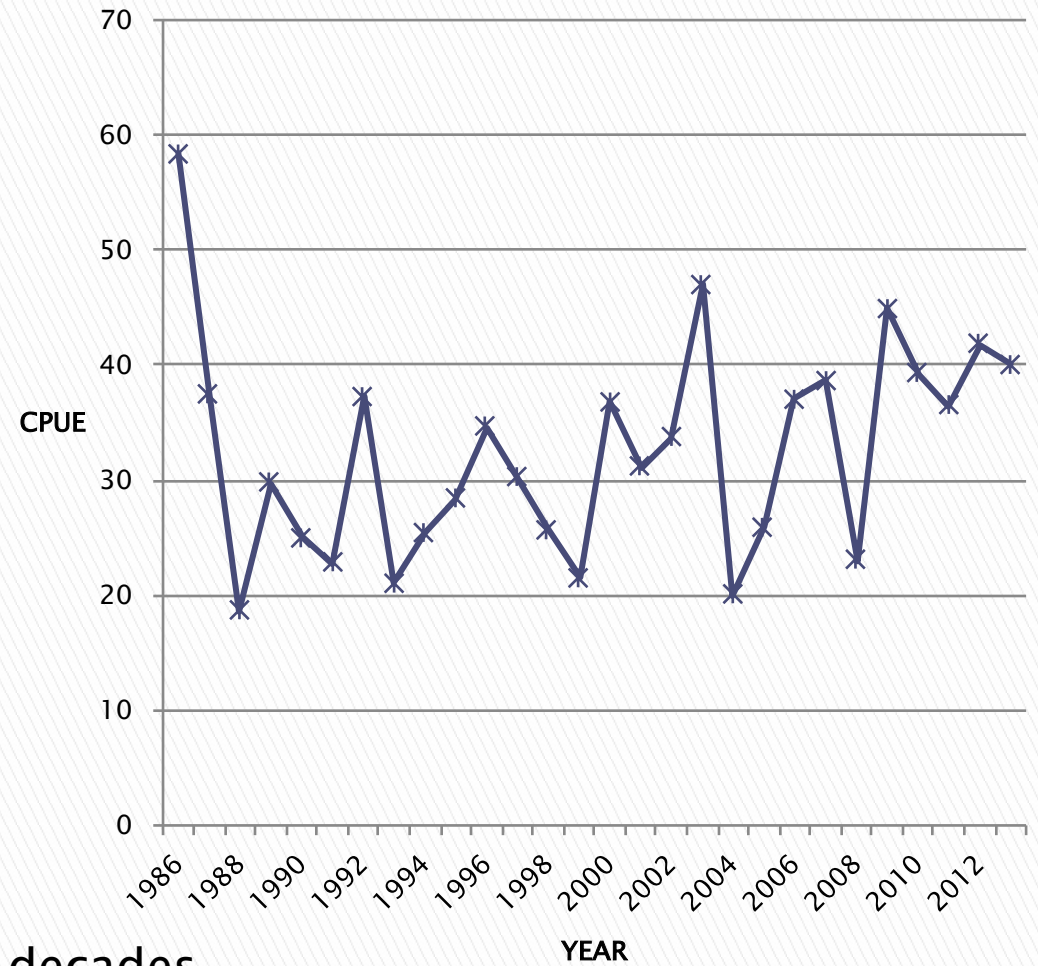
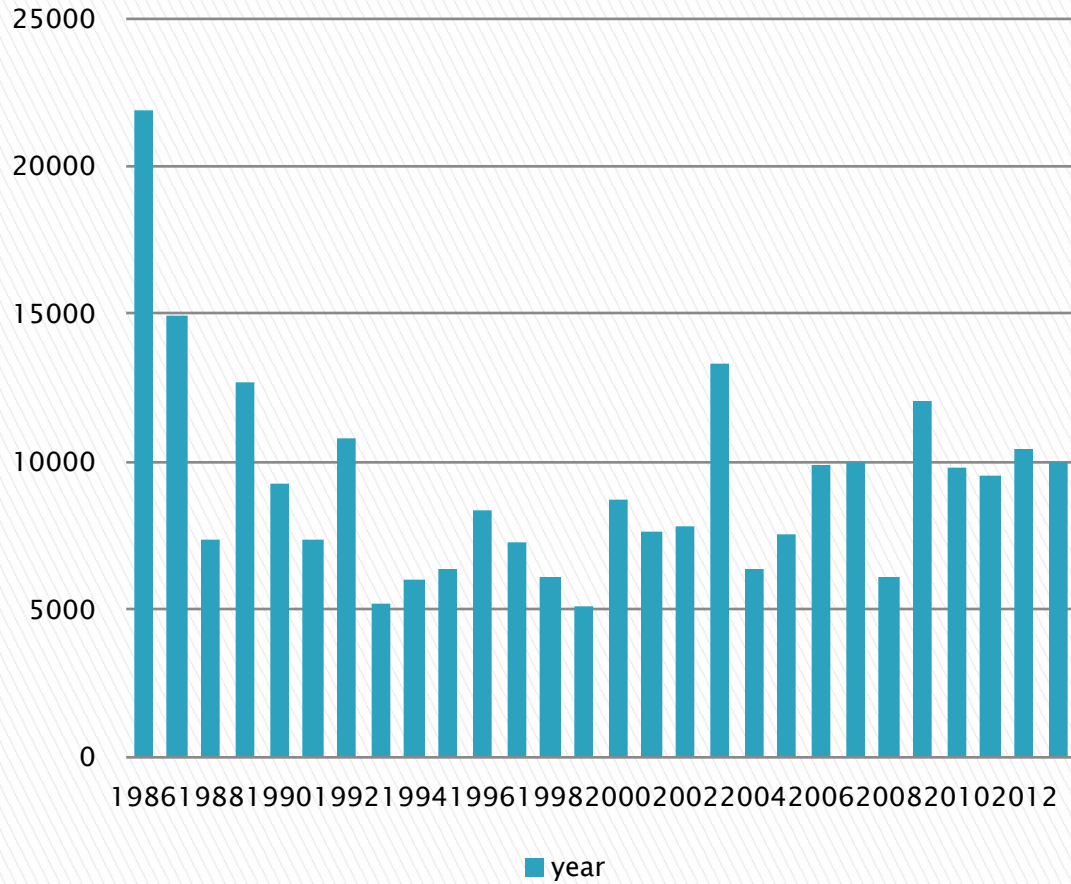


Threadfins with mean landings of 2000mt



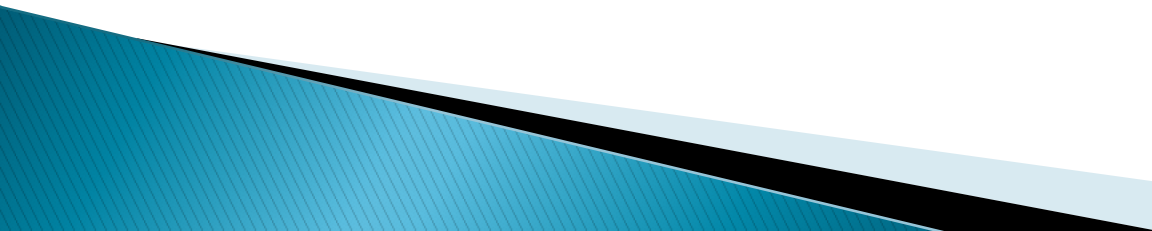
Mullets which are low in landings but highly preferred

