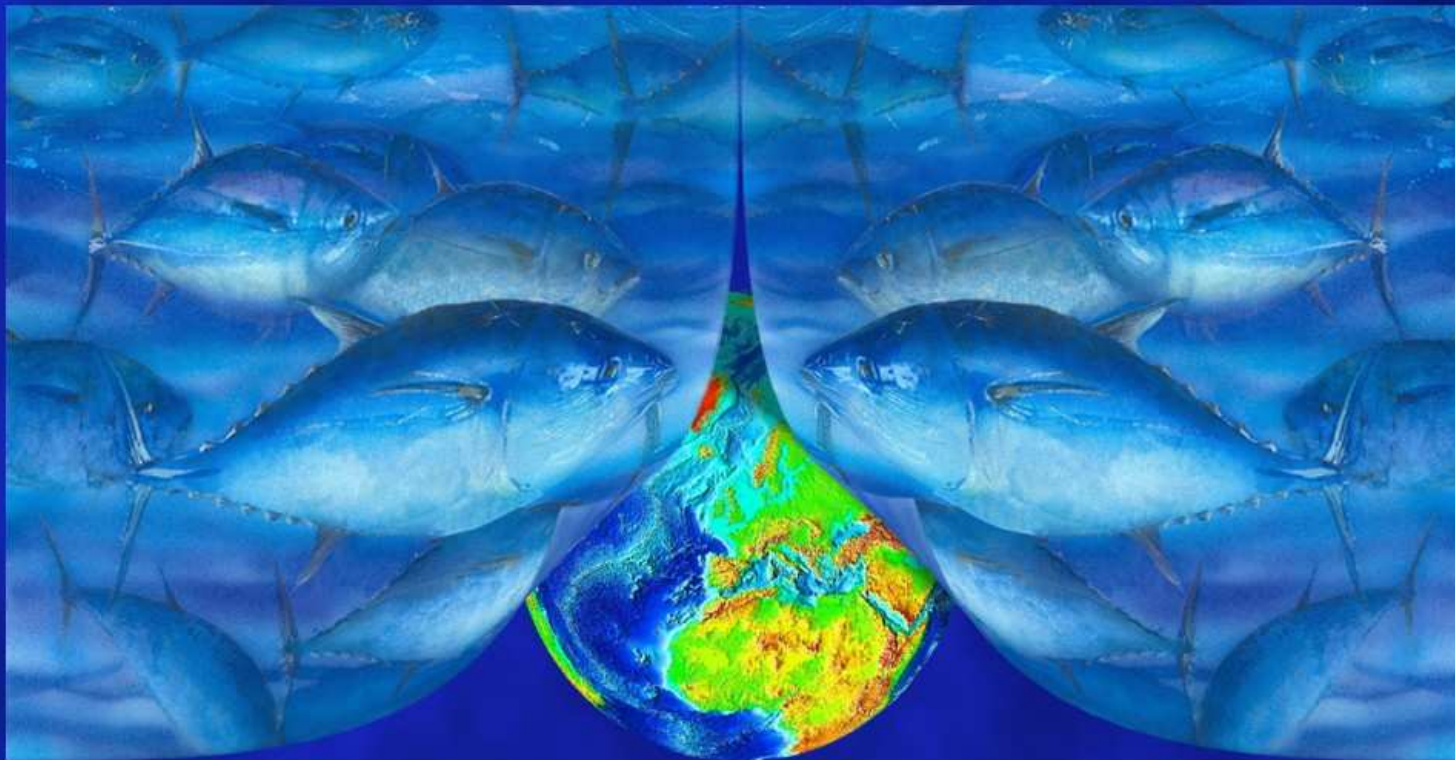


**WORLD SYMPOSIUM FOR THE STUDY INTO THE STOCK  
FLUCTUATION OF NORTHERN BLUEFIN TUNAS  
(THUNNUS THYNNUS AND THUNNUS ORIENTALIS),  
INCLUDING THE HISTORIC PERIODS.**

**SANTANDER**

**22-24 APRIL  
2008**

**SPAIN**



**SANTANDER**

**22-24 APRIL  
2008**

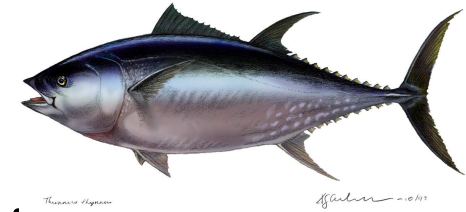
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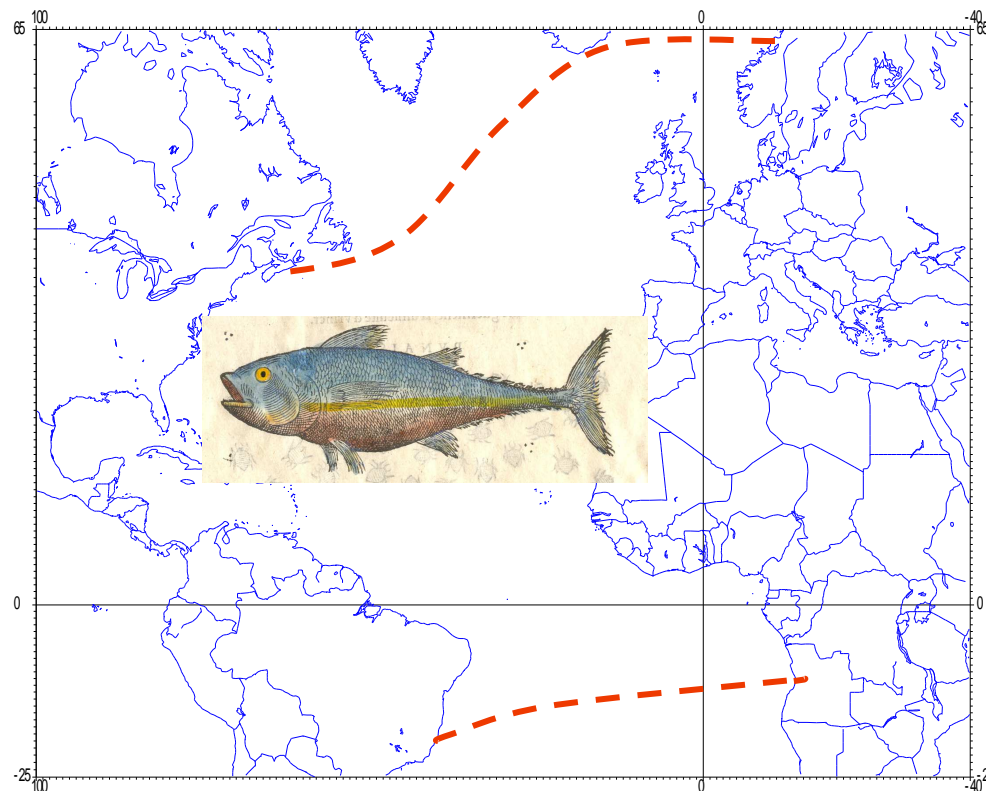
Plan Regional



# Atlantic bluefin tuna 100 centuries of changing fisheries

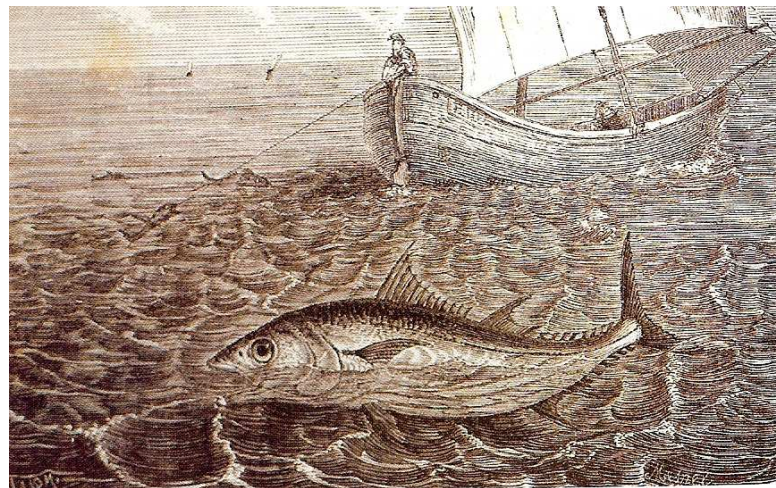


By alain Fonteneau  
IRD Tropical tuna scientist



## *Topics covered by the conference*

- 1) Prehistoric bluefin
- 2) Greek and roman antiquity
- 3) Middle ages to 1900
- 4) 20<sup>th</sup> century: a patchwork of changing fisheries
- 5) Conclusion: bluefin tuna is really unique

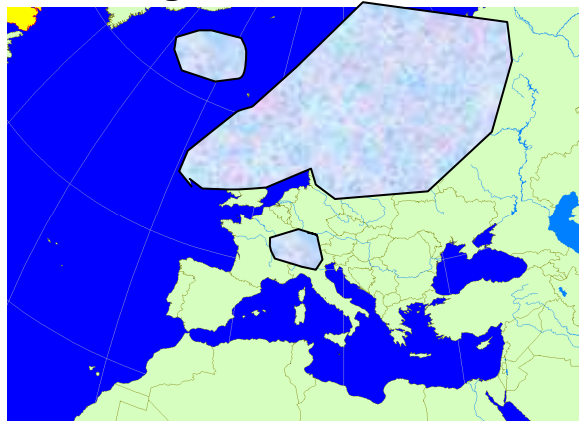


# 10.000 B.C.: the end of the last glacial period

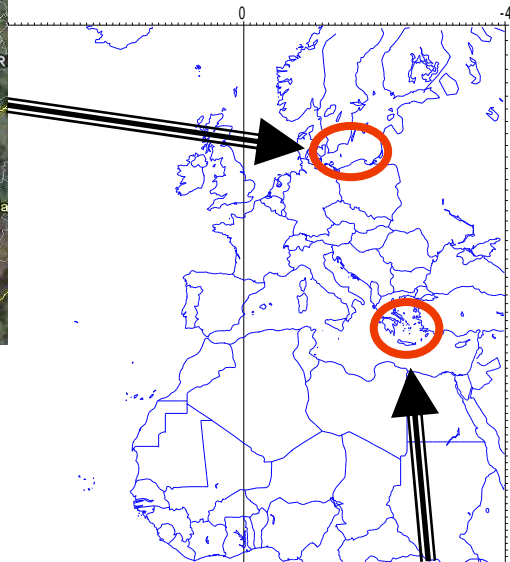
- The last glacial period was the most recent glacial period within the current ice age, occurring in the Pleistocene epoch. It began about 110,000 years ago and ended between 10,000 and 15,000 B.C. The end of the last glacial period was about 12,500 years ago
- During the last 8000 years, the climate around the Mediterranean Sea has been much the same as today (Webb & Bartlein 1992).

## **An interesting bluefin biological question:**

- No Bluefin spawning in the Mediterranean Sea during 10000 centuries due to its unsuitable environment? Too cold temperature, too variable salinities and low sea level.
- But, it is possible that some bluefin did maintain a successful spawning in the Eastern Mediterranean Sea even during the last Ice age (Doumenge), since even during the coldest periods, some regions in the Mediterranean area had temperate climate.



# 6500 to 5000 years B.C.



# 7000 to 6000 years B.C.



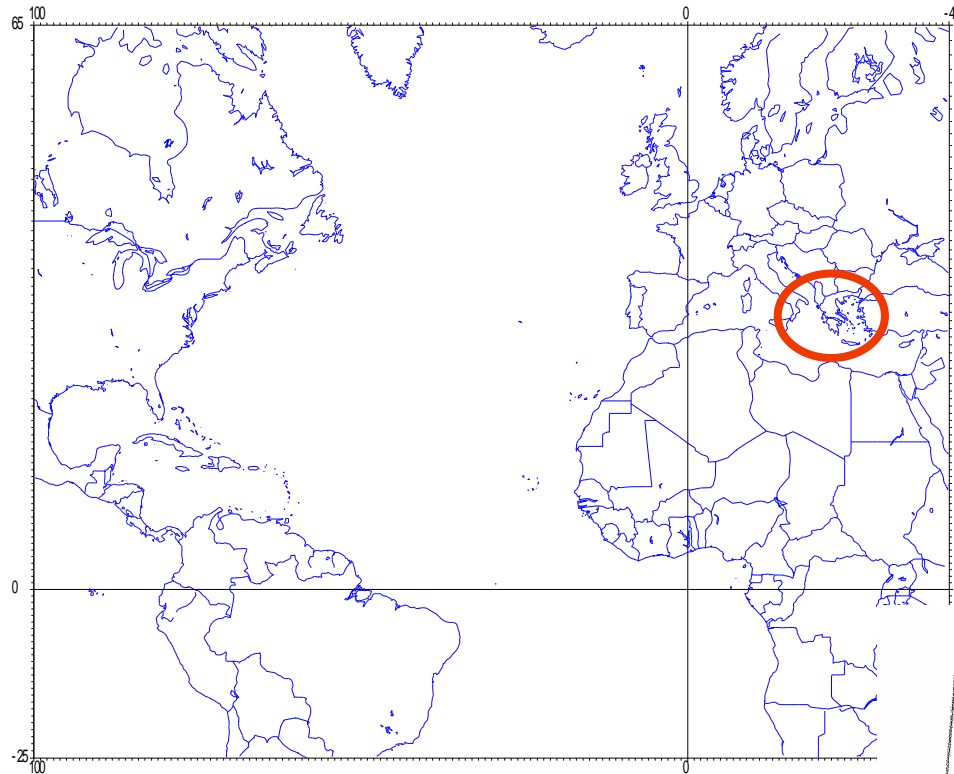
FOTO: LARS-ERIK GILLE FLT/PICA

## Gammal Öresundsbo levde på tonfisk

Vid utgrävningar av Skandinavien största stenåldersboplatz utanför Landskrona har arkeologerna hittat ett minst 6000 år gammalt infakt skelett av en man, 160 centimeter lång. På 90 kvadratmeters bryta levde hushall på 15-20 personer tillsammans. Fynd av kotor från tonfiskar på uppåt 150 kilo liksom vildsvin visar vilken djurvärld som omgav folket på boplatzen, som då var belägen vid en havsvik.



# Greek, roman, carthaginian and phenician active bluefin fisheries: 2000 BC -> 400 years AC



Preparing Sashimi in a Greek style  
3000 years ago



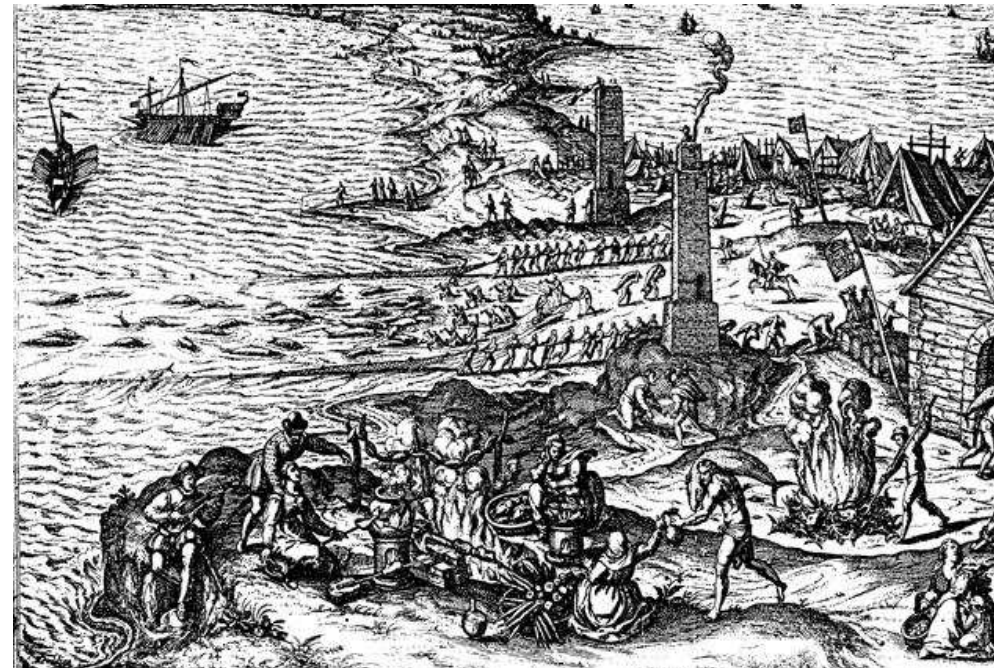
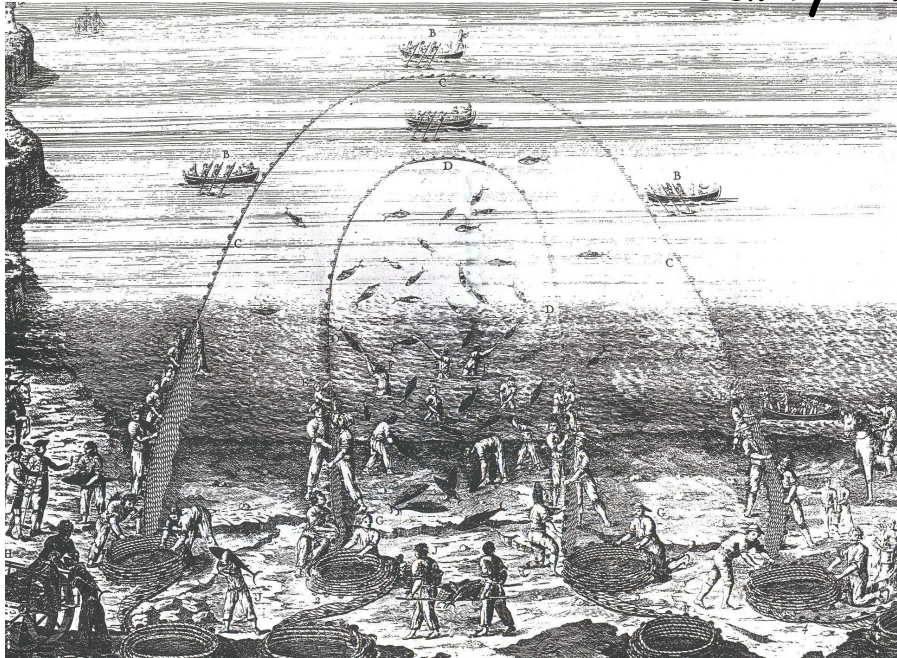
Roman hook, *Louvre museum*  
(this hook may have caught a bluefin  
2000 years ago)