Landings (mt) and CPUE (mt/inshore/trip) for the inshore fleet



Cpue fluctuating over the decades

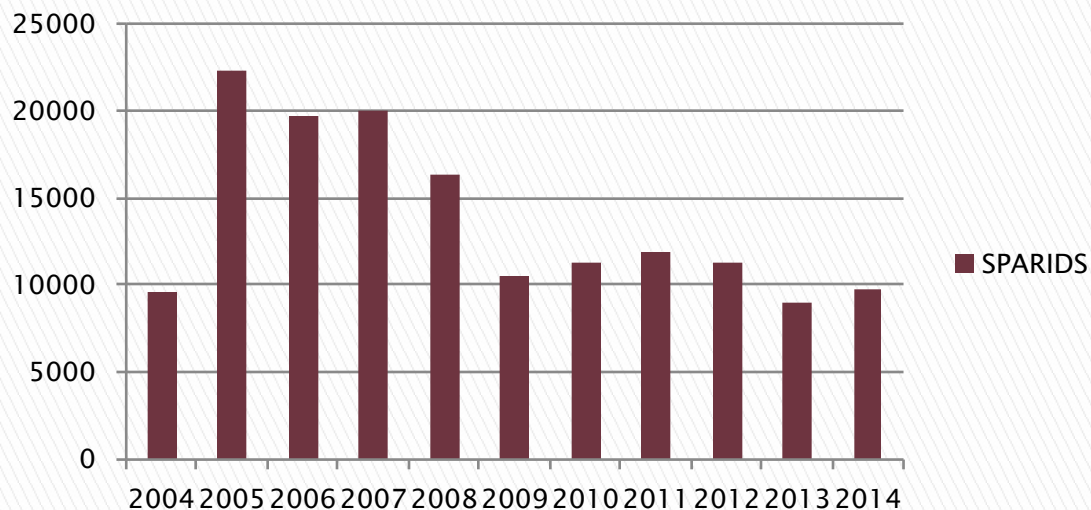
Where are we now with the Inshore fishery?

- ▶ The inshore fishery since the 2010's has had its “ups and downs” due to:
 - ▶ Changing environmental and climatic regimes affecting the availability of fish species;
 - ▶ The use of old obsolete engines;
 - ▶ Lack of spares and modern fishing gears to target specific species within depth ranges;
 - ▶ Generally the fishery has been erratic;
- 

Industrial fishery targets a variety of valuable demersal mainly trawling off the central and western shelf of the coast



Trawl fish demersals



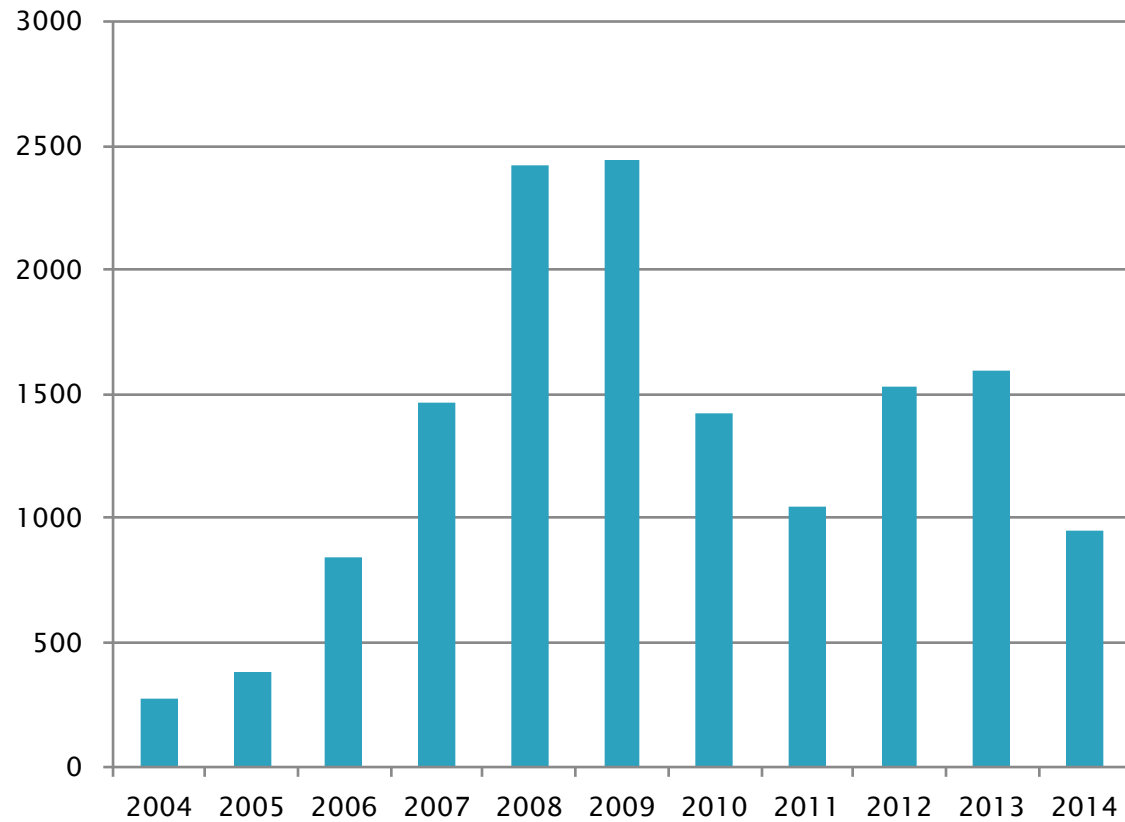
Mean landings of the Seabreams (often termed the “Redfishes”) from 2004–2014 have been around 13700mt



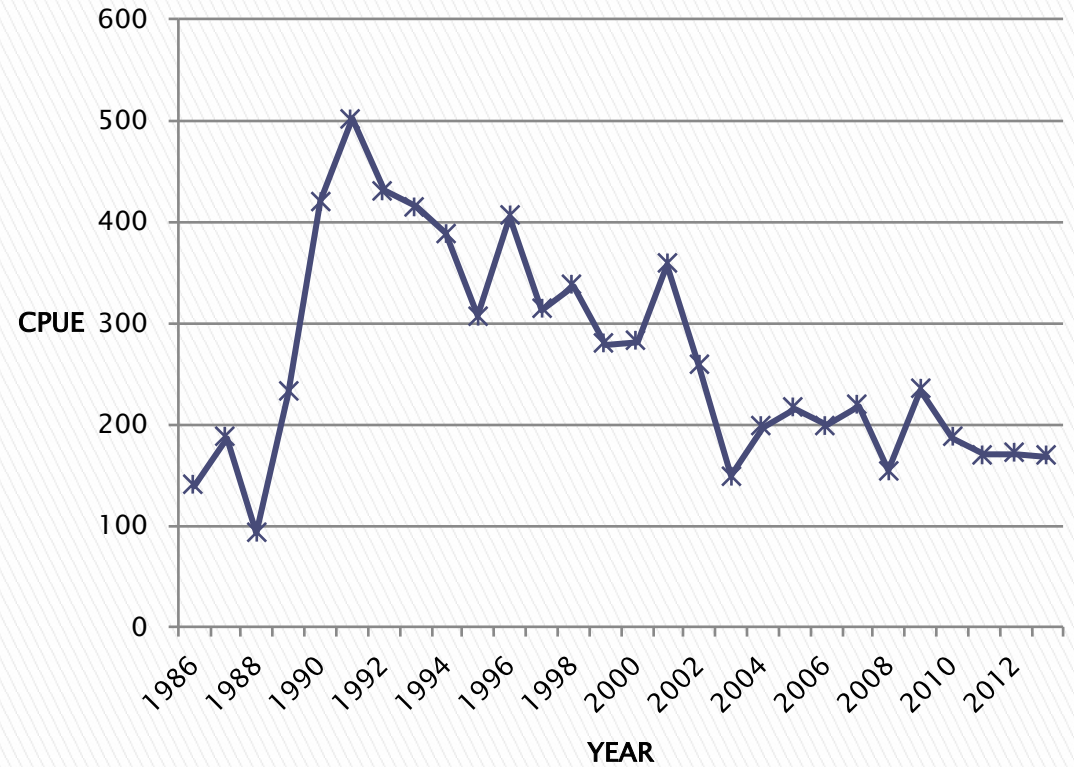
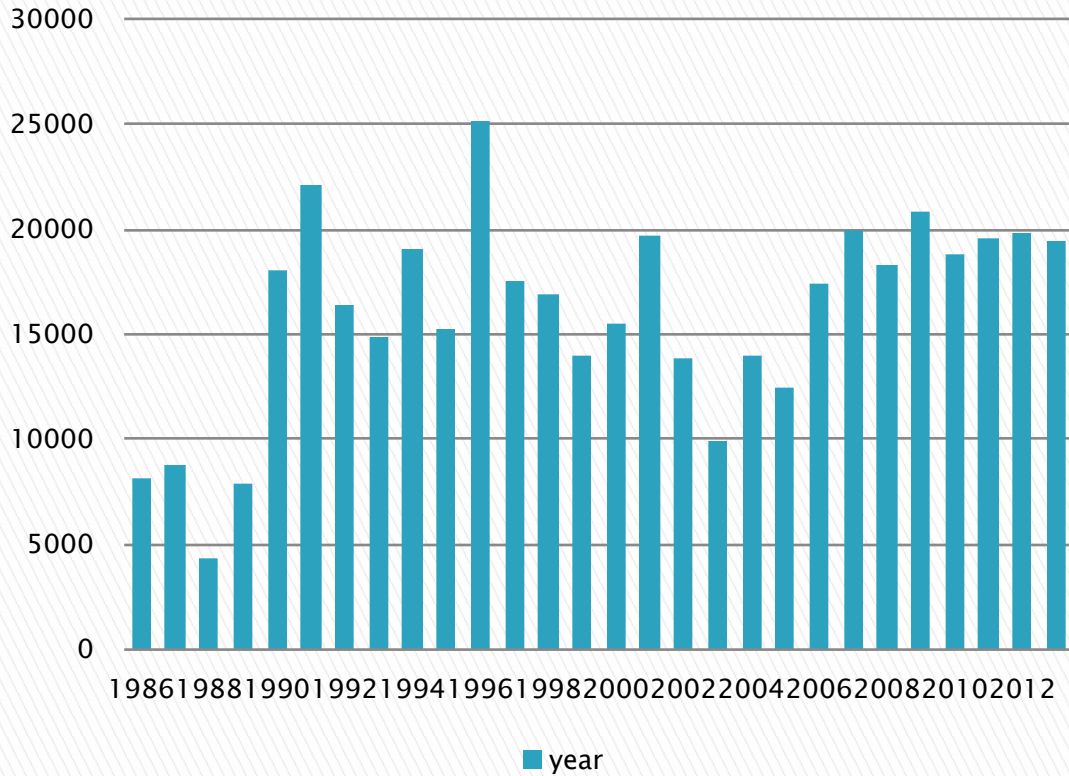
Groupers are one of the most valuable fish preferred by many due to its taste, shape, size, colour, texture and value. Landings are also for the export market. Mean landings 800 mt (2004–2014)



Soles are also targeted by bottom trawlers and every now and then for the export market




Landings (mt) and CPUE (mt/ves/yr) for the industrial fleet



General decline in CPUE from the 1990;s

Issues with the industrial fleet

- ▶ Too many trawl vessels fishing with a narrow area in the central and western shelf;
 - ▶ Information on the biological characteristics of species low
 - ▶ Exploitation rates high indicative of downward trends in CPUE since the 1990's;
 - ▶ Overfishing occurring due to mean sizes observed to be decreasing from landings and “discards”;
 - ▶ MCS improving but need to be “beefed” up in terms of manpower, training and logistics;
- 

GHANA'S TUNA FISHERY





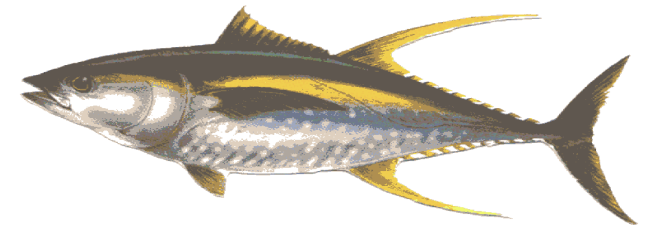
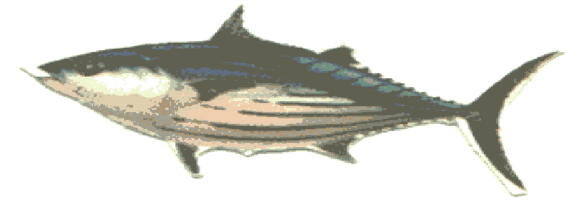
A TYPICAL BAITBOAT OPERATION

LARGE PELAGICS

The large pelagics comprise mainly tuna species belonging to the family Scombridae and other tuna-like species.

3 main tuna species occur as part of a large community in the Atlantic Ocean

- ▶ Skipjack (*Katsuwonus pelamis*)
- ▶ Yellowfin (*Thunnus albacares*)
- ▶ Bigeye (*Thunnus obesus*)



GHANA'S TUNA FISHERY

- ▶ There are currently 17 medium sized purse-seiners (50–65m) and 20 baitboats (40–50m operating from Tema)

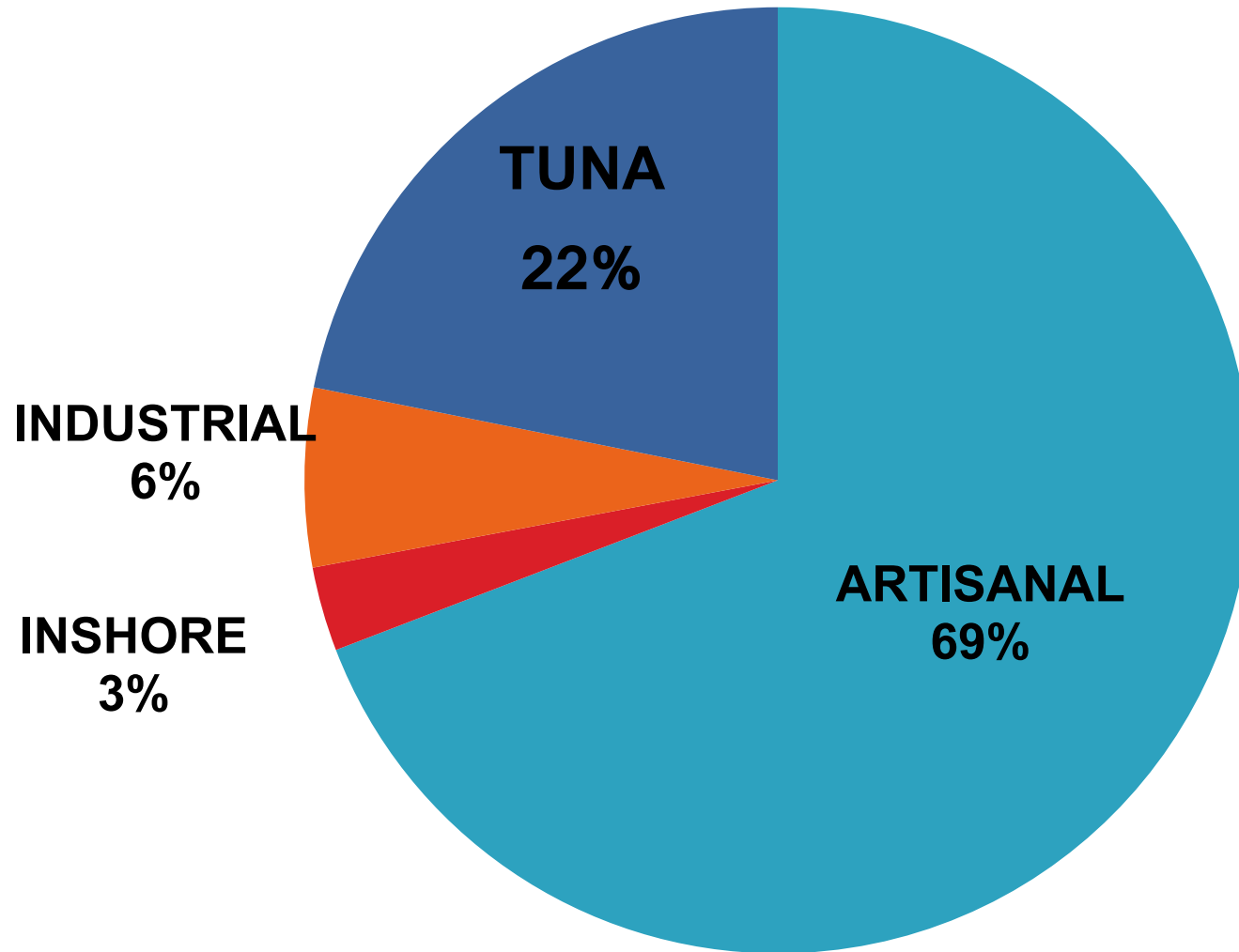


GHANA'S TUNA FISHERY (CONT'D)

- ▶ Baitboats have been dominant in the Ghanaian tuna fishery for the past 4 decades (1960–1990) whereas Purse-seiners were reintroduced in 1996.
- ▶ There are currently 11 tuna companies registered in Ghana.
- ▶ Purse-seiners usually stay at sea for up to 2–3 months whilst Baitboats have a shorter duration of up to a month.
- ▶ Fish landed is either sold to the local market or canneries for processing.