## 400 to 1300, a period of lower fishing activities

- This post roman empire period has been facing many disturbances, due to political/human problems
- The great Arabic Spanish civilization during the late 1<sup>st</sup> and early 2<sup>nd</sup> milleniums was not active on tuna fisheries
- The Viking assaults around the mediteranean Sea was a limiting factor for large sacle and fixed fishing installations
- Data on bluefin fisheries are very scare during this period, but it was probably a period of very low fishing activity
- Nothing can be said upon the levels of bluefin biomass during this period

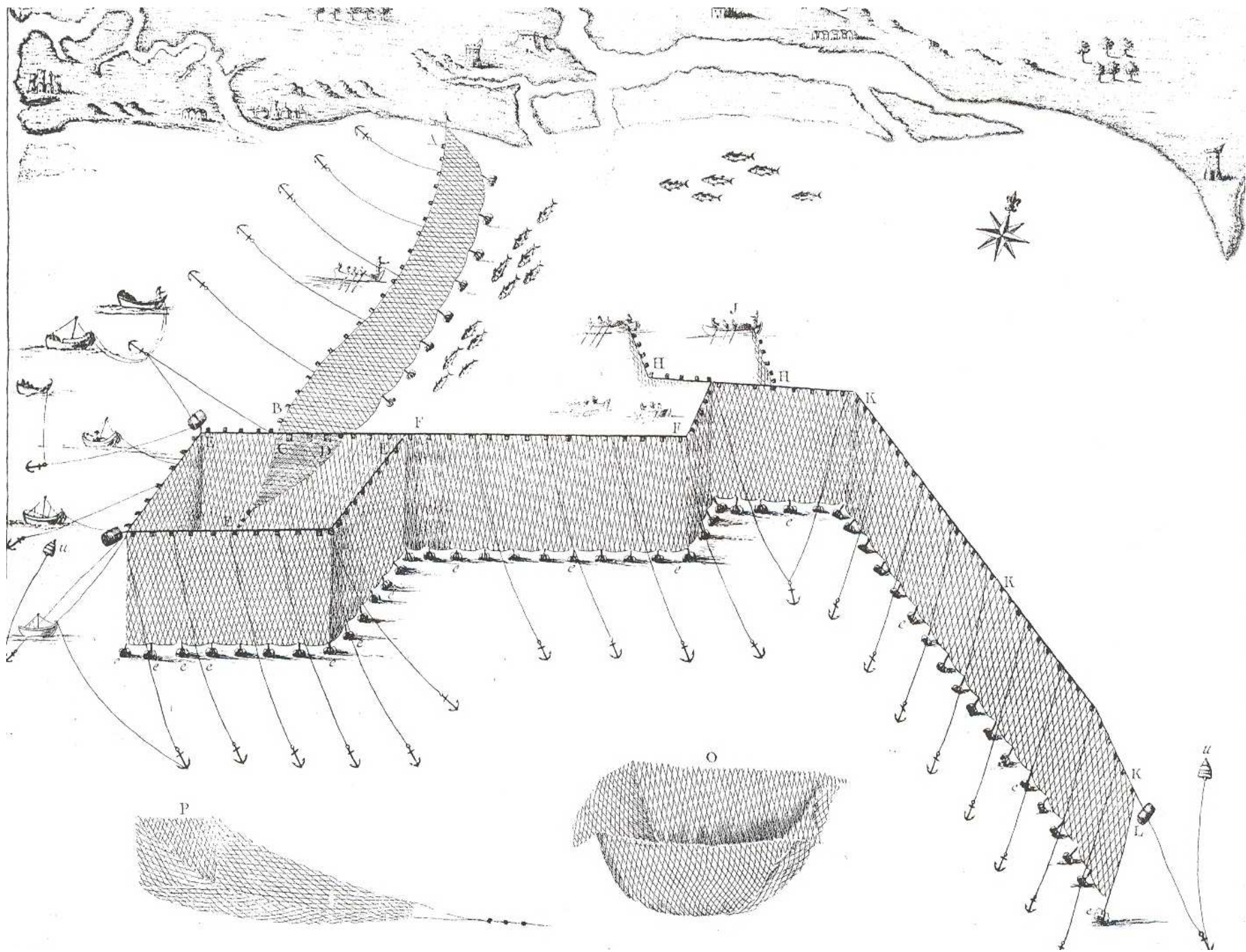
Around year 1200:  
the birth of large scale bluefin « big business »,  
mainly in Italy and later in Spain, widely under the  
control of Genoa bankers Beach seine still  
predominantly used in the Mediterranean Sea until the  
early 17<sup>th</sup> century



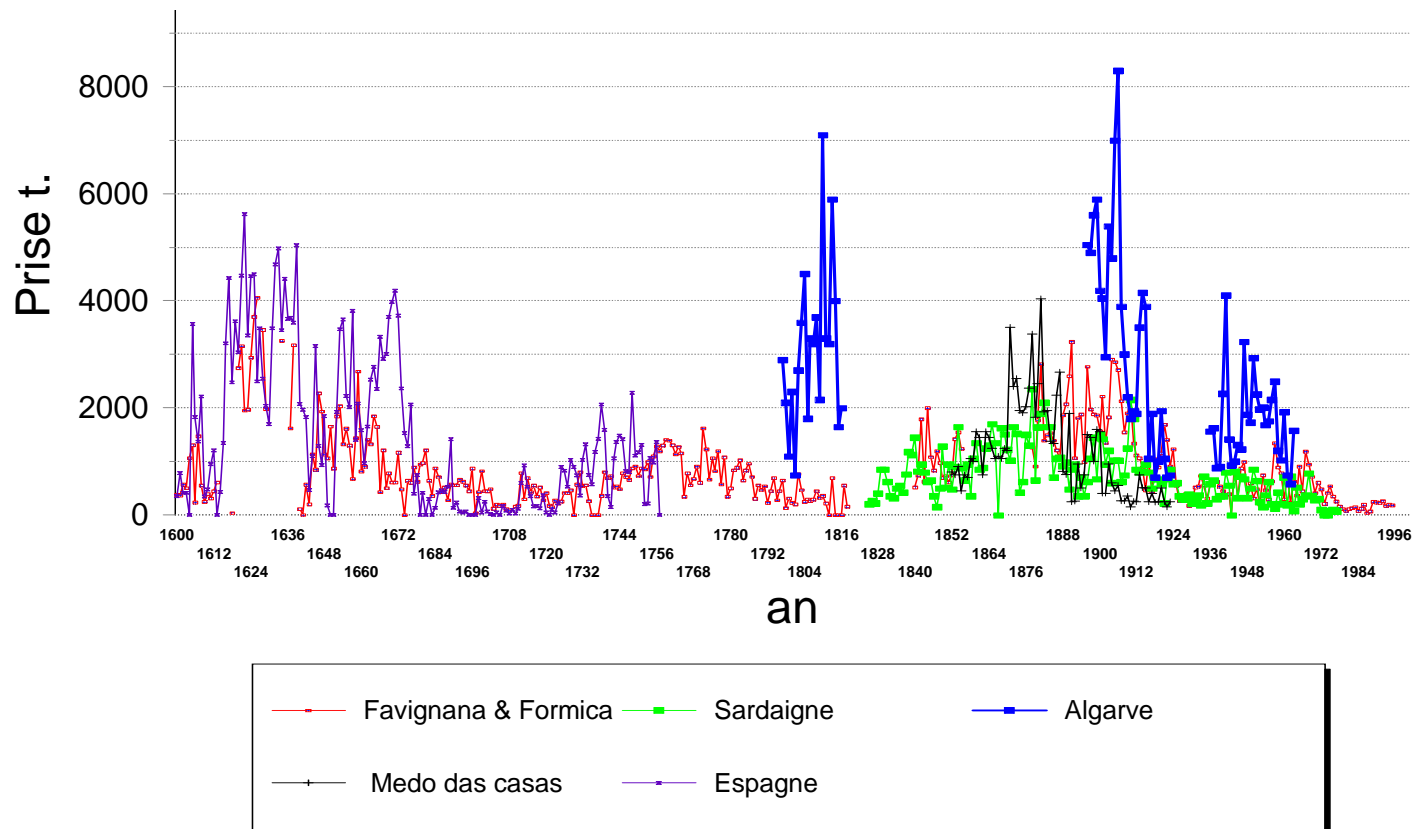


**After 1600: development of fixed seasonal anchored traps  
West & East of Gibraltar and in several spots of the Mediterranean Sea**





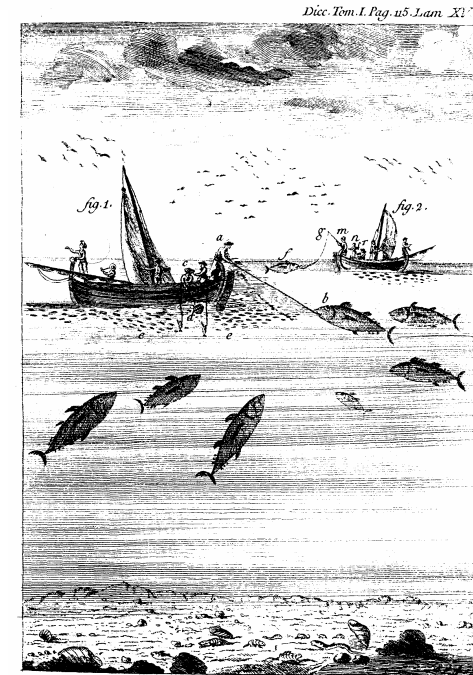
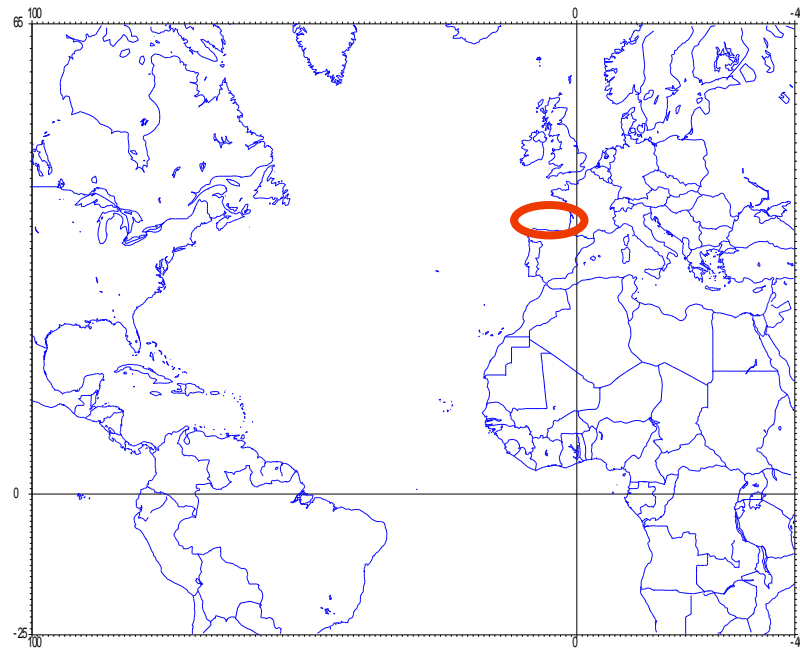




### **Mediterranean Sea, 3 centuries of « bankers » statistics showing:**

- Hundreds of traps, and centuries of high yearly BFT catches, spawners at large sizes
- Permanent trap activities during centuries, targeting pre or post spawners, but long term cycles of biomass, independent of exploitation rates, driven by the environmental variability that has been well shown by the Fromentin and Ravier analysis
- It can be concluded that the Mediterranean Sea has been, during most years and during milleniums, the/a major spawning zone for Atlantic buefin tunas

Lines and troll already used to catch bluefin in the Bay of Biscay in the 17th century, but mainly during the nineteenth century



But the development of the large scale bluefin fisheries in the Bay of Biscay Came later and during the nineteenth century (and mainly in Spain)

# Bluefin in the Black Sea?

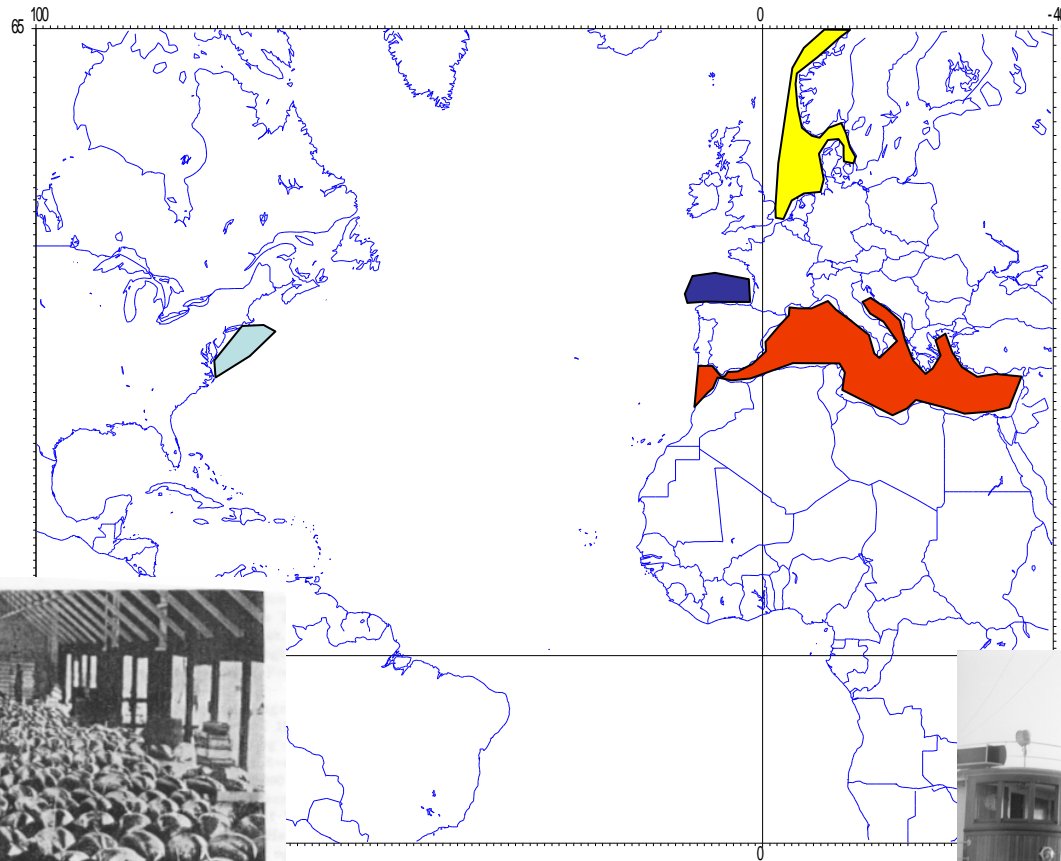
- Bluefin tuna was common in the Black Sea during ancient Greek times and found in Pantikapei (currently - Kerch).
- During first half of last century and until the 1960s, bluefin was often recorded in small schools off northern coast of the Black Sea in late summer and during the autumn (without target fishery)
- BFT used to migrate in the autumn to the mouth of the Kerch Strait (narrow strait between Azov and Black Sea) to forage on the Azov population of anchovy (*Engraulis encrasicolus*), which migrate for wintering to the Black Sea. It was reported (anecdotal records) that bluefin damaged anchovy purse seines breaking net wall during their movement in and out of the purse seine.
- Bluefin were often recorded as bycatch in the traps along Southern Crimea.
- Starting from early 1970-s bluefin becomes very rare in the north coast of the Black Sea: the last BFT caught in 1975 (trap bycatch).
- World record of the largest BFT ever caught in the Black Sea: 787 kg
- Nowadays: bluefin vanished from the Black Sea, most top predators are also gone



# 1900-1955



*During the 30ies:  
Norwegian harpoons were found  
on giant bluefin In the Med ?*



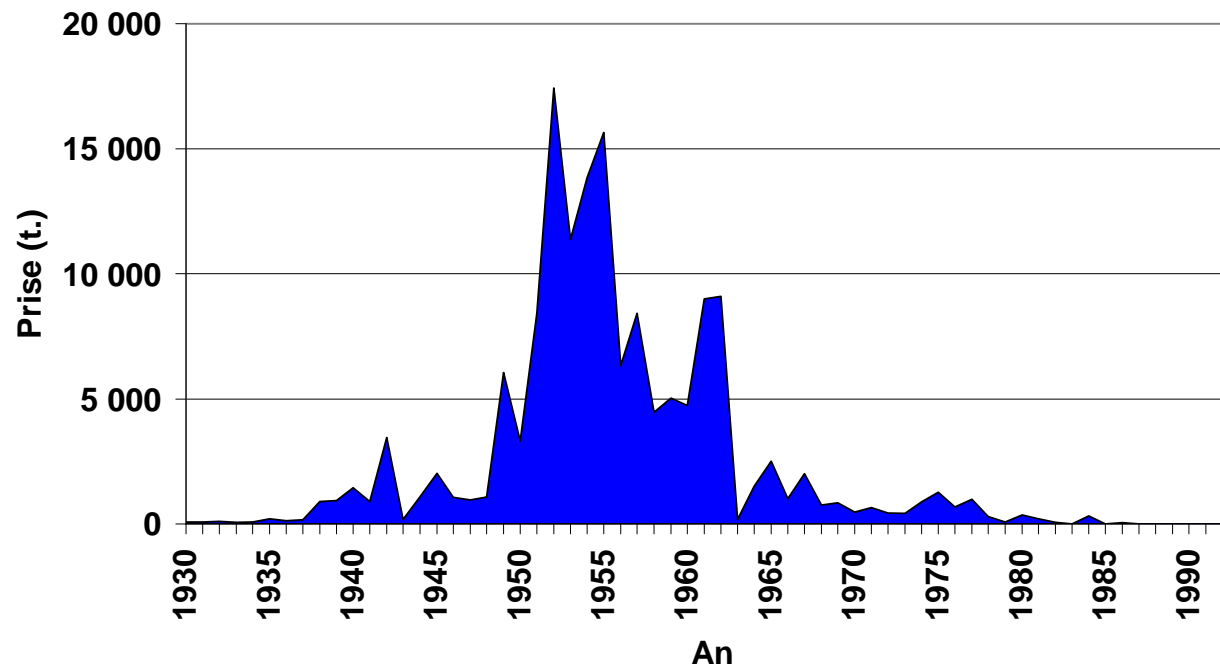
1100 Tunfisk i Auktionshallen paa Skagen.