PERCENTAGE CONTRIBUTION BY FLEETS





Some common marine fishes



**Round Sardinella -
*Sardinella aurita***



**Skipjack -
*Katsuwonus pelamis***



**Moonfish -
*Selene dorsalis***



**Red snapper -
*Lutjanus fulgens***



**Flat Sardinella -
*Sardinella maderensis***



**Anchovy -
*Engraulis encrasicolus***



**Yellowfin -
*thunnus albacares***



**Chub mackerel -
*Scomber japonicus***

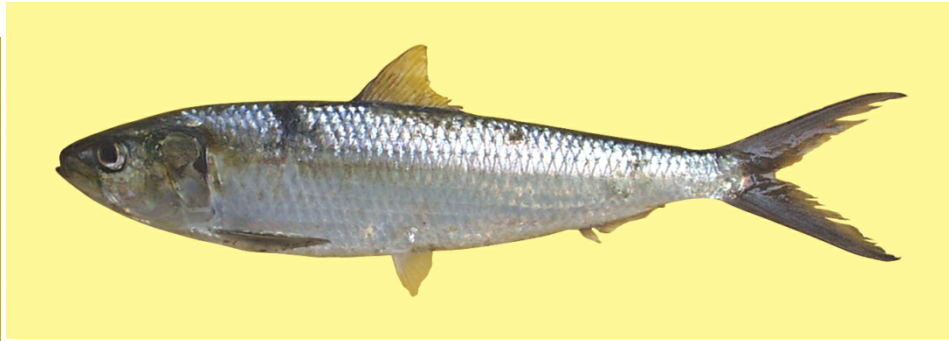


**Cassava fish -
*Pseudotoli senegalaensis***

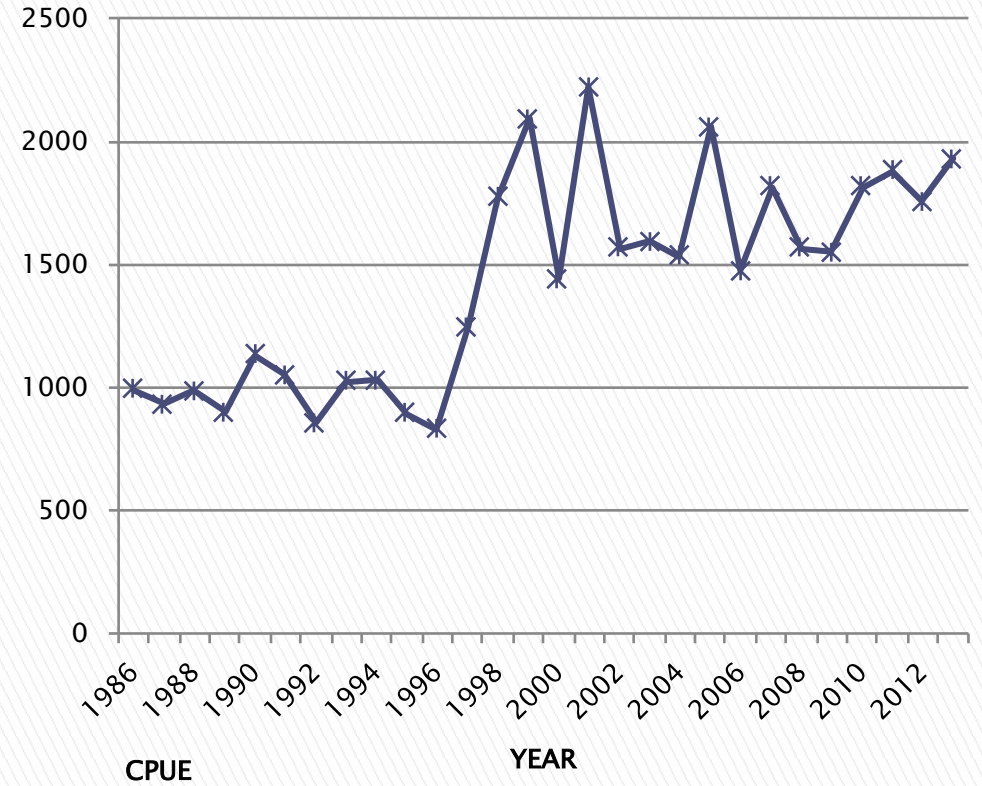
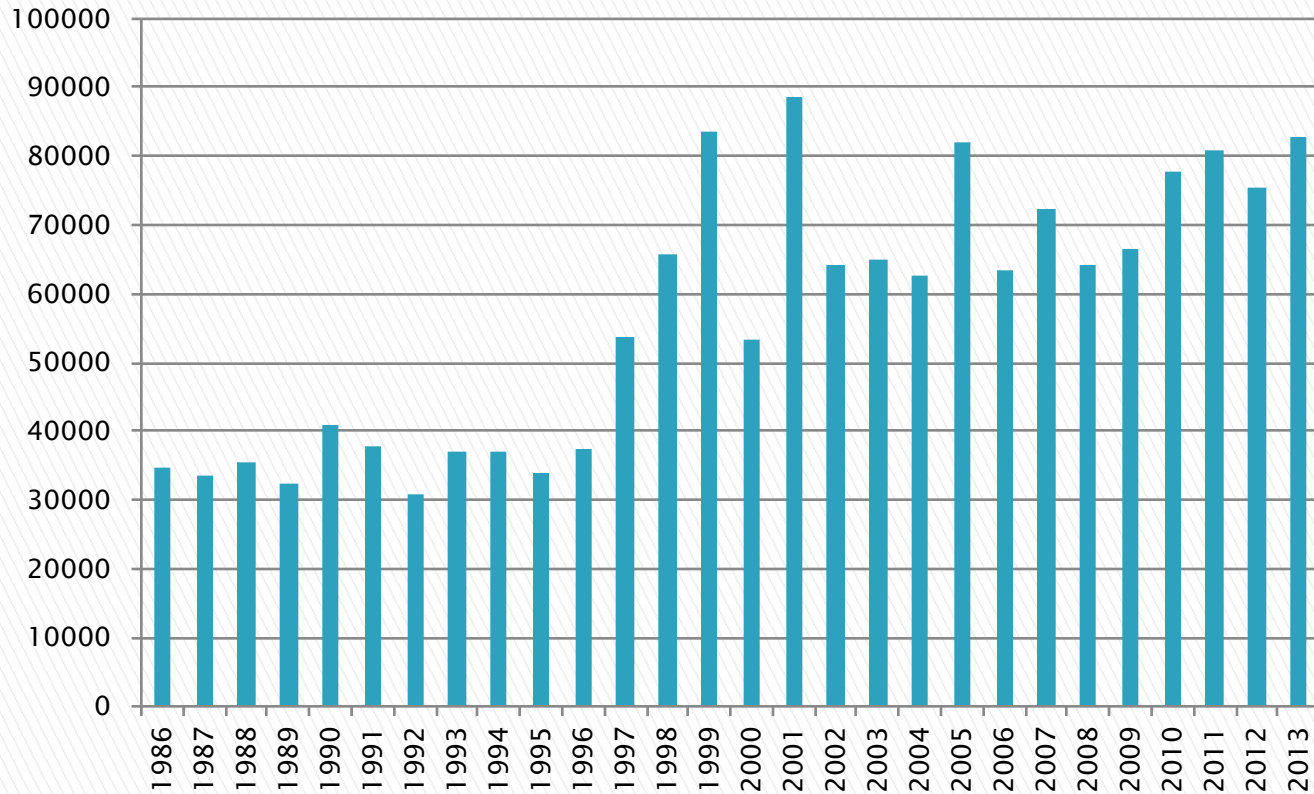


**Red Pandora -
*Pagellus bellotti***

SMALL PELAGICS



Landings (mt) and CPUE (mt/vessel./trip) for the tuna fleet



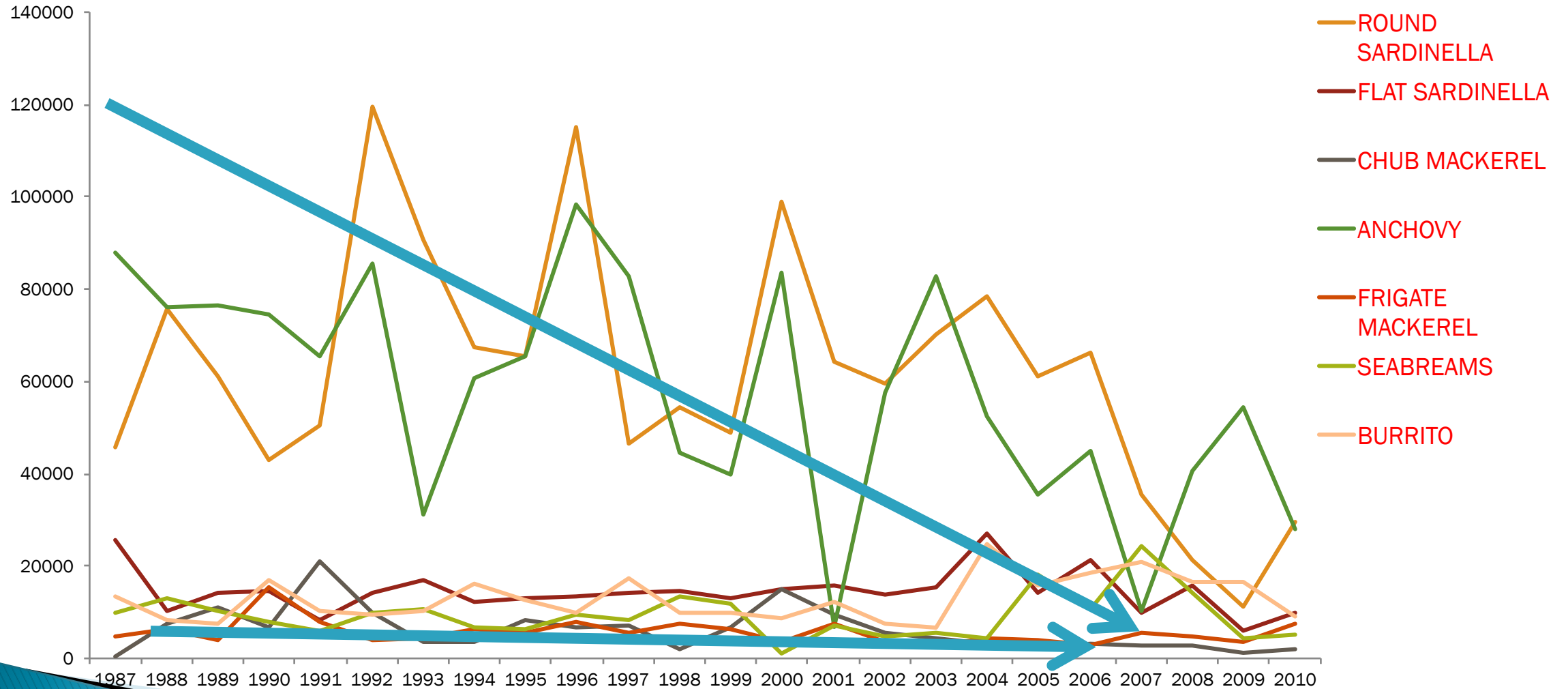
CPUE rising from the 1990'S . Resource seems healthy especially skipjack

By-catch from Ghana's fishery

- ▶ Sharks and rays are seldomly caught as bycatch in the Tuna purse seine fisheries
Those caught alive are thrown back however those caught dead are utilised.
- ▶ However Rays, sharks, and pelagic spp are often incidental catches from trawl gears
- ▶ Incidence of more sharks, dolphins and sea turtles being caught by the artisanal fleet



What do we see today



In summary the key issues are:

- ▶ Excessive fishing effort exerted in all fleets with more canoes being built along coastal shores
- ▶ Weak enforcement of Fisheries regulations
- ▶ Low levels of protection of marine biodiversity with more interactions in the oil and gas industry which could affect fisheries;
- ▶ Incidence of more endangered species being caught eg mammals and sea turtles being caught by the artisanal fleet
- ▶ Upwelling index lower in 2016 (16.9) as against 18 in 2015, Falling over the past 5 years

The Basic Problem of Overfishing

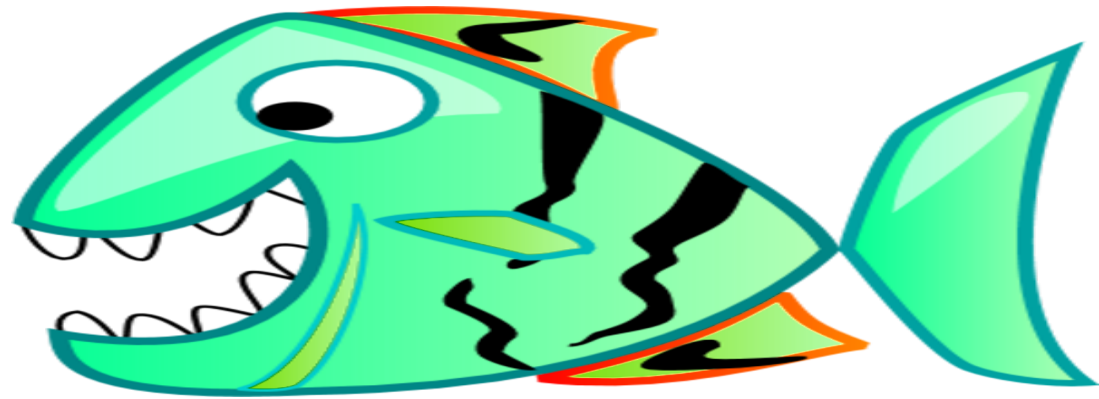
⚓ **Bycatch and discards** e.g. Ghana's shrimp industry



Implications of overfishing

- Poor catches
- High quantities of fish discards
- Low catch rates i.e. low CPUE
- Fishing down the food web (e.g. small sizes of landed fish)
- Changes in life history traits
- Extinction of some fish species
- Habitat degradation e.g. plastic pollution,
- Low profits
- High cost of fishing inputs

ADDRESSING KEY ISSUES



SURVEYS OF THE FISH RESOURCES AND ECOLOGY OF GHANA-NANSEN 2016

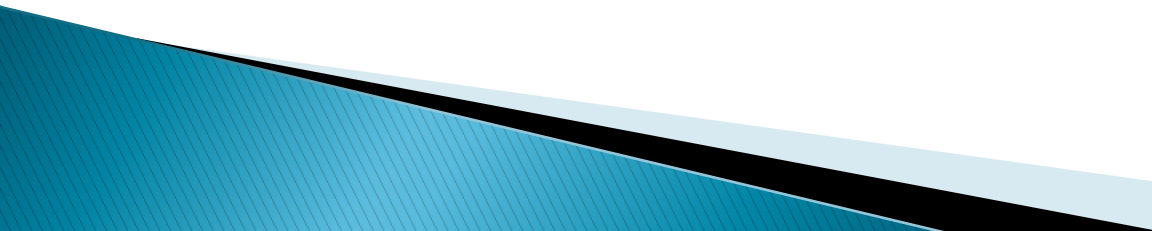
- ▶ A total of 211 species (fish and invertebrates) belonging to 109 families were recorded during the survey.
- ▶ This total is based on 190 species recorded during bottom trawls in combination with an additional 64 recorded during pelagic trawls and 1 species during manta trawls.
- ▶ Bony fishes (Actinopterygii) were by far the most represented taxonomic group with 160 species followed by Crustacea (22), Cartilaginous fishes (Chondrichthyes) (10) and Cephalopoda (8) species.
- ▶ Species belonging to other recorded taxonomic groups were poorly represented and accounted for the remaining 6% of the total number of species.