Foto: A. H.



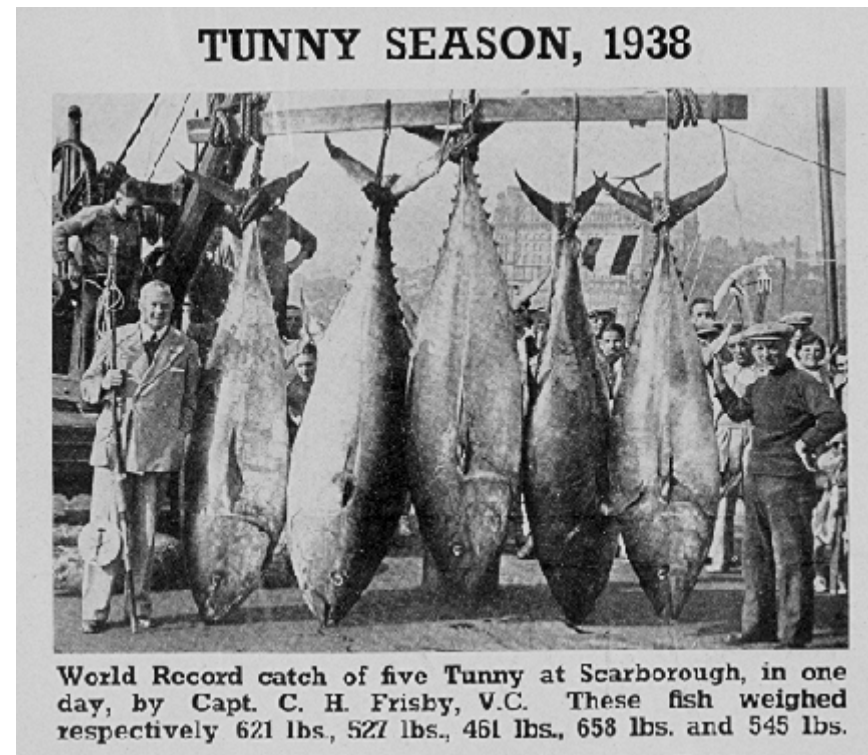
## North Sea bluefin fisheries:

- Active purse seine fisheries since 1930, but large biomass of bluefin observed well before by scientists and fishermen
- Harpoons have also been used by Norwegian fishermen
- Its major development observed post WW2
- But bluefin was sometimes very abundant well before: exemple of the 2000t of small bluefin caught in Gotheborg bay, in August 1942, by sardine vessels and hand lines





# Giant bluefin tunas in the Western and Eastern Atlantic: heavily targeted by sport fishermen since the early 1900<sup>ies</sup>



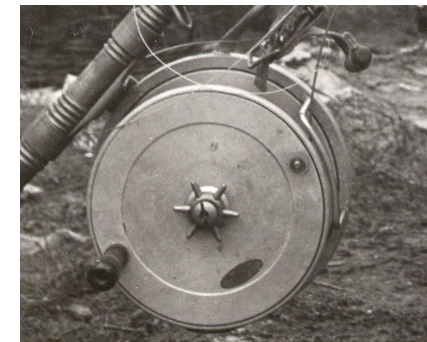
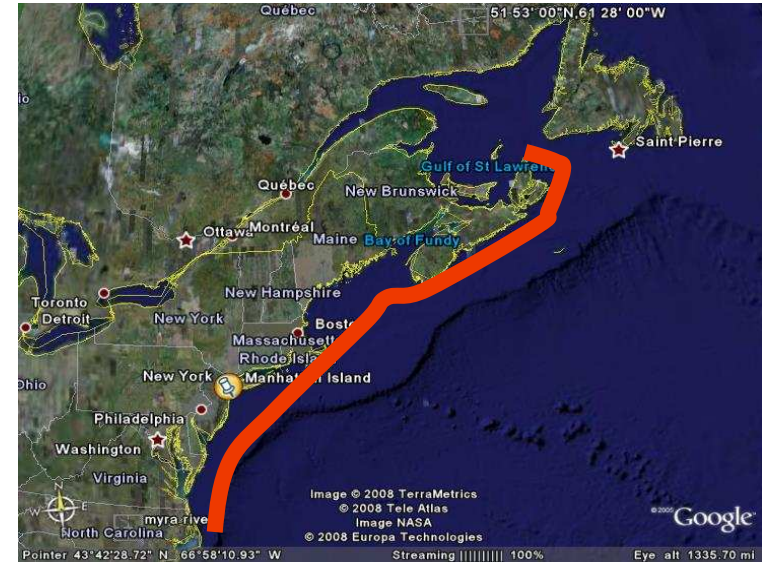
TUNNY- Blue Fin Tuna - caught off the Dogger Bank.  
In 1953 it was estimated that 3 - 4000 Tunny were caaught in the North Sea. Since then Tunny has disappeared from the North Sea.

Various bluefin sport fisheries existed in Denmark and England since the 1920s...and in Brittany 1946-1953

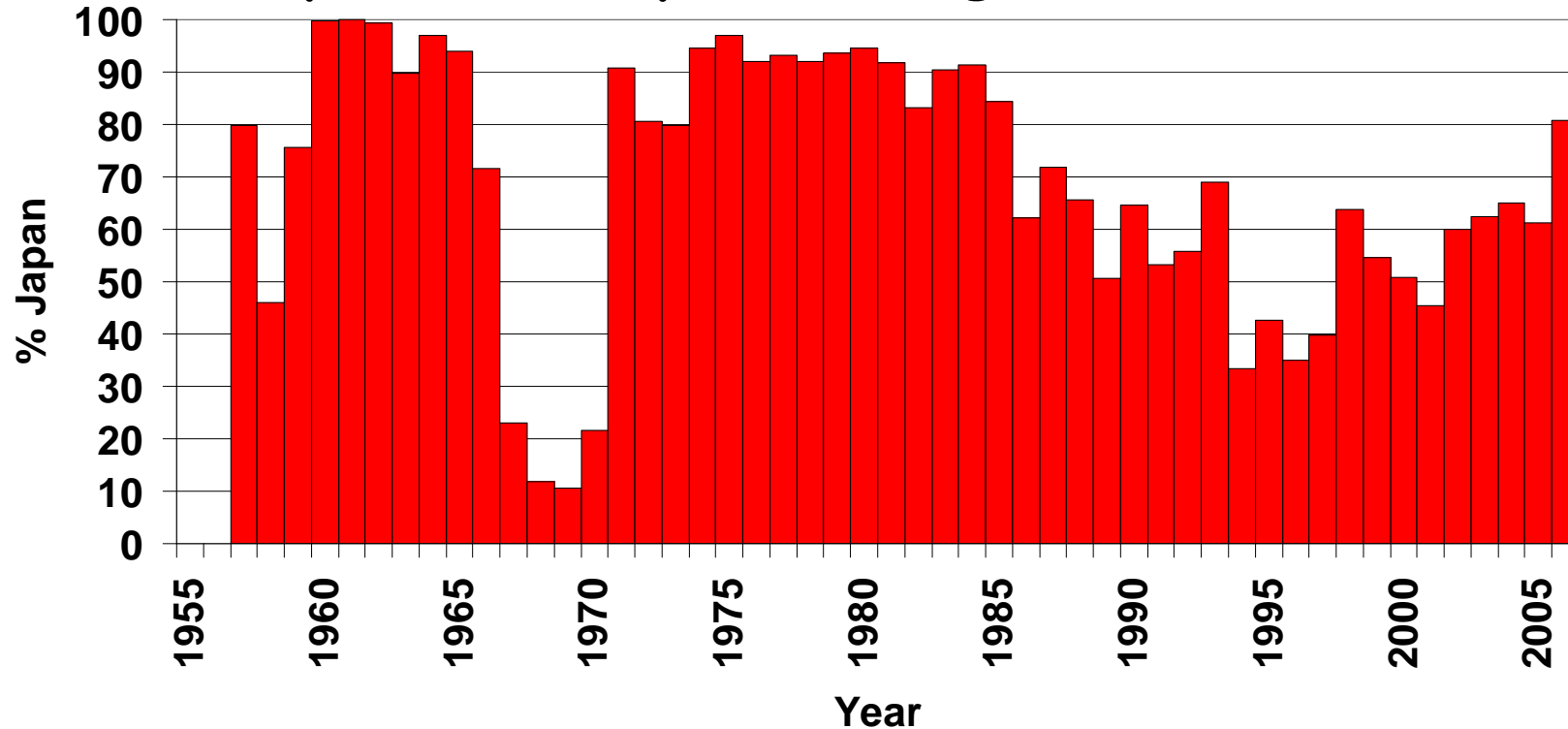
# East coast of Canada and USA: bluefin sport fisheries active since 1850

- Small bluefin were commonly caught recreationally from the mid 1850s
- The 1st giants, that were common during these years, were caught in the early years of 20th century
- Fishes over 250 kg became common in the sport R&R fishery, following the development of suitable fishing tackle, but after 1920
- A major bluefin tournament, the Sharpe cup, has been targeting giant bluefin in Nova Scotia since 1930.

**Bluefin world record:  
Nova Scotia, 1496 pounds, 1979** ⇒



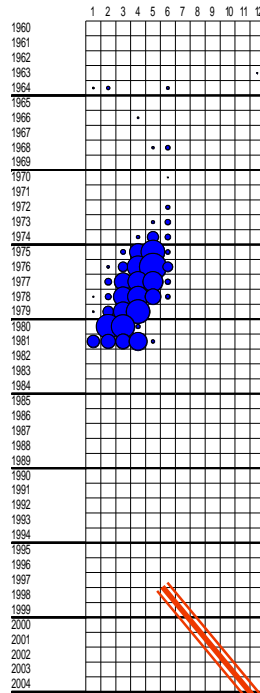
## An overview of adult bluefin fisheries centered on 55 years of Japanese longline data



Percentage of bluefin caught by Japanese longliners against total bluefin catches by longliners

- Japan: 70% of total BFT catches taken by longliners, 1950-2005
- Always with quite good C/E statistics, at least much better than all other blue fisheries

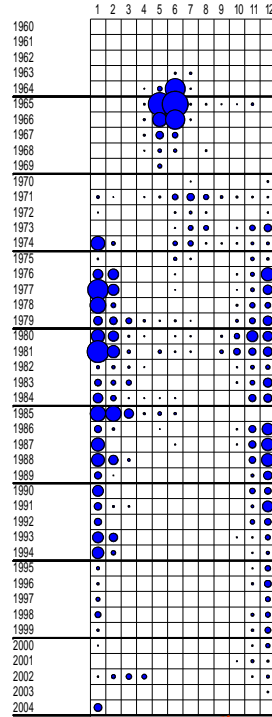
1960



1980

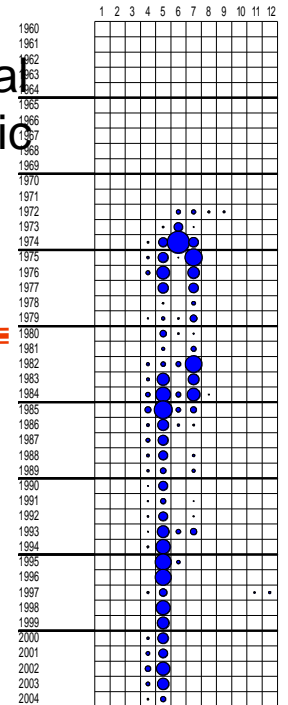
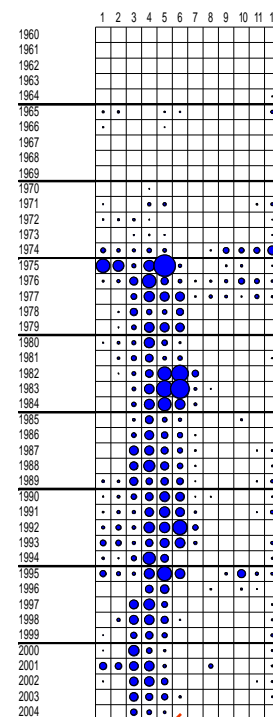
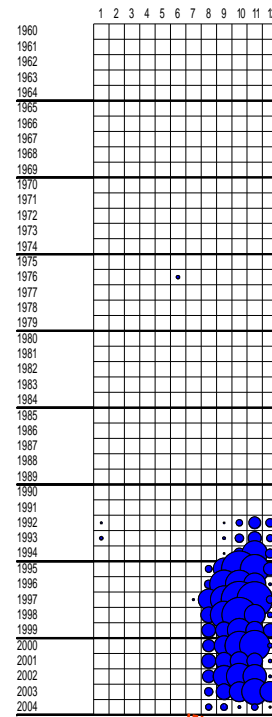
2000

1960

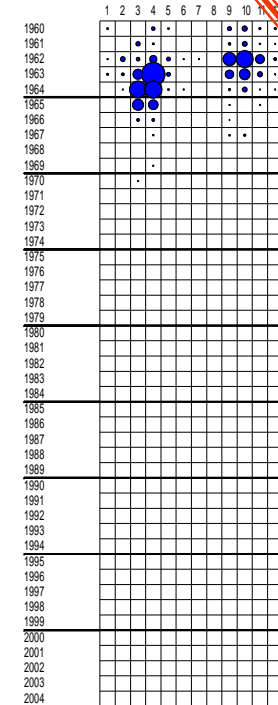


1980

2000



1960



1980

2000

Gulf Mexico

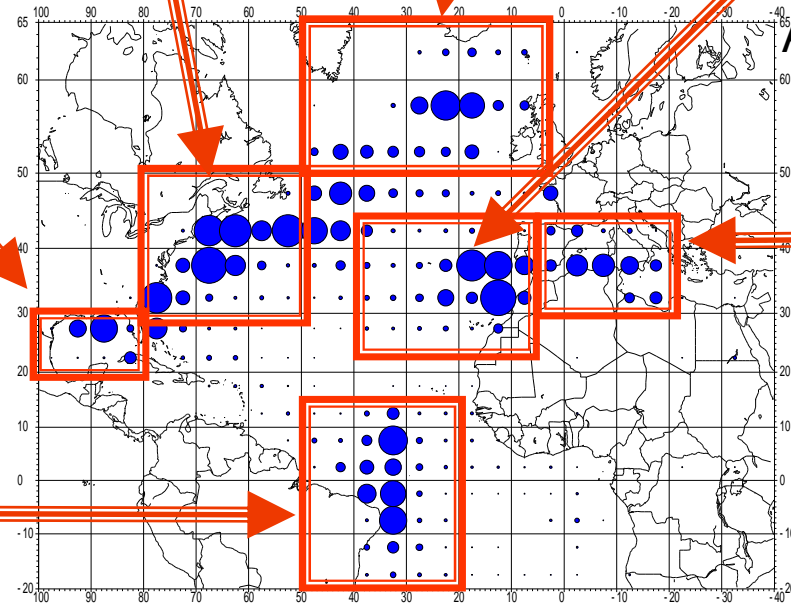
US E. Coast

Iceland

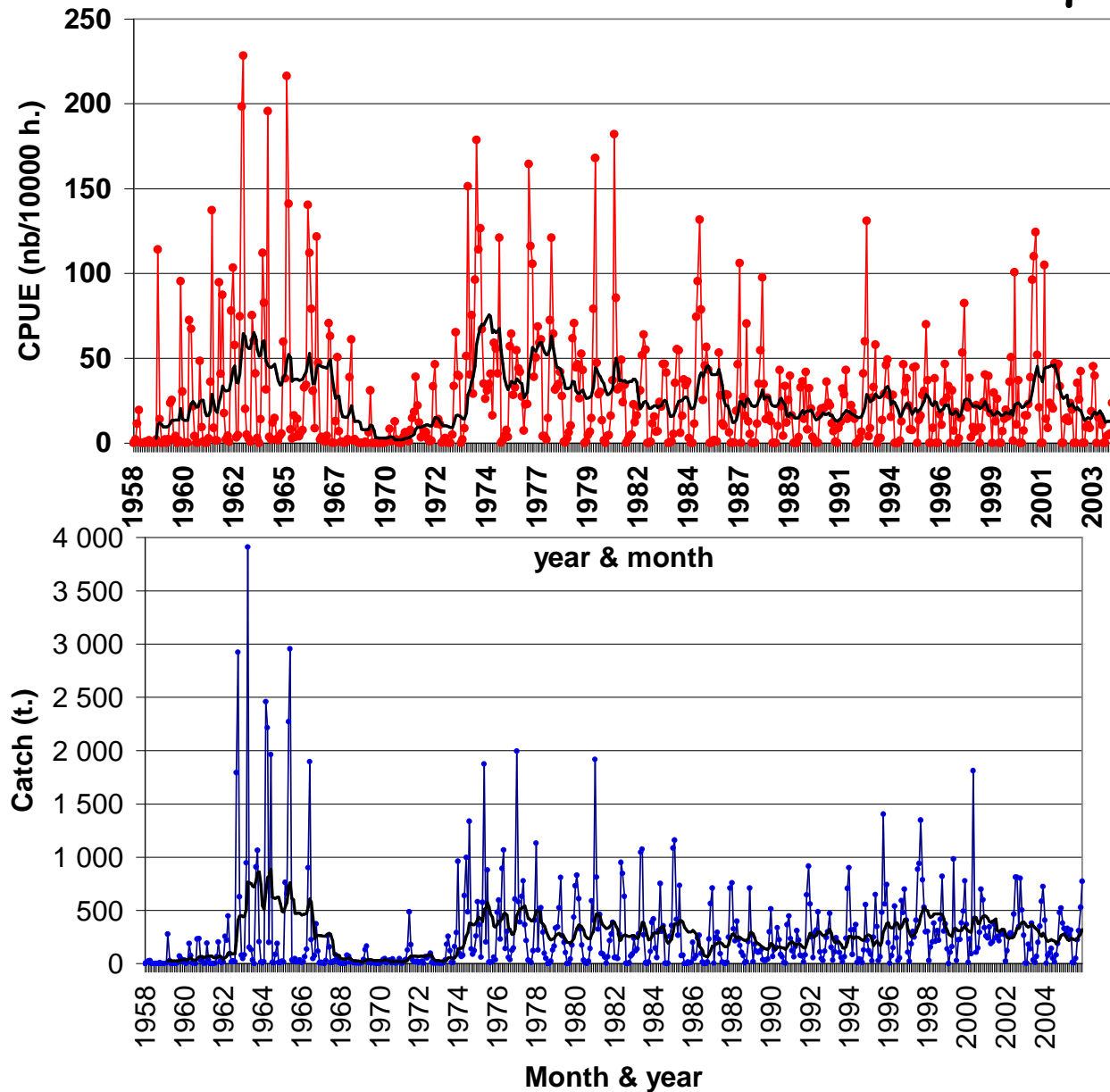
Central Atlantic

Med

Brasil



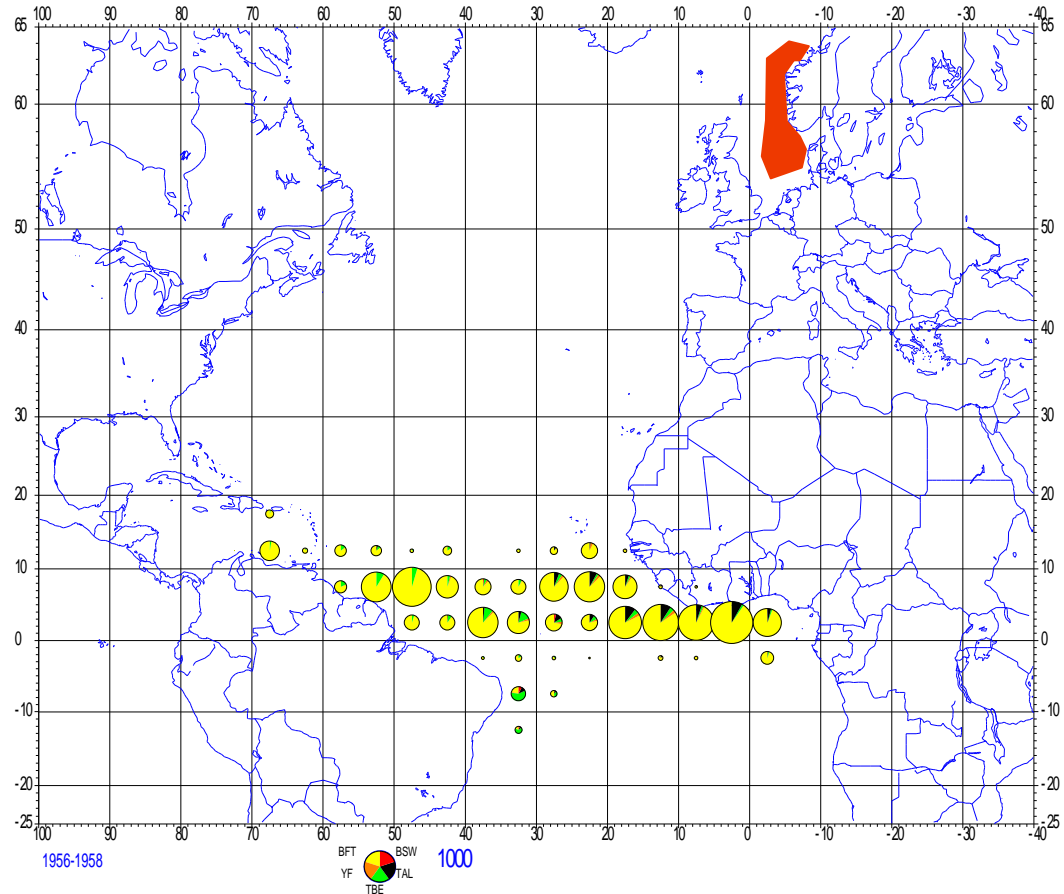
# Japanese longliners: average monthly bluefin nominal CPUEs and catches in the 3 best 5° squares



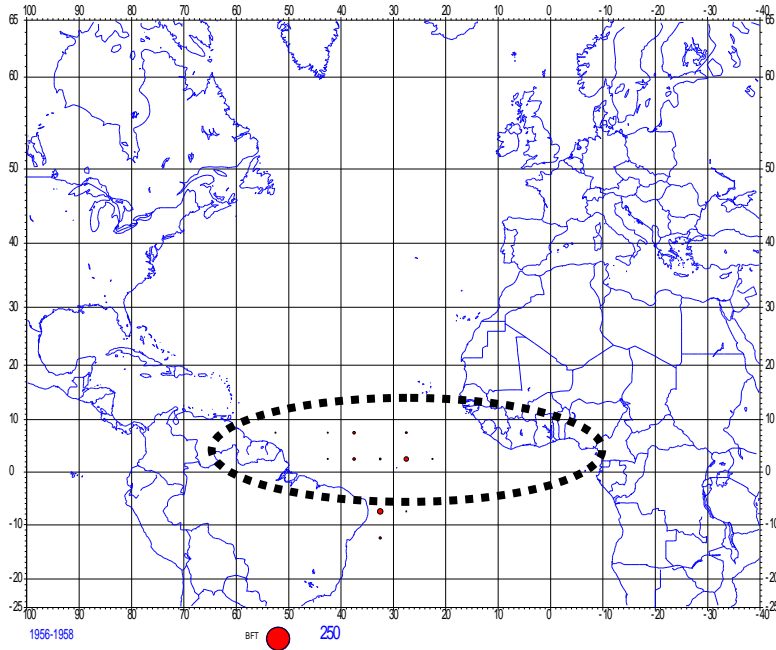
Bluefin Catches and CPUEs of Japanese longline  
fisheries:  
50 years of variable fishing zones and seasons

# Back to 1956: first Japanese longliners in the Equatorial Atlantic

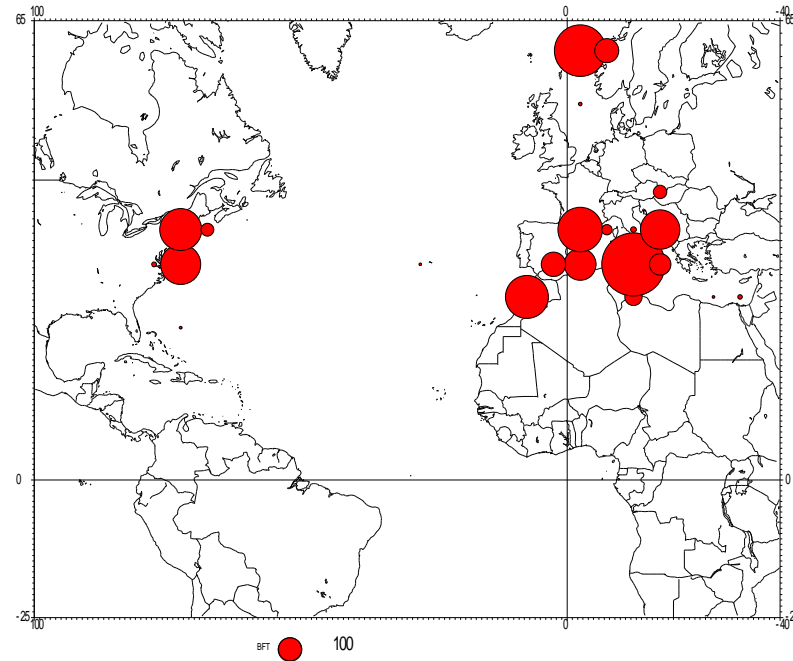
## A new equatorial longline fisheries targeting yellowfin,



# 1956-1958



**Japanese longliners still without significant equatorial bluefin catches**

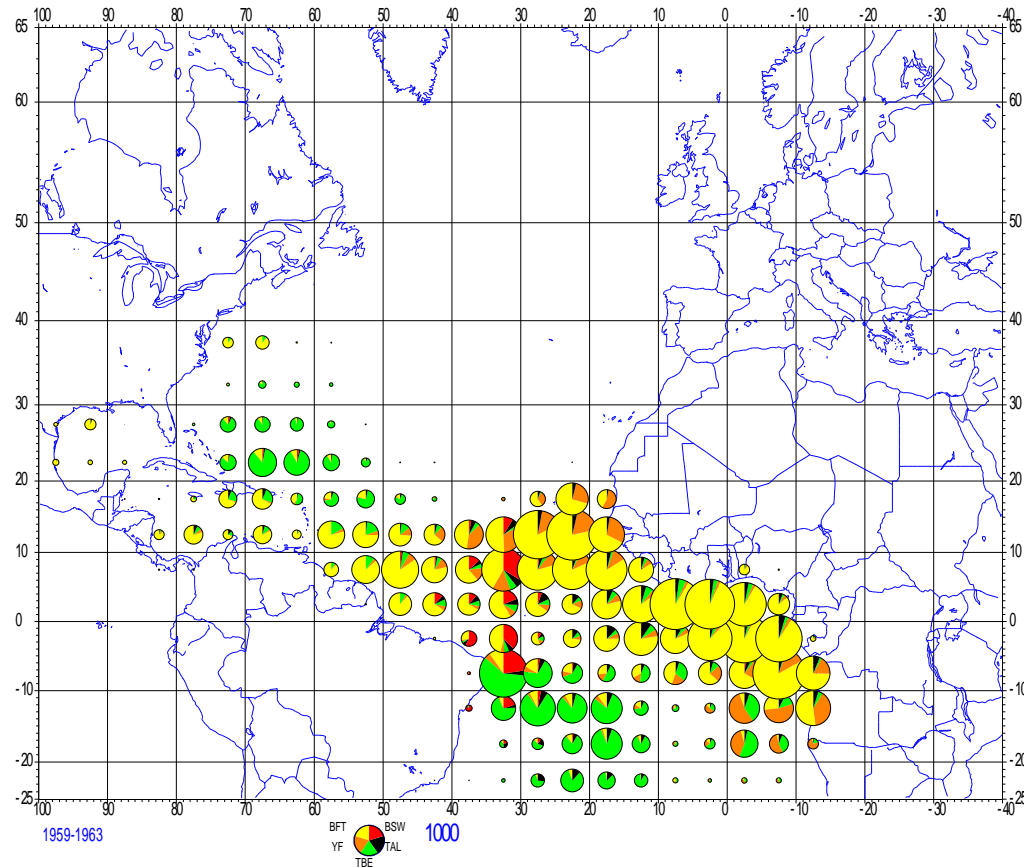


**while various bluefin fisheries are active, in the Northern Atlantic: at least in the Med., in Morocco, North Sea, and USA**



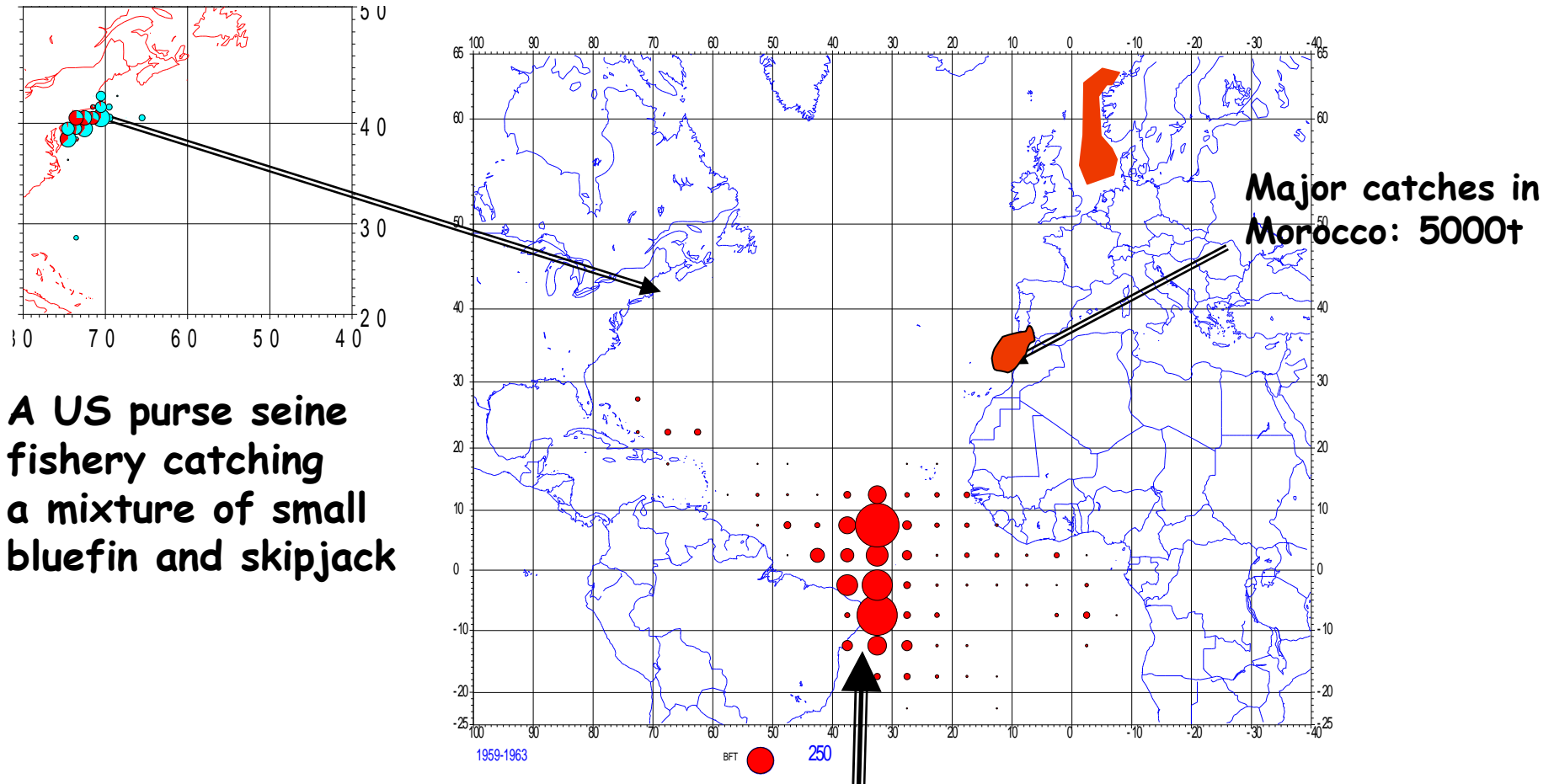
# 1959-1963

A moderate geographical expansion of the longline fisheries, but large bluefin catches seasonally taken in some 5°sq in the equatorial areas



# 1959-1963

Bluefin taken by longliners: large catches, but 100% in equatorial areas  
A period of low but increasing yearly catches: 1700 t. /year