- ▶ To address the general fluctuations and declines in the marine fisheries with the exception of the tuna sector coupled with man-made activities, the Government has enshrined in the ACT – section 42 a management plan 2015–2019 to reverse and improve issues threatening food security, livelihoods and also to meet international obligations

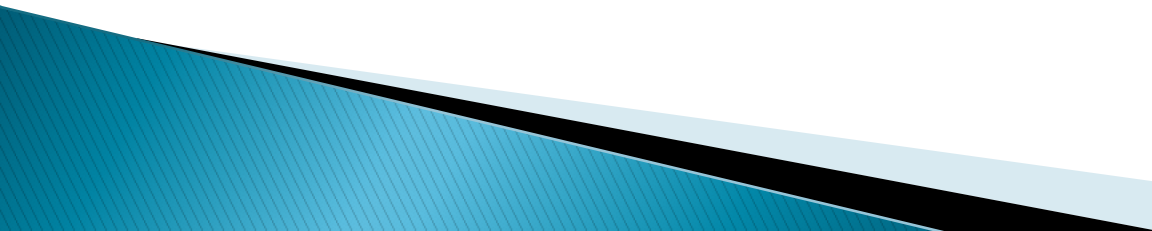
Reducing excessive fishing effort exerted in all fisheries

Some actions to take in the plan:

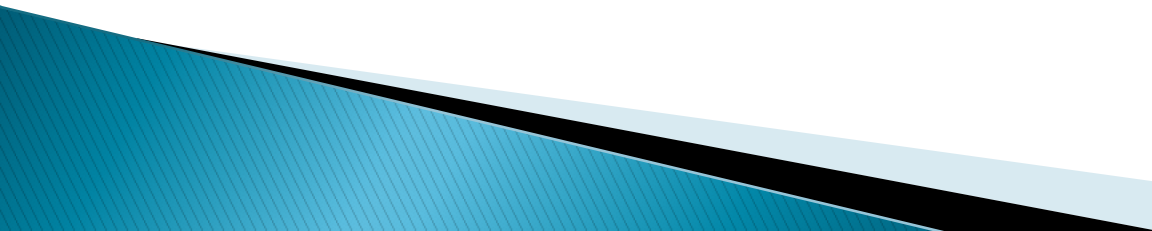
- Reduction in fishing days for trawlers (scaled annually).
- Deletion of inactive boats (t)
- Enact closed seasons (All)
- Cancellation of licenses for violators of fisheries laws and regulations (All).
- Replacement scheme for registered vessels (t)

- ▶ Increase the traditional one day per week fishing holiday to 2 days per week. ©
 - ▶ Control of new entrants to the fishery by encouraging alternative livelihoods ©
 - ▶ Facilitation of co-management systems in communities with other institutions ©
 - ▶ Strict adherence to current ICCAT capacity limits allocated to Ghana (t)
- 

Inadequate information on Fisheries Biology and Stocks

- ▶ Develop a Data Collection Regulation aimed at gathering fisheries data through recruitment, training and deployment of personnel;
 - ▶ Develop research plan and undertake assessments of key commercial fish stocks;
- 

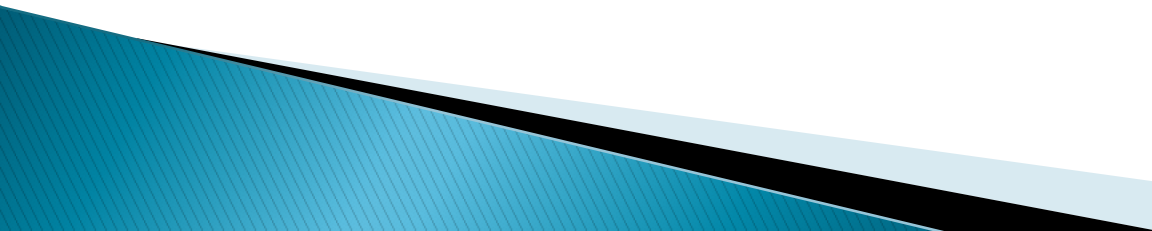
Weak enforcement of Fisheries Regulations

- ▶ Maintain and upgrade vessel monitoring system (VMS),
 - ▶ Enforce strictly, provisions in Act to eliminate IUU fishing
 - ▶ Collaborate effectively with regional bodies on MCS strategies to combat IUU fishing;
- 

Low levels of protection of marine Biodiversity

- ▶ Designate and create marine habitat protection areas, through research along the coast to protect nursery areas and spawning grounds, mainly in estuaries and mangrove areas;
- ▶ Deal with oil /gas/ fisheries/etc issues such as breeding grounds off the Western shelf
- ▶ Actively collaboration with Govt-(MDA), Research institutions, Universities, NGO's etc in protecting the marine resources

Product certification and reducing post-harvest losses

- ▶ Promoting community group (women fish processors) involvement in post-harvest and facilitating business opportunities thru improving landing facilities to increase food safety and hygiene;
 - ▶ Facilitate the creation of and traders associations to access micro-credit financial schemes to enhance fish production and marketing;
- 

The Threat of Global Climate Change

Potential impacts on physical features of oceans:

- Sea surface temperatures
- Sea level rise
- Changes in Ocean circulation patterns
- Salinity fluctuations
- pH

Potential impacts on marine fish:

- Migration patterns
- Changes in reproductive patterns
- Food web effects

Poor catch – full of algae & litter



Management of the large pelagics-tuna /tuna-like species

- This is done by ICCAT of which Ghana is a member.



- Estimates of the Biomass of the Bigeye species in the East Atlantic show a low stock status and probably threatened
- A lot of recommendations such as Area closures and Quotas have be recommended, adopted and implemented to conserve the species.

Issues with the industrial fleet

- Too many trawl vessels fishing within a narrow area in the central and western shelf;
- Information on the biological characteristics of species low;
- Exploitation rates high indicative of downward trends in CPUE since the 1990's;
- Overfishing occurring due to small mean sizes of fish observed during observer programmes;

In summary the key issues are:

- Excessive fishing effort exerted in all fisheries;
- Inadequate information on Biology (spawning, maturity distribution) of fish stocks;
- Low enforcement of Fisheries Regulations;
- Low levels of protection of marine Biodiversity eg. Lack of designated and gazetted MPAs.

What can be taken out of our waters and with what capacity of fleets?

- From catch assessment surveys conducted by the Fisheries Commission, (1986-2013)

the Maximum sustainable yield (MSY) was computed using a production model Shaeffer 1954.

SUMMARY OF SUSTAINABLE LEVELS IN RELATION TO CURRENT FLEET NUMBERS

	No of units in 2014	MSY mt	Units required to sustain fishery
Artisanal	10500	239,913	9,095
Inshore	403	13,713	272
Industrial	107	30,637	48

AQUACULTURE

AQUACULTURE DEVELOPMENT IN GHANA

- Fish production through aquaculture has grown steadily over the last six (6) years from **10,200mt** in 2010 to **44,610mt** in 2015.
- Large scale private commercial aquaculture farmers have been the main driving force.
- The long term objective of the FC is that aquaculture will play a key role in filling the growing gap between demand and supply through the ff:
 - Adoption of best management practices through extension service delivery
 - Increased production of good quality fingerlings from public and private hatcheries
 - Improving fish data collection
 - Training and education of staff and stakeholders
 - Aquaculture research

AQUACULTURE PRODUCTION

	Production (mt)		
Holding System	2014	2015	% diff.
Pond/ Tank	2,912	2,410	17.2↓
Cage	33,075	40,150	17.6 ↑
Dam/Dug out/Reservoir	2,548	2,050	19.5 ↓
Total	38,535	44,410	13.2 ↑

Aquaculture farms visited and inspection of prospective sites

Region	No. of Farms visited	No. of ponds inspected	No. of sites inspected	suitable	unsuitable
Greater Accra	83	16	7	6	1
Ashanti	85	239	35	29	6
Northern	12	30	12	10	2
Eastern	235		12	12	
Brong Ahafo	239	208	80	70	10
Western	41	208	56	52	4
Upper East	25	6	7	6	1
Upper West			2	2	
Volta	22		9	9	
Central	54		28		
Total	796	707	248	196	24

FISHERIES MANAGEMENT

Fisheries Management

- Manage = to be in control of something

AIM / GOAL

- Sustainable management – wise use of resource in order to meet the needs of present and future generations
- Equitable use of resource by all interested groups.