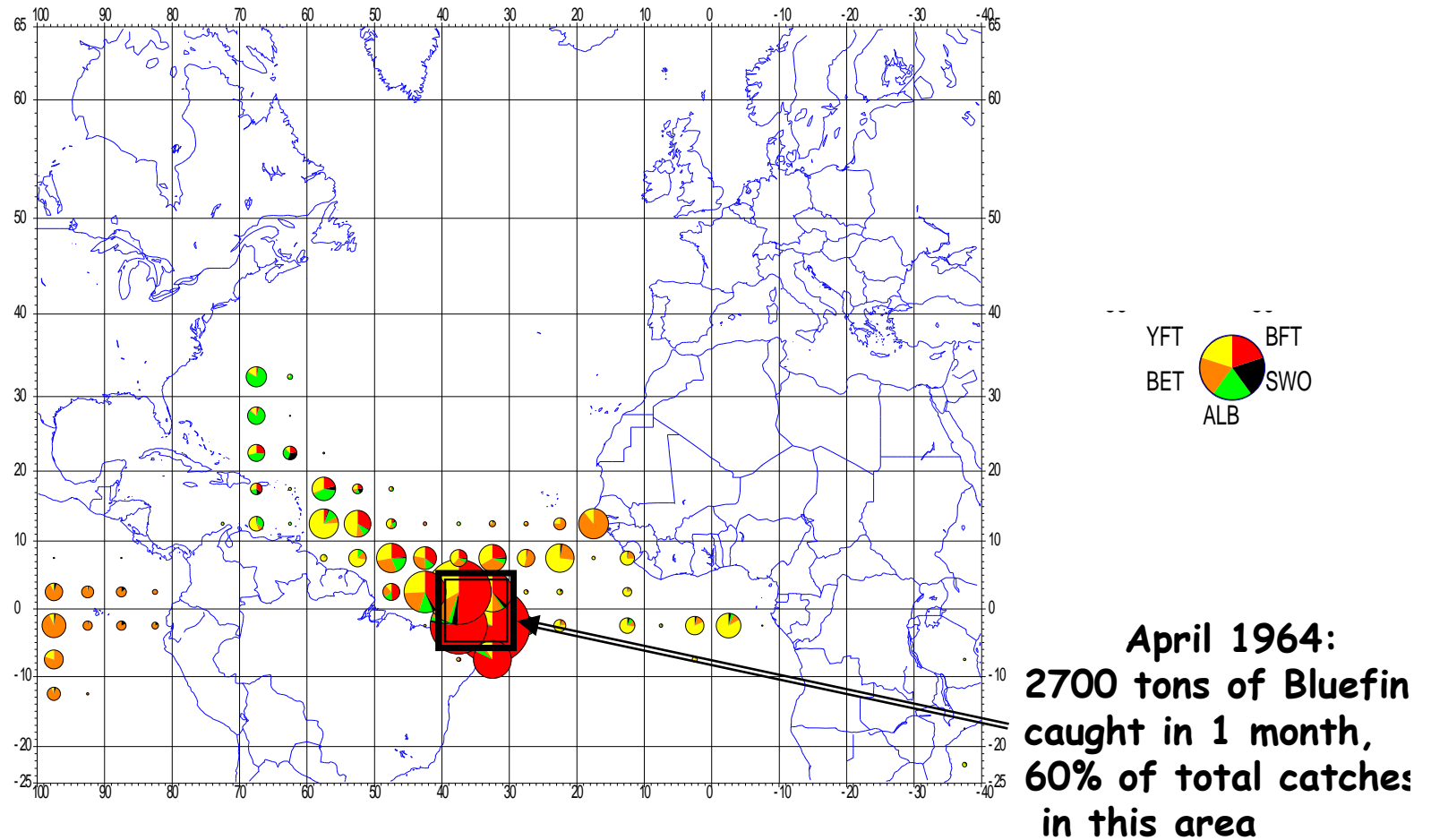


A US purse seine fishery catching a mixture of small bluefin and skipjack

Major catches in Morocco: 5000t

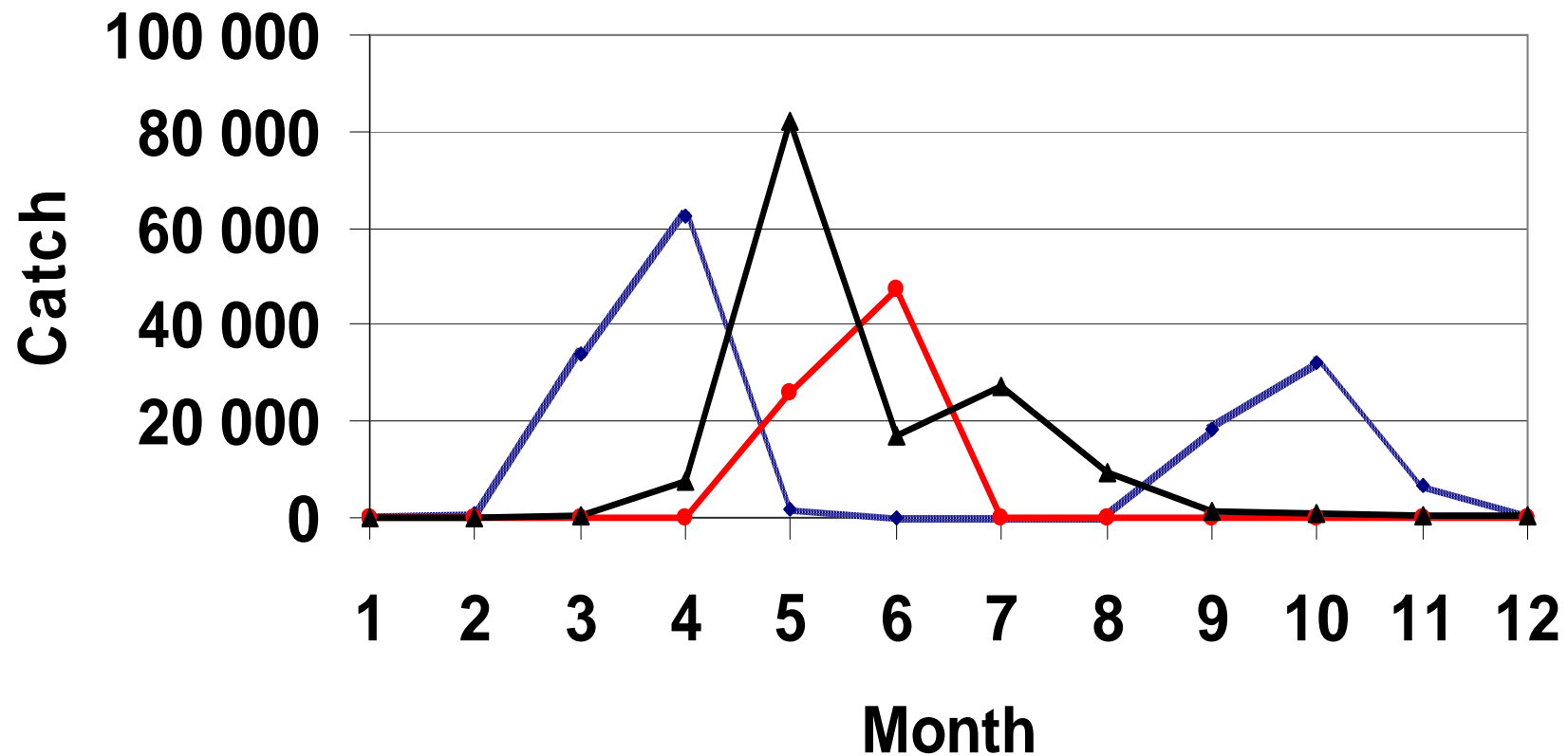
A new & very surprising bluefin fishing zone by japanese longliners

**Brasil: bluefin was not « the » target species,  
but seasonally the dominant species,  
then « a » real target, as in April 1964**



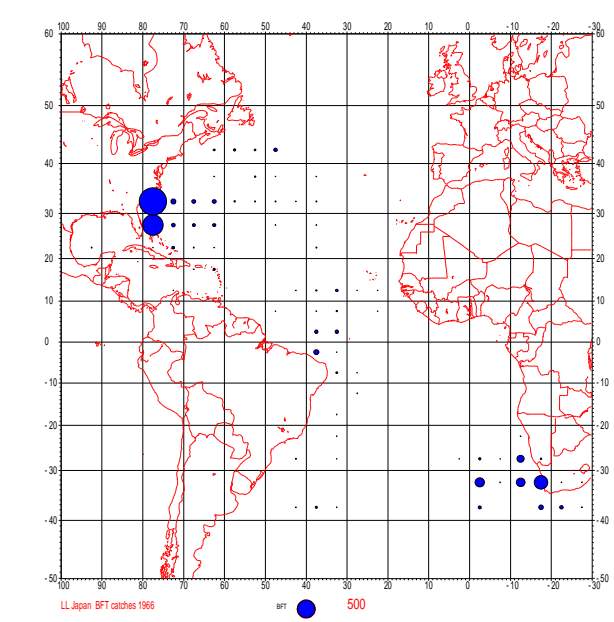
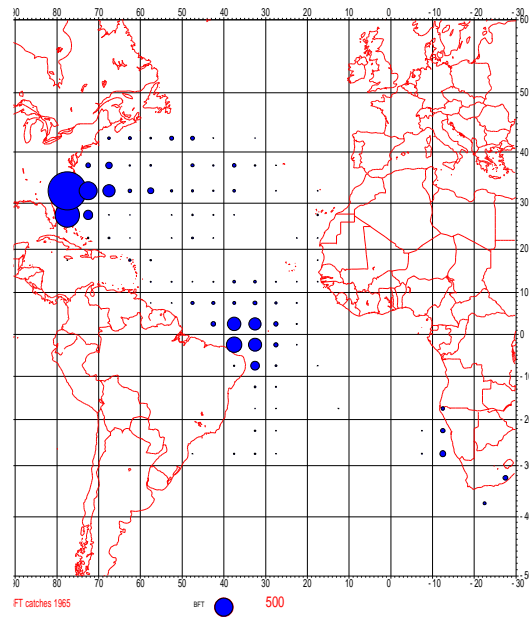
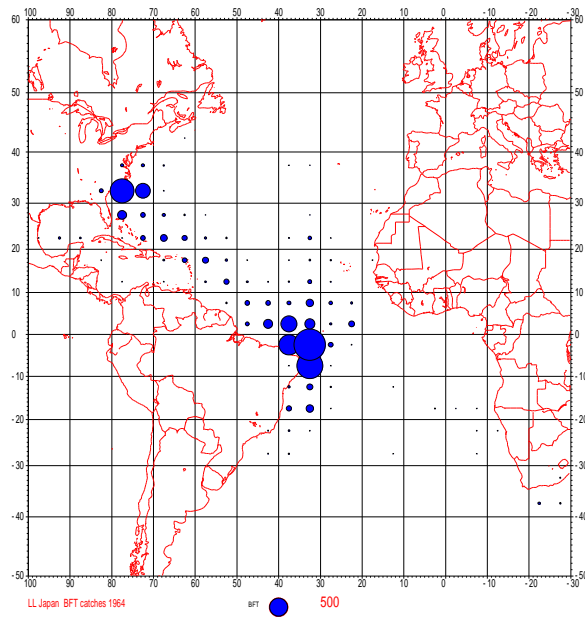
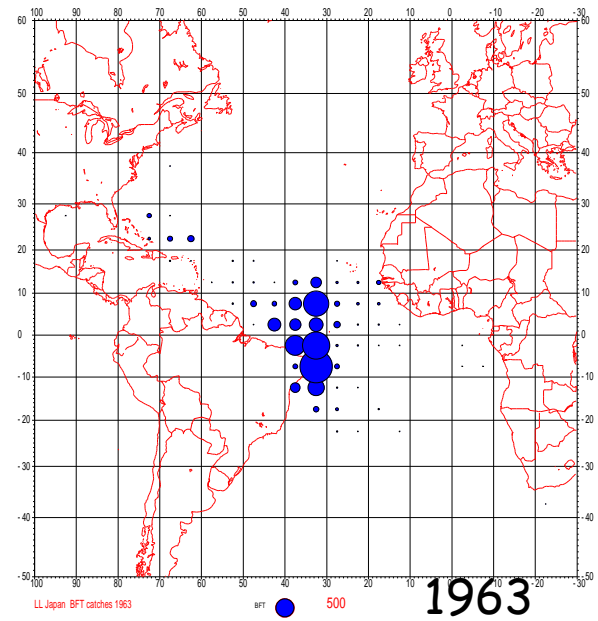
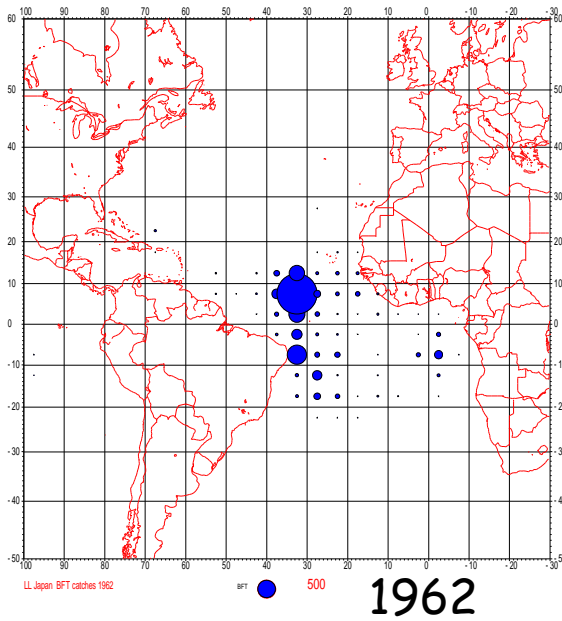
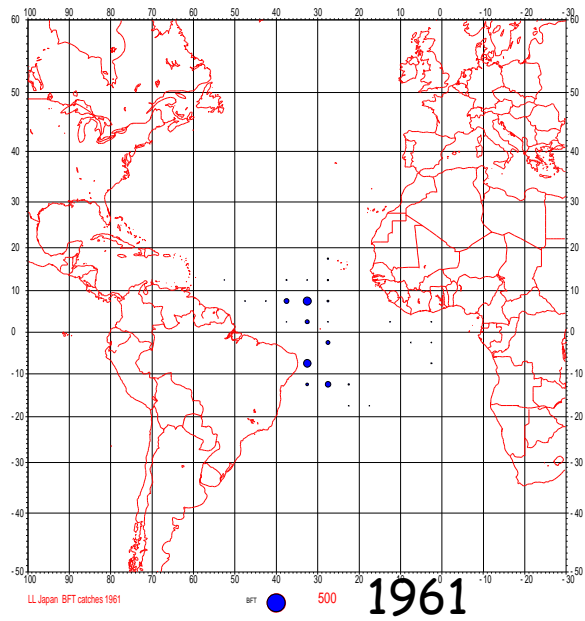
**Catches by species by Japanese longliners in April 1964**

### Monthly bluefin catches in the Brazilian, Bermuda (early 60ies) and mediterranean fisheries (total 1972-2006)



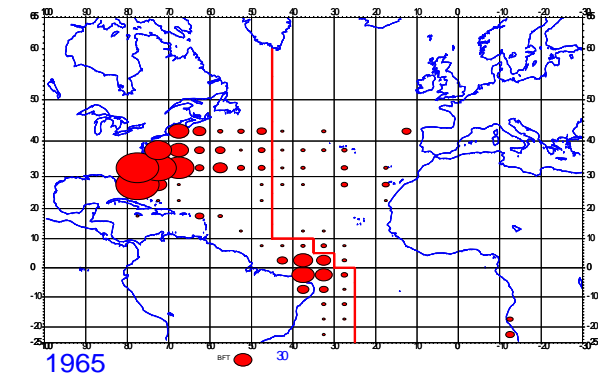
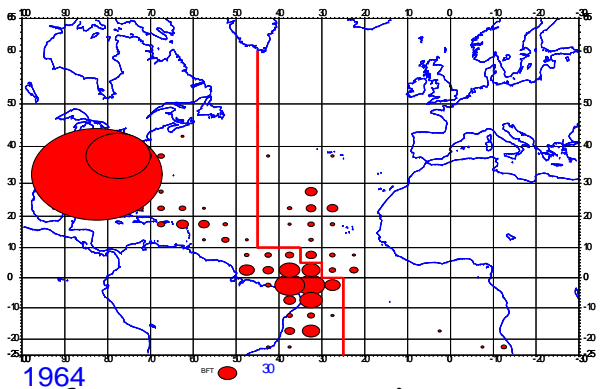
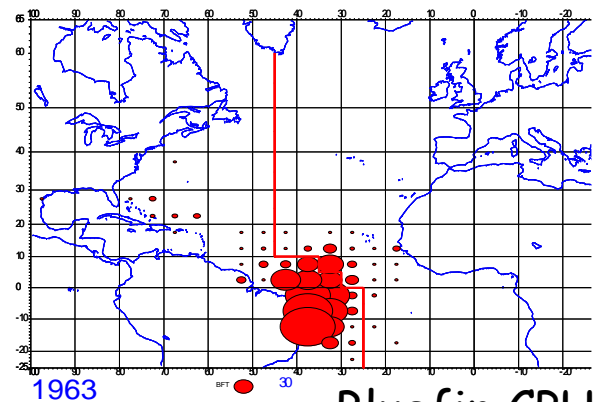
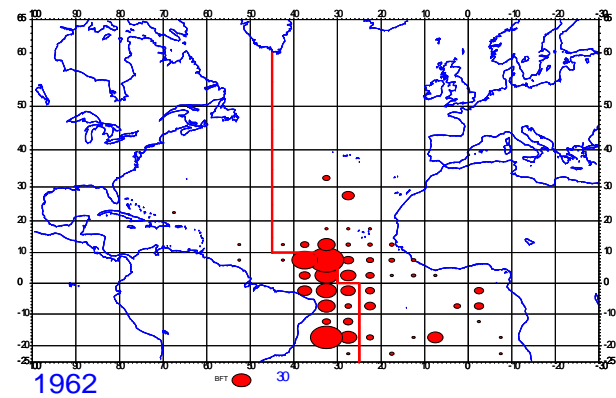
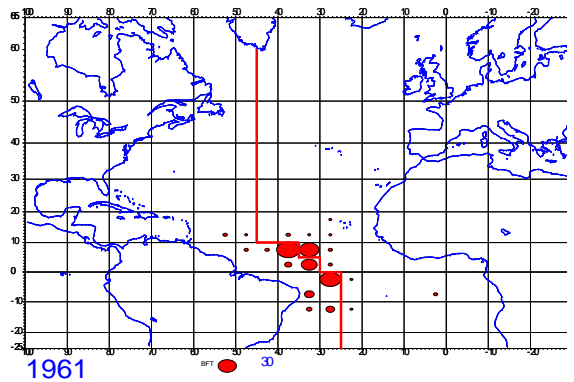
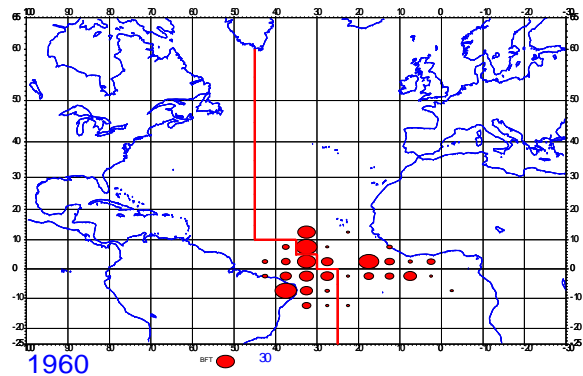
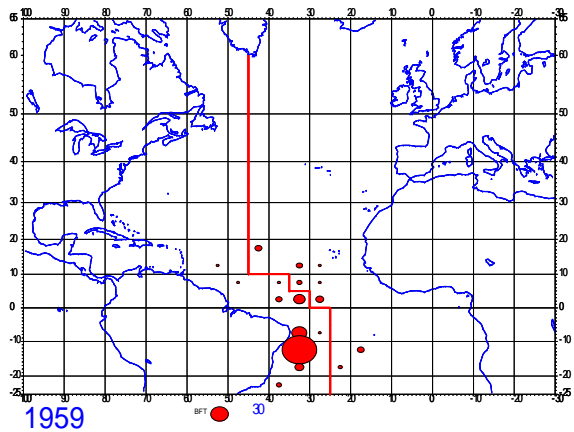
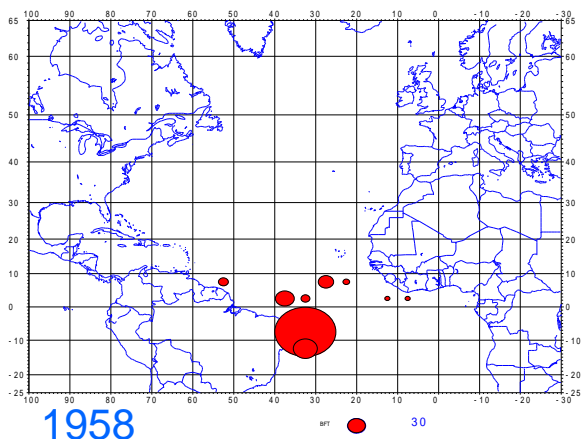
—◆— **Brasil** —●— **Bermuda** —▲— **Mediterranean Sea**

A highly seasonal fishery, before and after the typical Bluefin spawning season. There was opposite fishing seasons in the Mediterranean Sea and other areas (Mediterranean Sea, Gulf of Mexico and Bermuda area)



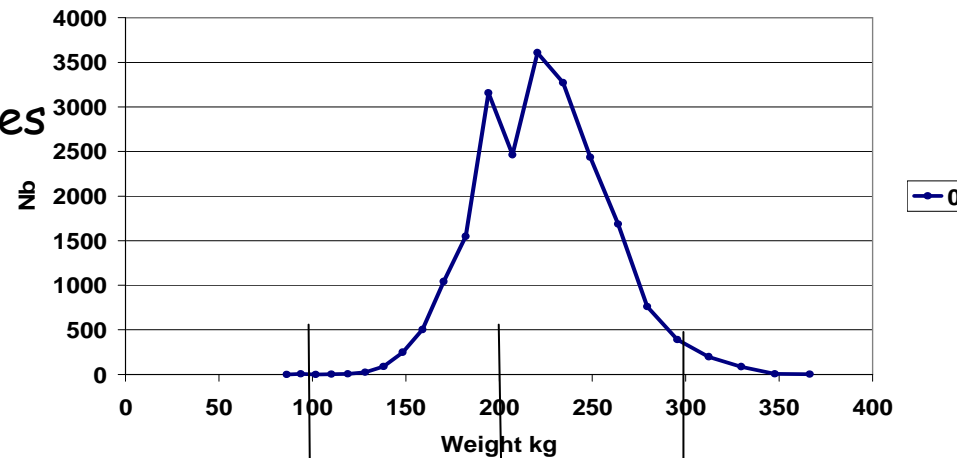
1964 1965 1966

Bluefin catches by Japanese lonliners 1961-1966: 6 years of changing Bluefin fishing zones

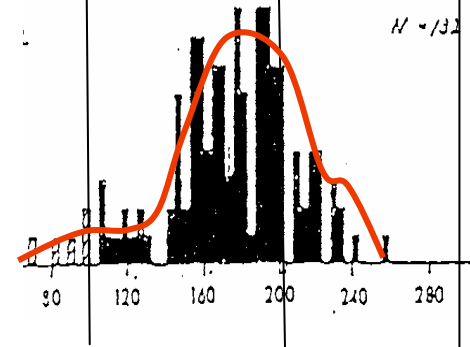


Bluefin CPUEs of Japanese Lonliners 1958-1965

Nordic sizes



Brasil sizes?