Requirements for Management

Quality Information / Data about the fishery

- The fishery – its operation & constraints
- Participants – social aspects
- Species e.g. stock assessment, catch assessment
- Environment – physico-chemical e.g. monitor Temperature, Salinity, Dissolved O₂ of water

Specific Management Objectives

Single or combination of a number of objectives:

- For sustainable exploitation
- To increase yield
- To increase value and profitability in fisheries
- To increase employment
- To increase income (local & hard cash)
- To protect critical species
- To protect critical habitats
- To reduce IUU
- To improve on policy
- To strengthen governance, etc. etc

MANAGEMENT OF GHANA'S FISHERIES

THE REPUBLIC OF GHANA
MINISTRY OF FISHERIES AND AQUACULTURE DEVELOPMENT



**A MANAGEMENT PLAN FOR THE BEACH SEINE
FISHERY IN GHANA**

July, 2013

Some options in the Fisheries Management Plan:

- Enact closed seasons;
- Cancellation of licenses for violators of Ghana's fisheries laws and regulations
- Facilitation of co-management systems in communities with other institutions
- Develop research plans and undertake assessments of key commercial fish stocks;
- Collaborate effectively with regional bodies on MCS strategies to combat IUU fishing;

National Fisheries Policy and Development Plan

- The vision for Ghana's Fisheries Sector is linked to the national and international development frameworks expressed in the ff:
 - Ghana Shared Growth Development Agenda II (GSGDA 2014 - 2017),
 - New Partnership for Africa Development (NEPAD)'s Comprehensive African Agricultural Development Programme (CAADP) and the
 - Sustainable Development Goals (SDGs).
 - AU Agenda 2063

National Fisheries Policy and Development Plan (cont'd)

- According to the SDGs by 2020:
- there should be mobilization and significant increase from all financial resources aimed at improving ocean health and reducing economic and social incentives for its misuse,
- including the prohibition of fisheries subsidies that contribute to overcapacity and overfishing,
- eliminate subsidies that contribute to IUU fishing, and
- refrain from introducing new such subsidies, recognizing that appropriate differential treatment for developing and LDCs should be an integral part of the WTO fisheries subsidies negotiation.
- There will also be sustainable management of fisheries resources among others.

National Fisheries Policy and Development Plan (cont'd)

- According to the AU agenda 2063:
 - African fisheries companies will exploit the resources sustainably for the benefit of Africans and market-led aquaculture would close the supply gap in fish.
 - Africa would rid themselves of IUU fishing.

The agenda identified a challenge thus, climate change (temperatures and ocean acidification) is leading

- to the weakening of the capacity of the ocean as a carbon sink and
- reduction in the size of inland water bodies e.g. Lake Chad.

The Medium Term Fisheries Development Plan (2014-2017)

- The main objective of the Plan is to enhance operational effectiveness and efficiency of MOFAD and all implementing partners towards the achievement of stated sector policy objectives and time-bound targets...
- The Plan derives its policy base from
 - Ghana Shared Growth Devt Agenda(GSGDA II)
 - Ghana National Aquaculture Development Plan (GNADP) (2012 – 2016) of MOFAD
 - Sustainable Marine Resource Management Plan of MOFAD (2015 - 2019),
 - and a number of gov't dev't policy statements and Research works relating to the accelerated transformation of the fisheries sector in Ghana.

The Plan focuses on:

- (i) Review of existing Fisheries Laws and Regulations (Fisheries Act 625, 2002) in line with national and international emerging issues,
- (ii) reducing national fish consumption deficit through Accelerating Aquaculture production from 38,585mt (2014) to 120,000mt (2017), and creating an additional annual average of 900 direct job opportunities ,
- (iii) Reducing IUU fishing activities and “fishing efforts” through **enforcement** of fisheries laws and regulations to promote sustainable fisheries resource management,
- (iv) Re-engineering, Transforming and Positioning the Fisheries Industry as a viable economic hub to attract Private Sector Investment, and
- (v) Enhancing Institutional Capacity to improve efficiency in the overall Fisheries Sector management.

KEY ISSUES IN THE FISHERIES SECTOR

- (1) Consistent decline in national output and dwindling stock levels of aquatic resources,
- (2) Increasing national fish consumption deficit resulting in higher level of importation of fish and fishery products,
- (3) Over exploitation of fish stocks on all water bodies,
- (4) weak enforcement of fisheries Laws and Regulations,
- (5) Inadequate fishing infrastructure,
- (6) Lack of national aquaculture suitability map (zonation),
- (7) weak collaboration with communities in the management of fisheries resources,
- (8) inadequate supply of fishery inputs,
- (9) inadequate skilled labour in the fisheries industry, and
- (10) weak institutional capacity to implement Government policy initiatives in the fisheries sector

How is it done?

- **Use management plans**
 - For single species or group of species?
 - Specify objectives
 - Identify and implement strategies
 - Time bound
 - Monitor & evaluate gains
 - Feedback mechanism
 - Involve relevant stakeholders to ensure compliance

Management Tools

Strategies

- De-centralization
- Ecosystem-based management
- Input and output controls
- Technical measures
- Indirect controls
- Co-management

What works in developed country industrial fisheries may not apply in small-scale tropical fisheries

Management Tools (cont'd)

INPUT CONTROLS – Directly limit or control the amount of fishing effort.

Examples include:

- Limits on number of fishers
- Limits on number of boats
- Limits on the types of fishing gear
- Minimum & Maximum size limits

Management Tools (cont'd)

OUTPUT CONTROLS — Directly limit or control the amount of fish coming out of the fishery.

- Catch quotas (e.g. TAC, ITQ)
- Minimum landing sizes
- Trip and bag limits

TECHNICAL MEASURES

- Area closures (MPAs, Marine reserves)
- Closed seasons (lagoons, etc.)
- Gear/method restrictions – e.g. FADs use, gear selectivity (size of fish caught)
- Discarding restrictions – prevent high grading and may reduce catch per trip
- Reduce sex specific harvesting
- Size restrictions

PROPOSED MPAs

- Ports and Harbours (Tema and Takoradi)
- Security Zone around oil installations (Current and future)
- Beyond 75 metres depth of the Exclusive Economic Zone
- Butre estuary
- Cape Three Points
- Amansuri wetlands / Esiama Beach / Ankobra estuary
- Miamia bay
- Akwidae bay
- Keta lagoon complex
- Songor Ramsar site
- Sakumo Ramsar site
- Densu delta.

Management Tools (cont'd)

INDIRECT CONTROLS –

- Taxes
- Increasing costs of inputs
- Alternative source of livelihood

Management Tools (cont'd)

Co-management / Traditional Management – vary among communities; sometimes linked with cultural practices

- No fishing days
- Closed areas / Closed seasons
- Festivals
- Taboos e.g. ladies forbidden, no sex at beaches
- Other local bye-laws

Enforced by Chiefs, Traditional Council, Chief Fisherman, Gear leaders, Traditional Priests e.g. Wulomo

International Institutional Framework

- **FAO** of the United Nations
- **Committees/Commissions** – (Regional & sub-regional)
e.g.
 - ICCAT
 - Committee for the Eastern Central Atlantic (CECAF)
 - Committee on Fisheries (COFI)

International Legal Framework

- **UNCLOS** – United Nations Convention on the Law of the Sea (1982)
- **FAO** Code of Conduct for Responsible Fisheries (CCRF, 1995)
- **CBD** - Convention on Biological Diversity
- **CITES** – Convention on International Trade in Endangered Species
- **IPOAs** – International Plan of Actions

National Institutional Framework

- Minister of State (Min. of Fisheries and Aquaculture Development)
 - Fisheries Commission
 - Fisheries Directorate
 - MFMD, IFMD, FSSD, MCSD, F&AD
 - Regional Fisheries Directorates
 - District Fisheries Officers
(Community Based Fisheries Management Committees)
 - Fisheries Technical Assistant / Enumerator

Summary - How and what do we do to contribute to a sustainable fisheries for posterity?