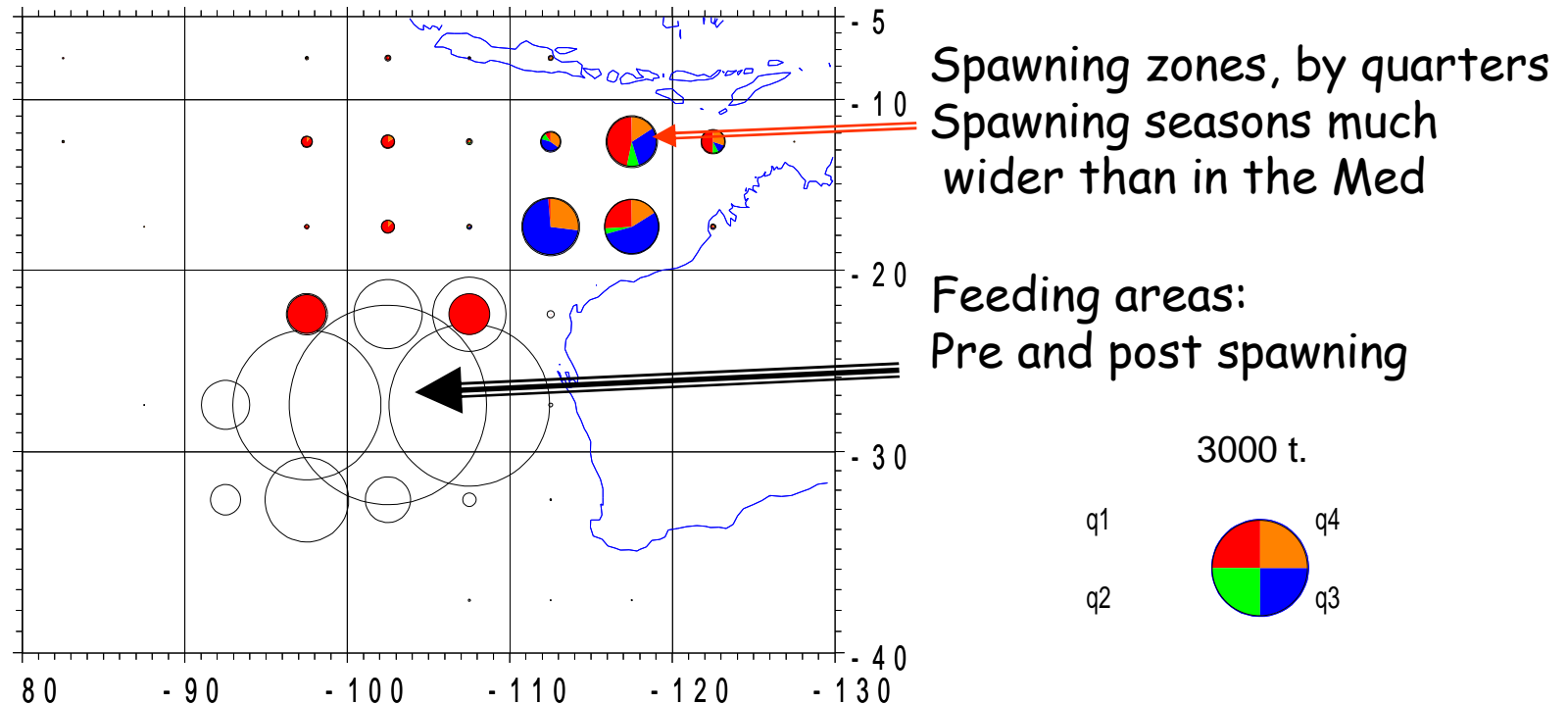
Sizes caught were quite different in the North Sea and Brasil areas:

Smaller fishes taken off Brasil:

- a majority of North Sea BFT > 200kg
- a majority of brasilian BFT < 200kg off Brasil

# Brazilian BFT and Southern Bluefin?

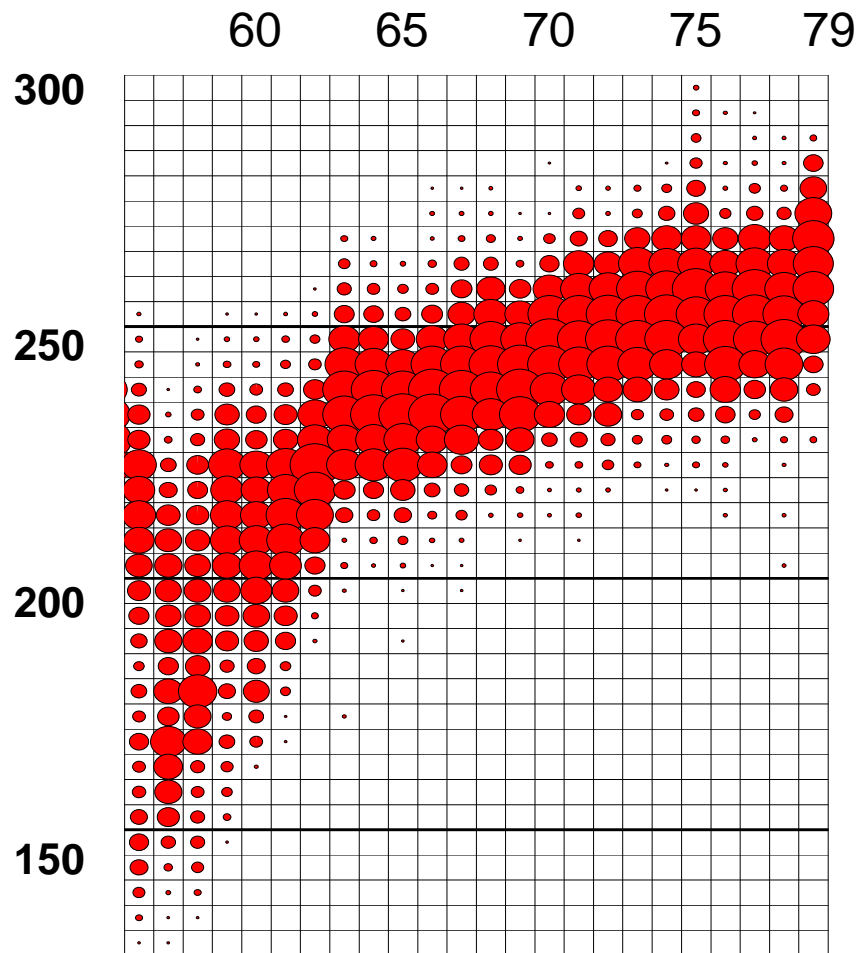
pre and post spawning seasonal feeding ground?  
similar to the OKI areas of Southern Bluefin off Australia?



- All the SBT catches in the pre and post spawning zones off Australia have been taken seasonally before and after SBF spawning at temperate latitudes 25 to 35°S, and in quite cold waters <25°C
- This SBT scheme may have similarities with Atlantic Brazilian BFT, but quite weakly



# 1962: the end of the North Sea large scale bluefin fisheries by purse seiners



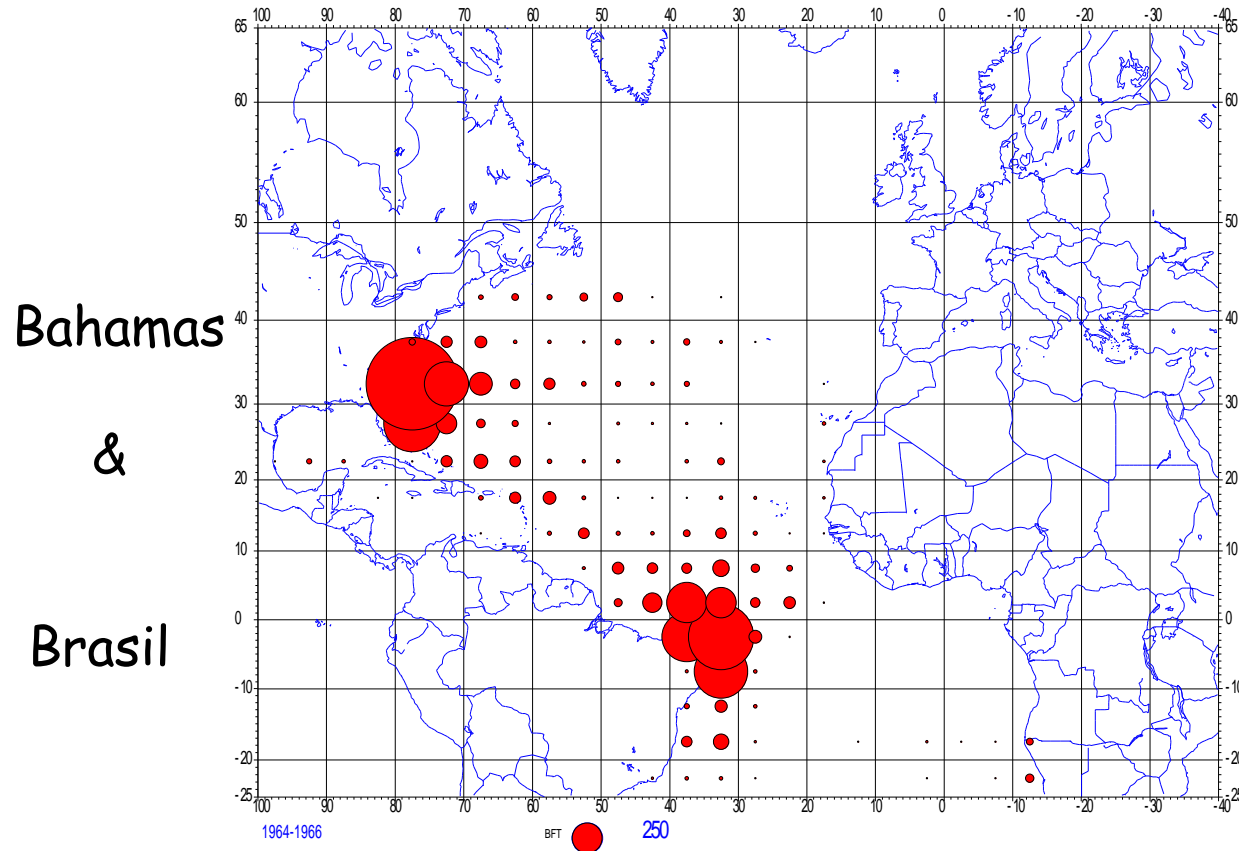
BFT Norway

- Increasing sizes of bluefin caught in the North Sea indicate that there was no recruitment in the Northern fishery since the late fifties
- The end of this fishery is not fully understood, but it remains widely unexplained, but it is not really due to stock overfishing (Fromentin 2008)



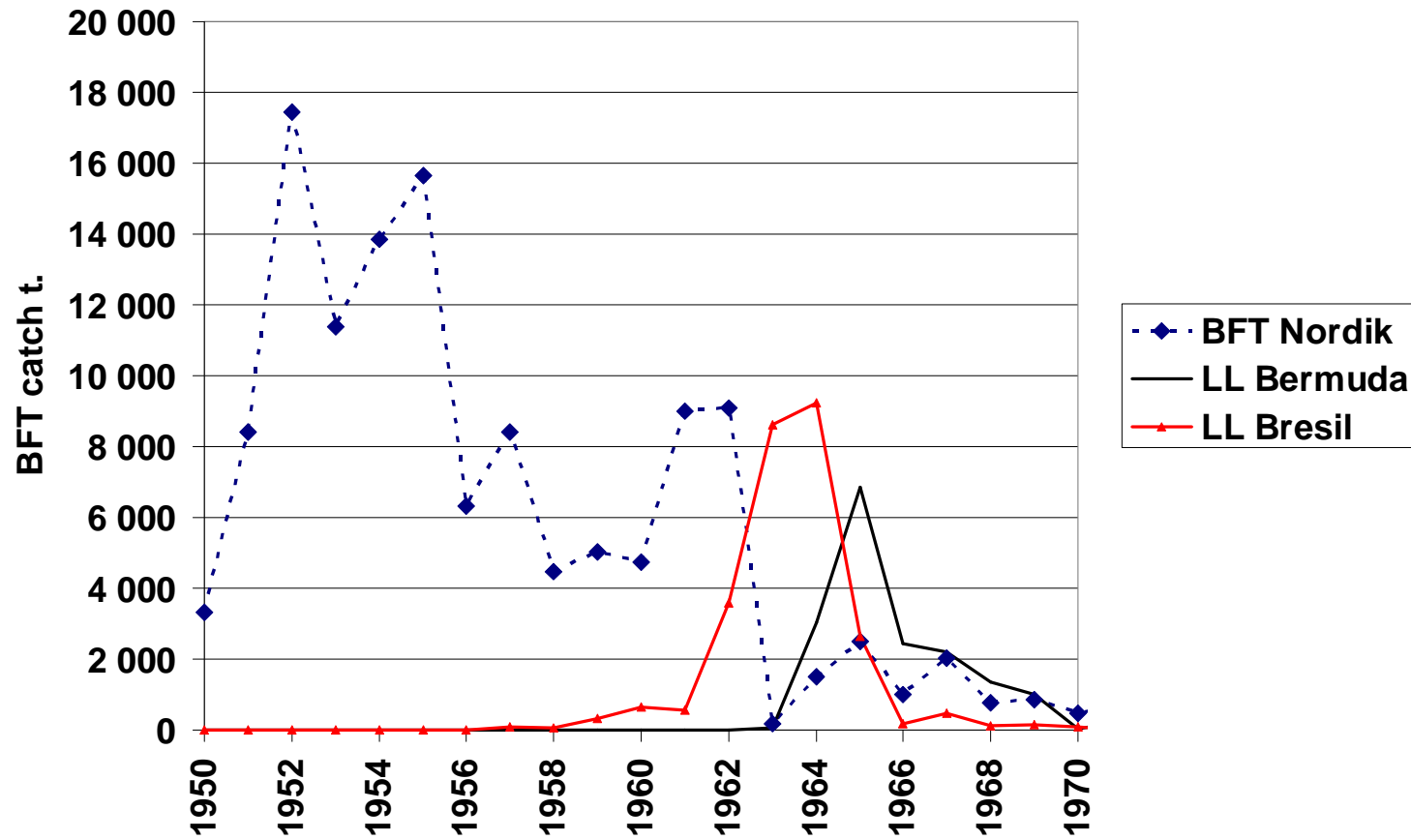
# 1964-1966

Period of very high yearly catches: 14000 t. /year



Brasil area, more probably a feeding zone: , low gonad indices.....

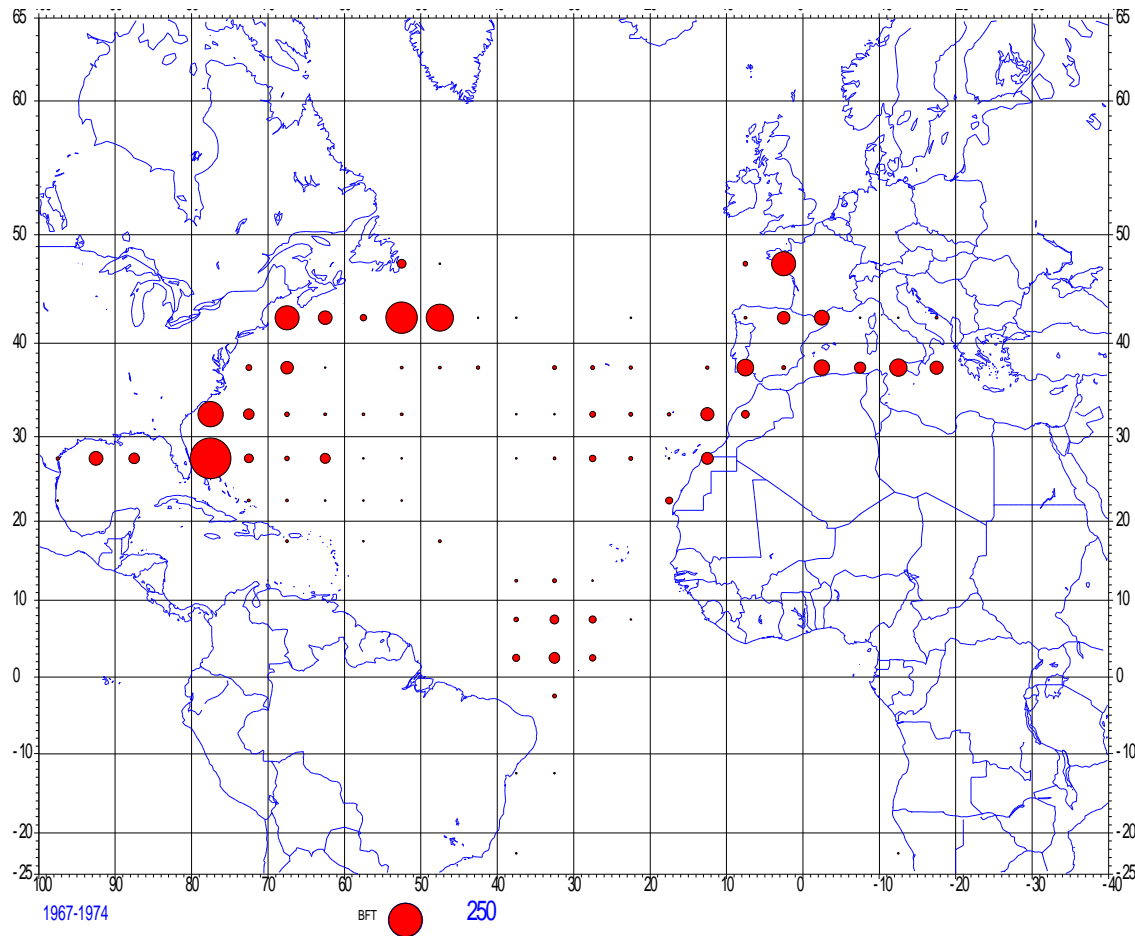
**Bahamas, a typical spawning stratum?:** highly concentrated in time & area  
And in June, « the » typical spawning month of Atlantic bluefin tuna.



Brazilian catches of bluefin have been at a high level during the 1962-1965 period; When 1962 was the last year of very high catches by the nordic fisheries

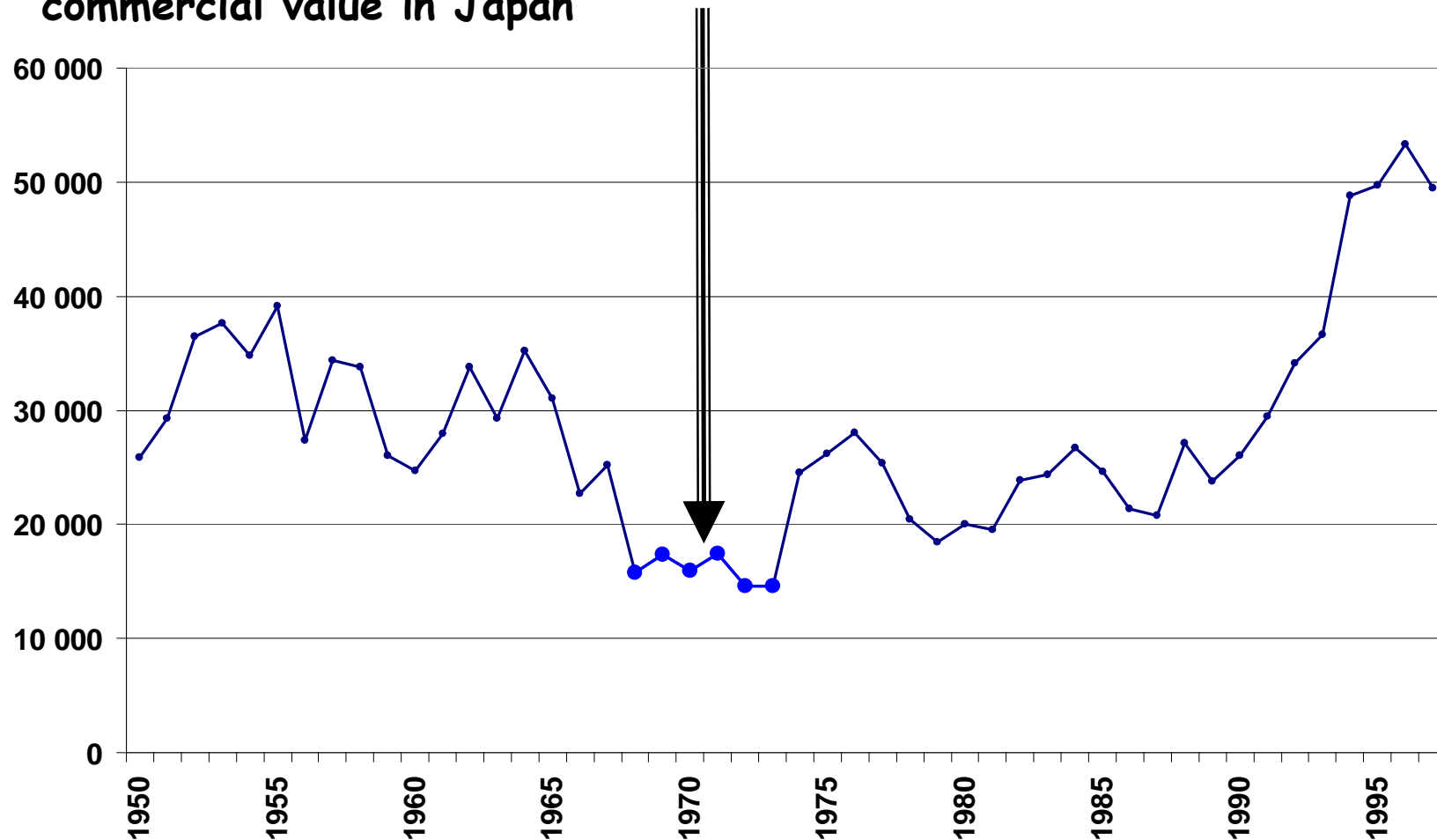
# Japanese longliners 1967-1974

Period of very low yearly catches: 1300 t. /year,  
just before the implementation of ultrafreezing and its  
subsequent sashimi boom

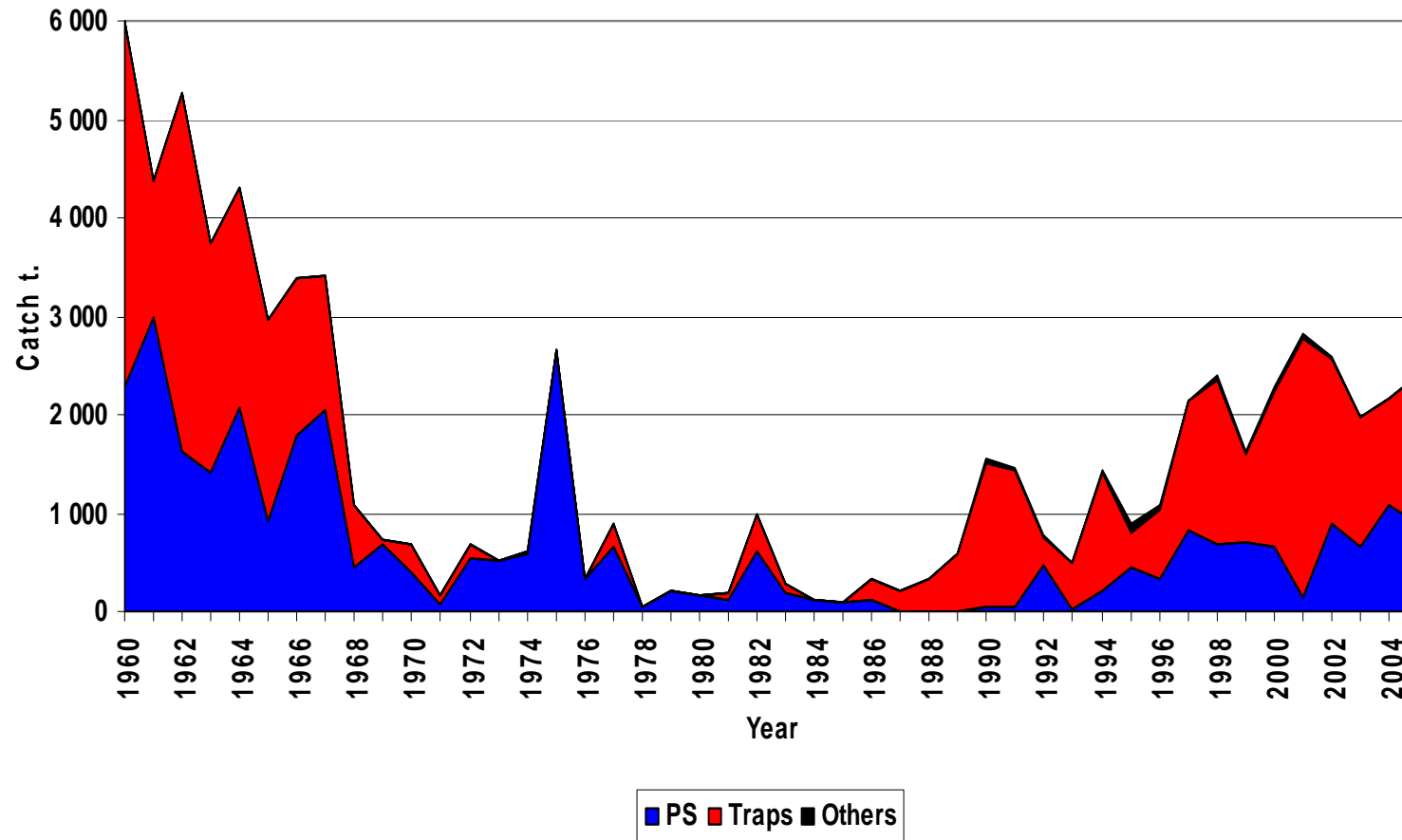


# 1968-1973

Also the period of lowest bluefin total catches in the Atlantic: 16.000t, Probably due to a combination of low abundance, and still a low commercial value in Japan



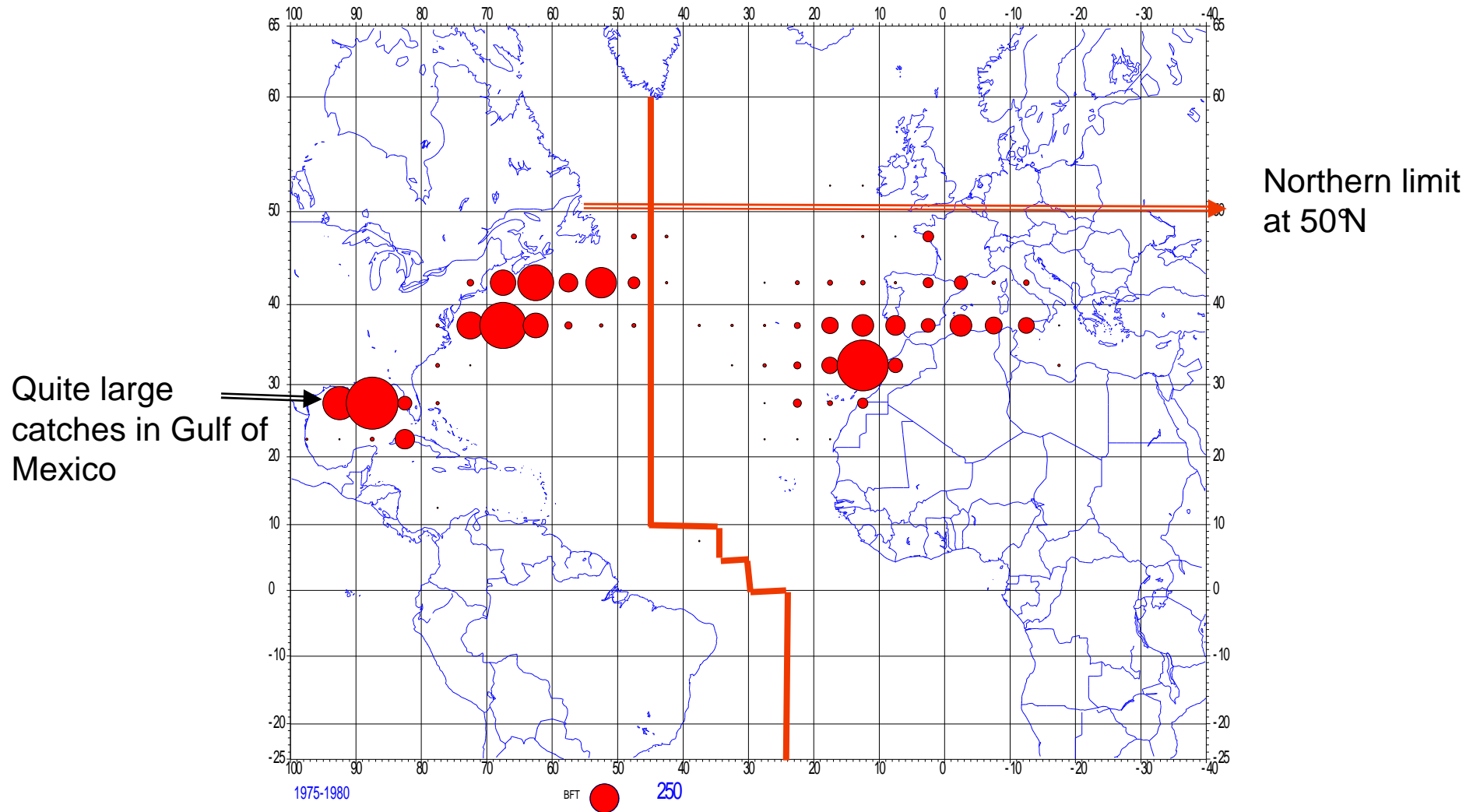
# Morocco: a major bluefin fishing country, permanently active in the Atlantic, Gibraltar and the Mediterranean Sea



But also facing a period of major decline of its bluefin fisheries, at the end of the sixties and seventies

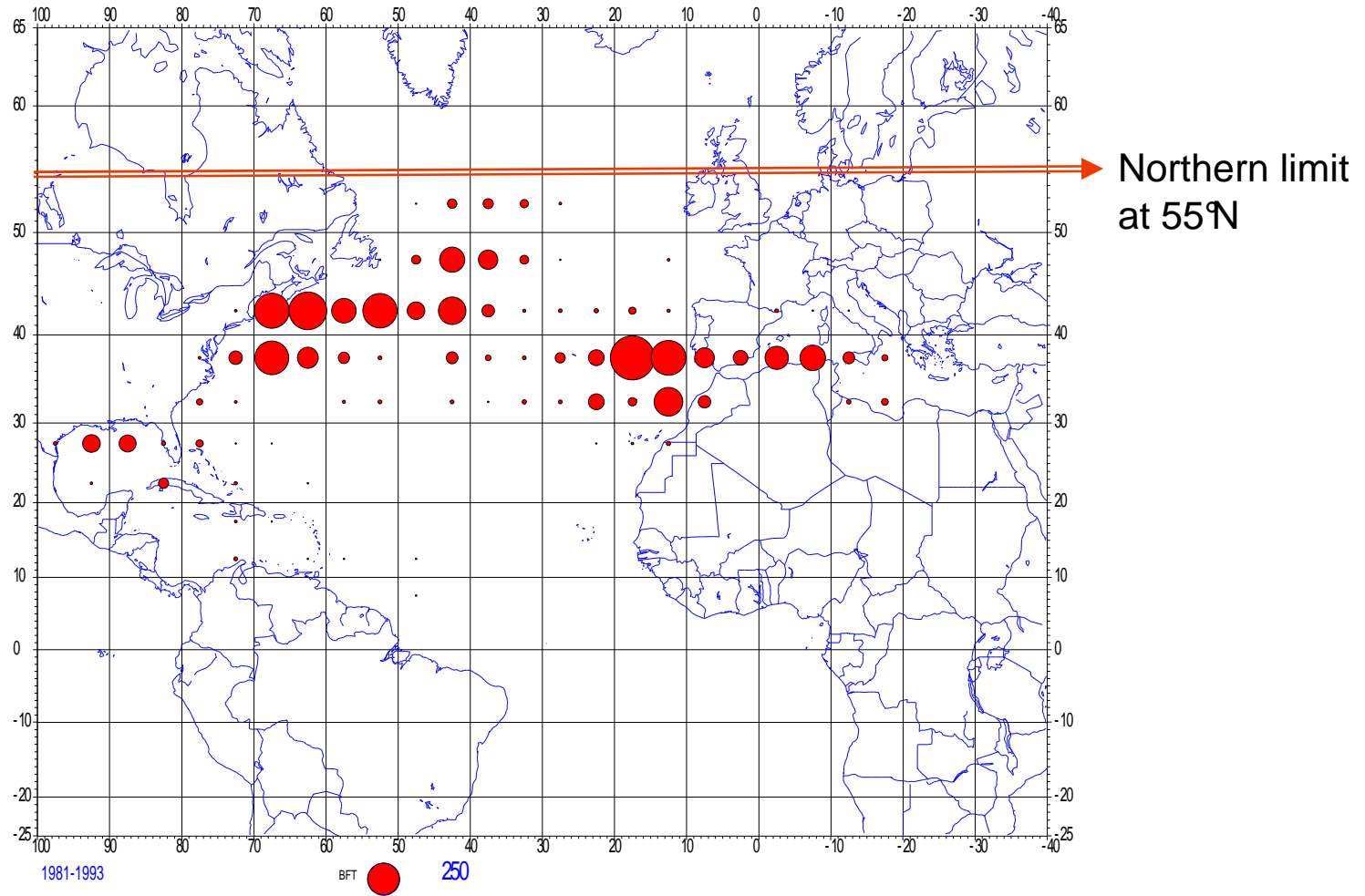
# 1975-1980

Bluefin now increasingly targeted by longliners (and other gears), because of its increasing value on the sashimi market