- Monitoring the environment?
- Stock Assessment?
- MCS operations ?
- Education and Research?
- Reduction of Effort – where and how amidst of socioeconomic considerations ?

Summary - How and what do we do to contribute to a sustainable fishery for posterity?

- Training in Alternatives? E.g. Aquaculture production
- Enacting sanctions to defaulters of Law & regulations?
- Application of multiple approaches, User rights, Conservation techniques e.g. MPAs,
- **Ecosystem based concepts,** Enhanced CBFMC's etc.
Wealth creation in fisheries

THE EAF-NANSEN PROJECT

Assisting Developing Countries to implement an ecosystem approach to fisheries

- The goals and activities of the programme evolved over time in response to changing needs in the developing world
 - exploratory surveying
 - integrated resources management
 - implementation of the ecosystem approach to Fisheries (EAF).
- The vessel has been a key tool at all times.

EAF-NANSEN Project Components

- Support for fisheries policy formulation and review
- Support for EAF management planning
- Ecosystem assessments and monitoring
- Capacity development
- Support to national/regional research vessels for ecosystem surveys
- Project planning, management and dissemination of lessons learnt

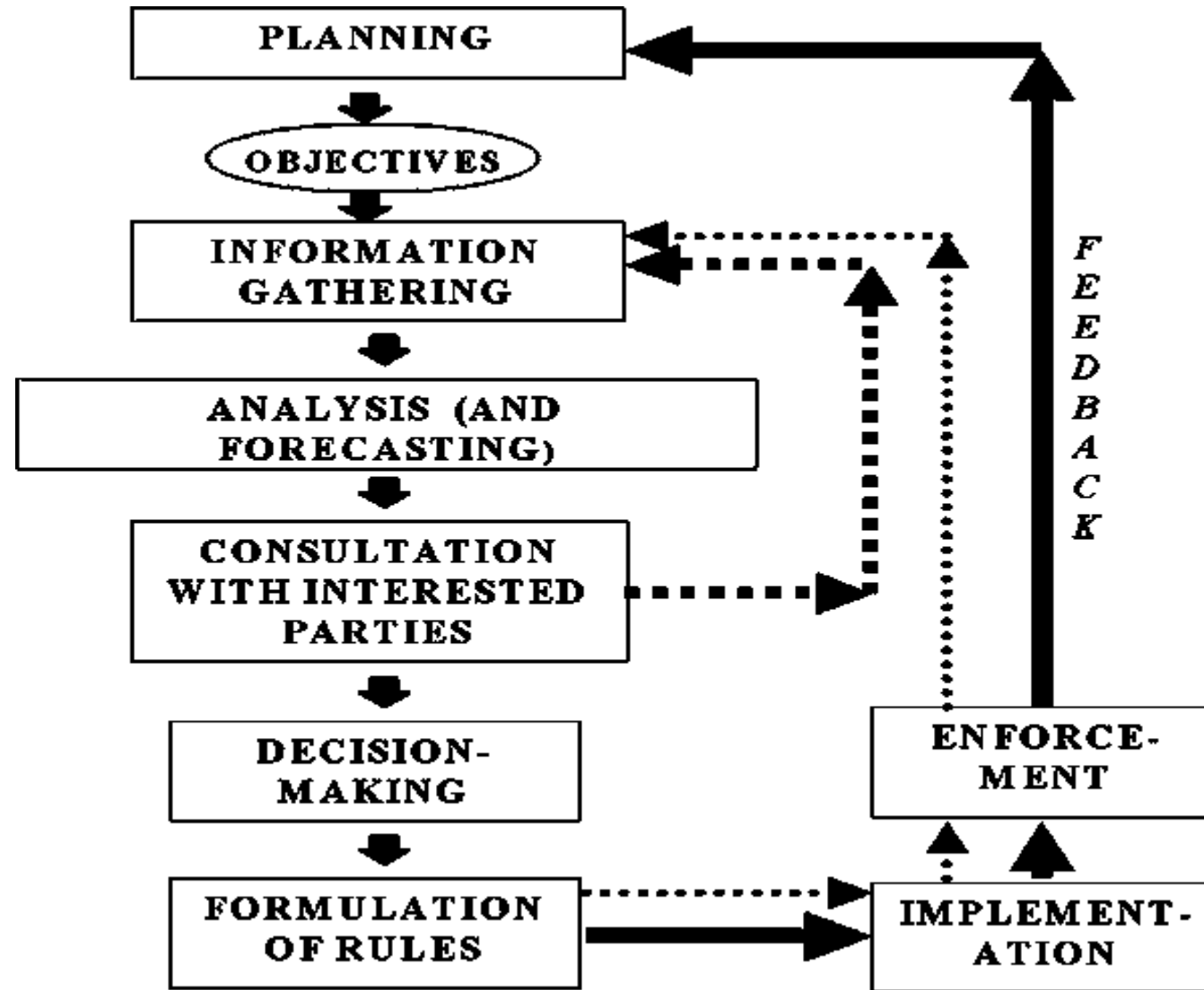
RESEARCH?

- The ECOWAS Coastal and Marine Resources Centre through the Monitoring for Environment and Security in Africa (MESA) Program,
- funded by the EU under the 10th EDF Rule, is providing earth observation (EO) applications to enhance effective policy formulation for sustainable fisheries management.
- The Centre is providing marine services to support fisheries with science-based decision making through:

RESEARCH (Cont'd)

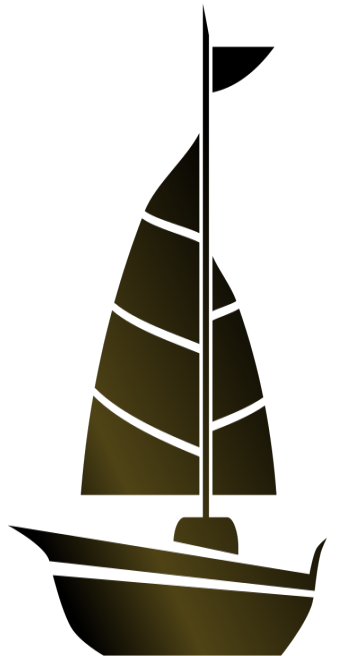
- Production of Potential Fish Zone (PFZ) overlaid with fishing vessel traffic
- Early warning system to ensure safety for artisanal fishers by forecasting ocean conditions and disseminating them via SMS, etc.
- Installation of MESA stations in all countries to ensure reliable access to continuous data stream
- Building of collaboration and synergies in the region to avoid duplication, and maximise resources
- Institutionalisation to ensure sustainability at the regional and national levels, and with National Centres of Excellence and universities.

STEPS IN FISHERIES MANAGEMENT



In conclusion

- More knowledge on our stocks through research is needed to understand the dynamics of our ever-changing fisheries;
- More training and education on responsible fishing practices is needed to sustain our fisheries;
- Enforcement of fisheries laws, policies and regulations
- We all have a part to play to manage our resources for posterity.



FURTHER READING

- Cochrane, K.L., Neil, L. Andrew and Ana, M. P. (2011). Primary Fisheries Management: A Minimum Requirement for Provision of Sustainable Human Benefits in small-scale fisheries. *Fish and Fisheries* **12**: 275 – 288.
- Allison, E.H and Ellis, F. (2001). The Livelihoods Approach and Management of Small-Scale Fisheries. *Marine Policy* 25: 377-388.
- Berkes, F. (2009a). Social Aspects of Fisheries Management. In: A Fishery Manager's Guidebook (Cochrane, K.L and Garcia, S. M. Eds). FAO, Rome and Blackwell Publishing, Oxford. Pp 52-74
- FAO (1995). Code of Conduct for Responsible Fisheries. Fao, Rome. 41 pp.