# 1981-1993

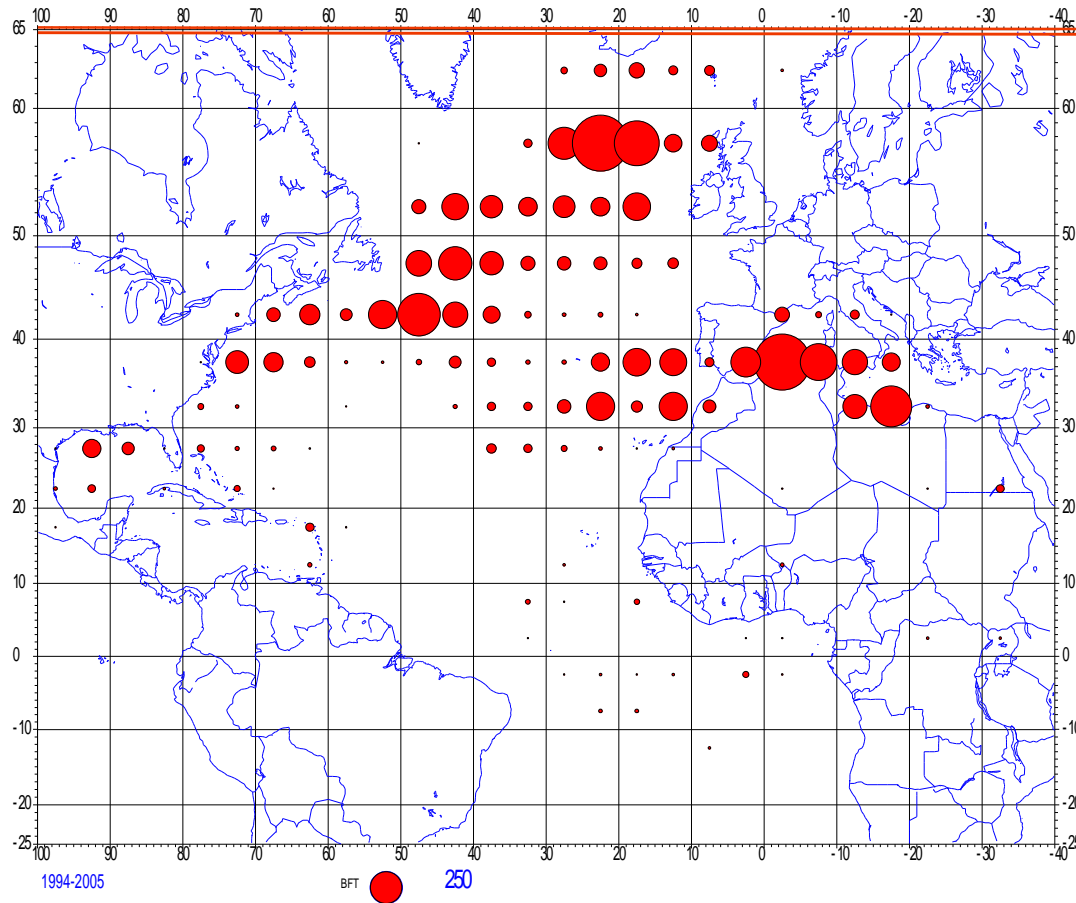
A transition period of moderate yearly catches for Japan:  
3000 t. /year





# 1994-2006

Period of moderate but increasing yearly catches:  
3600 t. /year

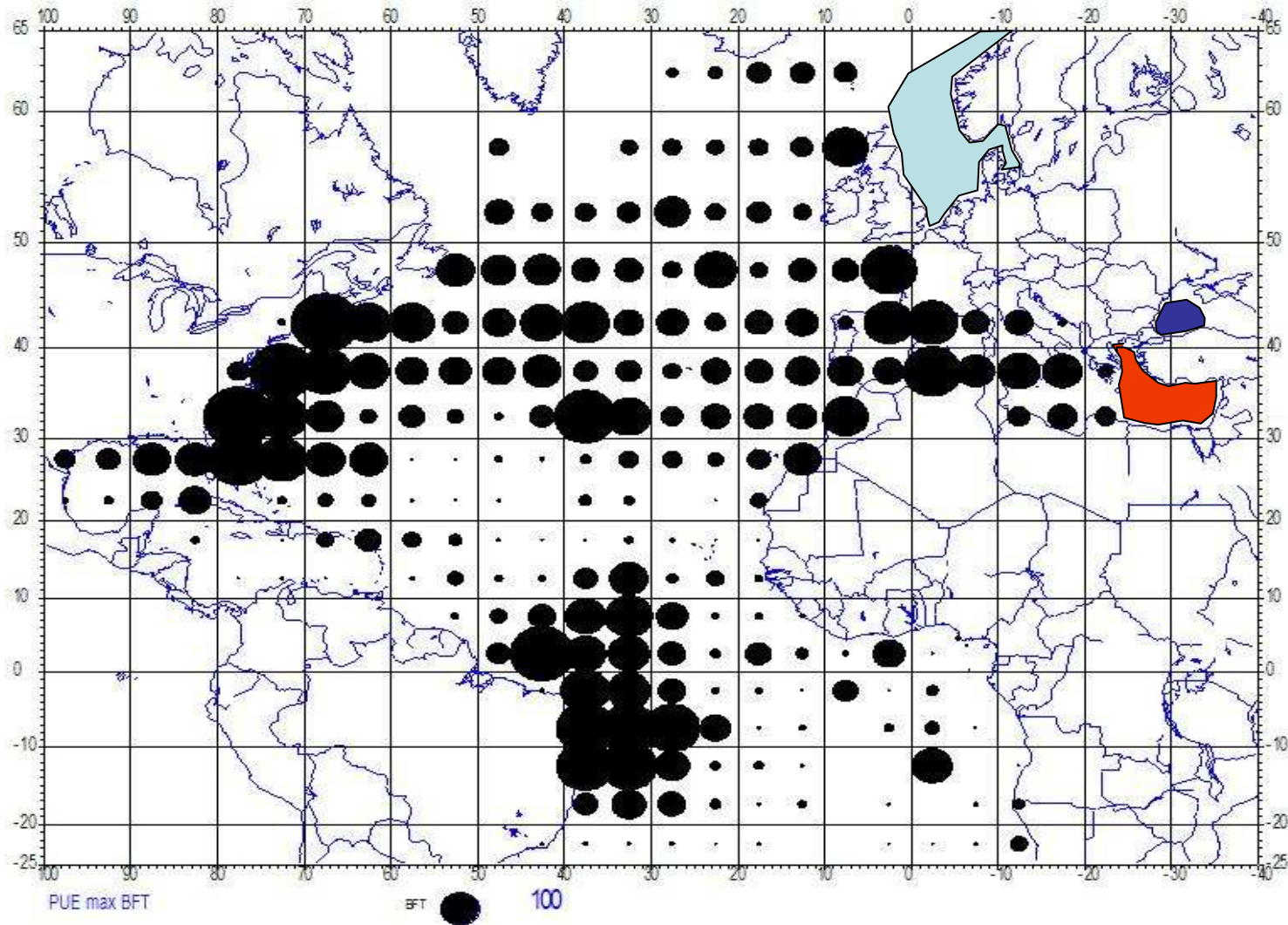


➤ Northern limit at 65°N,

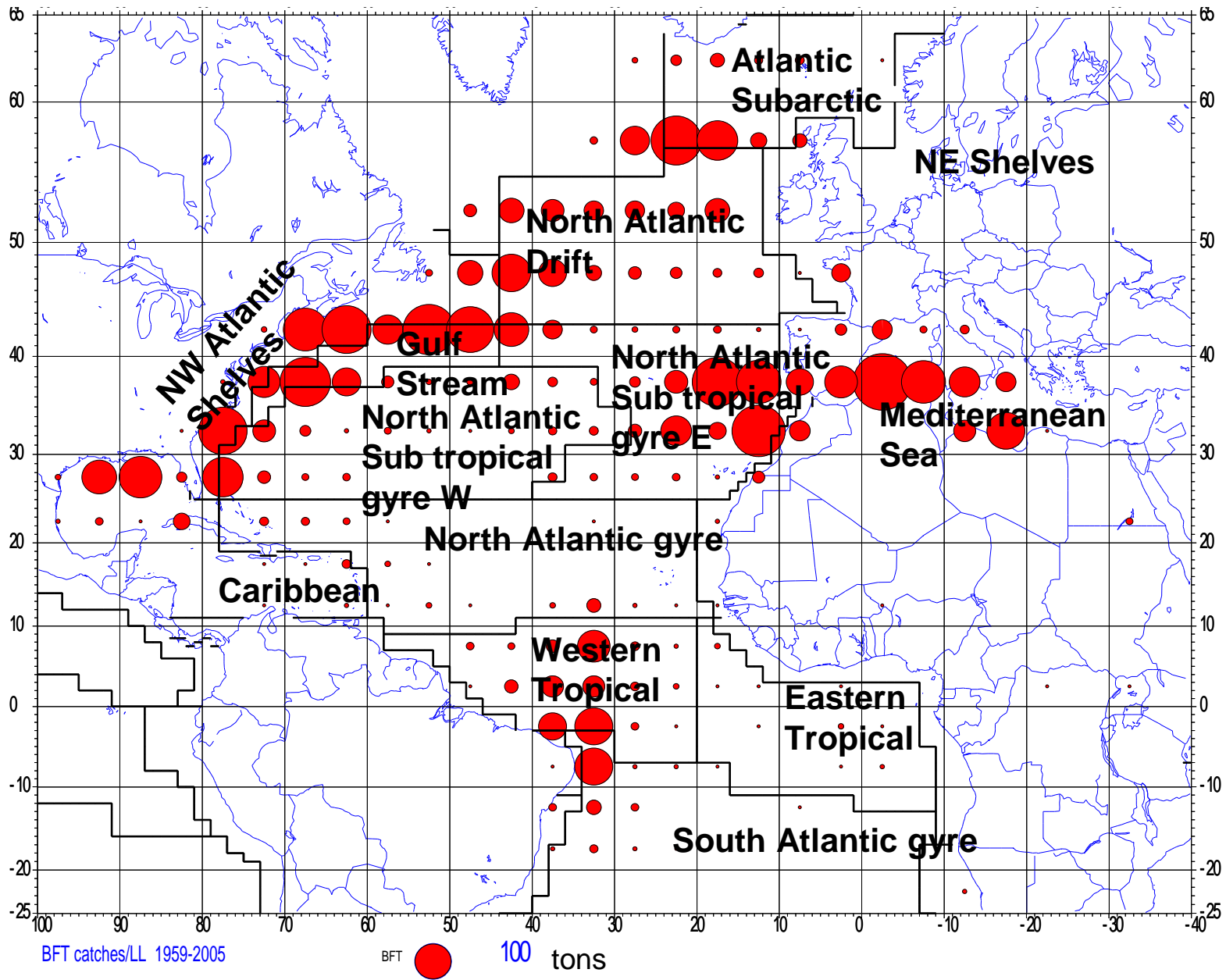
➤ A new major fishing zone in the (Gulf Stream) North Atlantic drift

## Recent changes in other bluefin fisheries

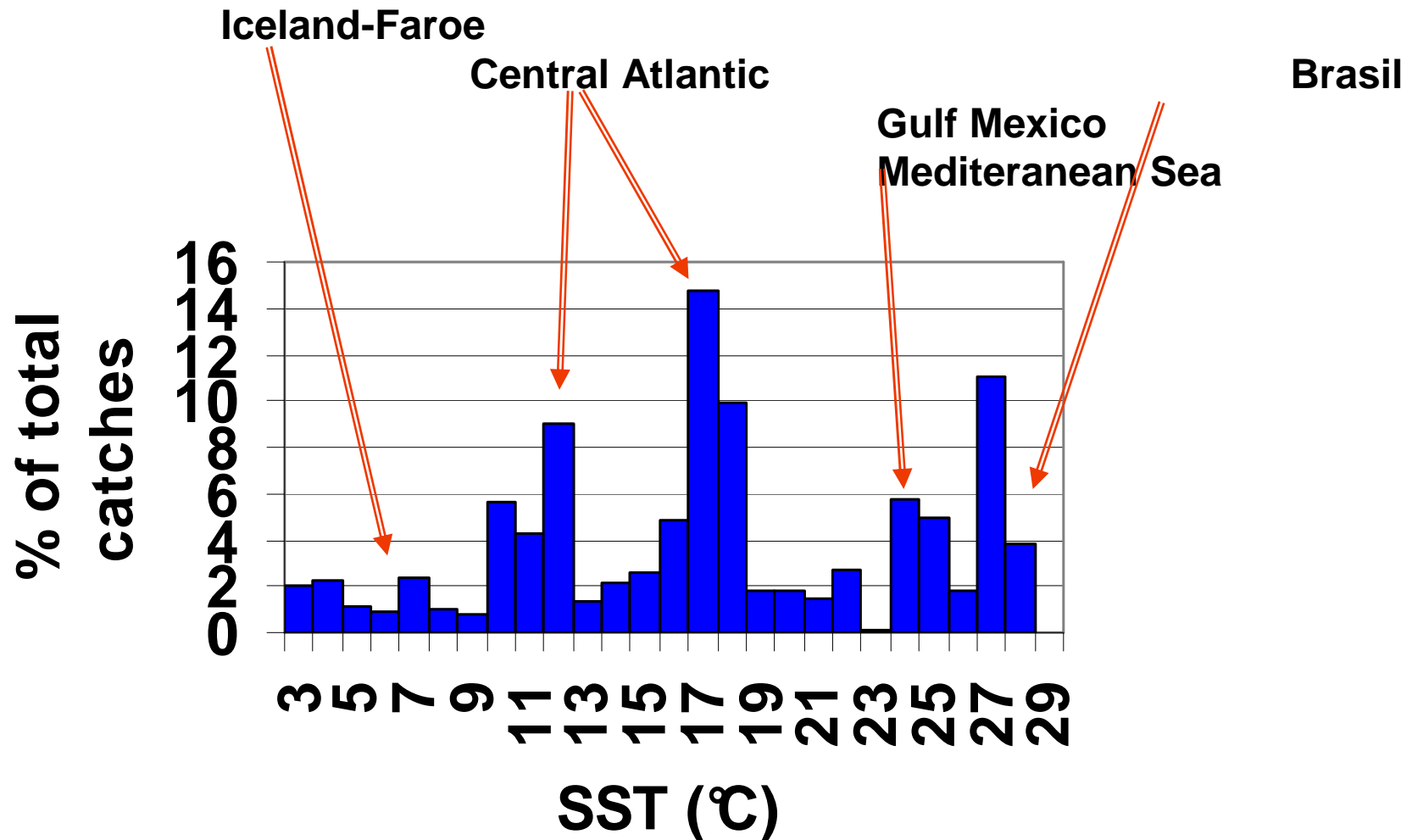
- US bluefin catches/CPUEs of large bluefin by rod and reel are very low, since 2004, probably due to a local effect,
- While simultaneously in Canada, the Gulf of St Lawrence bluefin catches/CPUEs are high
- Record high catches in the Mediterranean Sea by a wide diversity of fisheries and gear, and major changes of fishing zones in the Med., but unfortunately a nearly complete lack of TASK2 statistics does not allow to analyze these major changes:
  - The major spawning zone off Balears of stock since 1997 (?), possibly an overfished and vanished sub population?
  - Very high catches off Lybia since 2001 (?), probably also a major spawning zone?
  - Major declines in most Mediterranean trap fisheries, probably indicative of the adult stock decline



**An average overview of the best monthly CPUE ever observed in each 5° squares and month for Japanese longliners during the 50 years period. A map showing all the areas where bluefin had a high local abundance, sometimes during the period**



An average overview: 50 years of bluefin catches by 5°s quares by Japanese longliners.  
*The geographical ditribution is quite wide and scattered in various ecosystems, but without any dominant fishing zone, each area being mainly fished during part of the 50 years period*



Bluefin tuna: a great flexibility to live in a wide range of Sea Surface temperature, as shown by Bluefin catches by Japanese longliners as a function of the corresponding average sea surface temperature (by quarter and 5° squares)

*Bluefin tuna is by far, among all other tuna species, the tuna taken in the widest range of SST: from sub Arctic to equatorial waters*

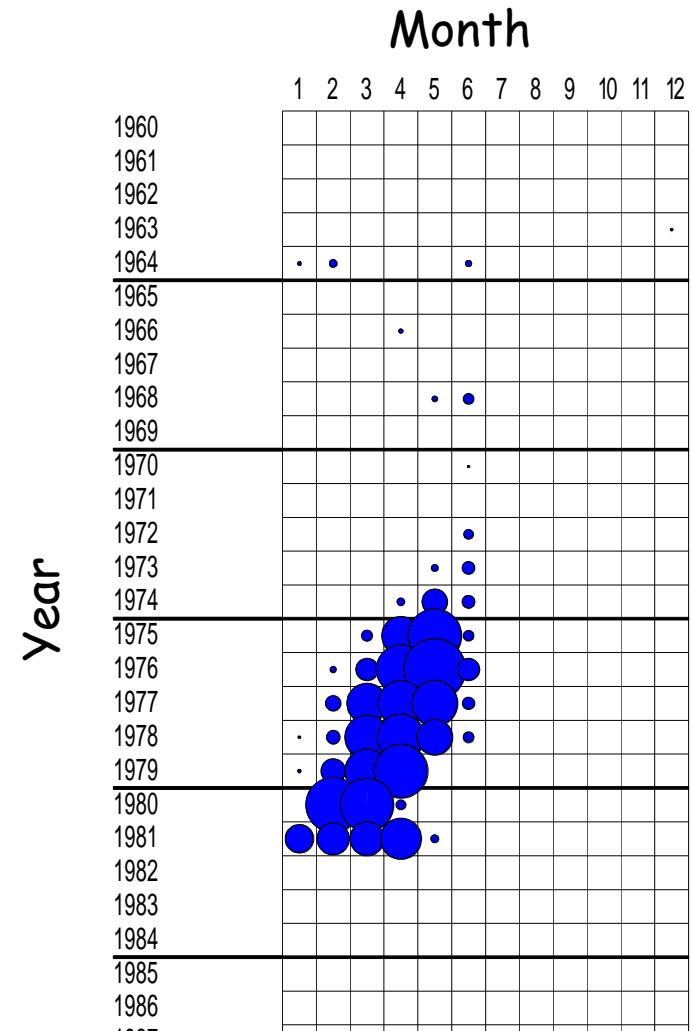
**Bluefin fisheries and stocks:**  
a poorly explained permanent major variability.  
Without clear W-E or N-S frontiers between stocks

**Bluefin historical fisheries have been permanently showing large scale variabilities: at local and global scales**

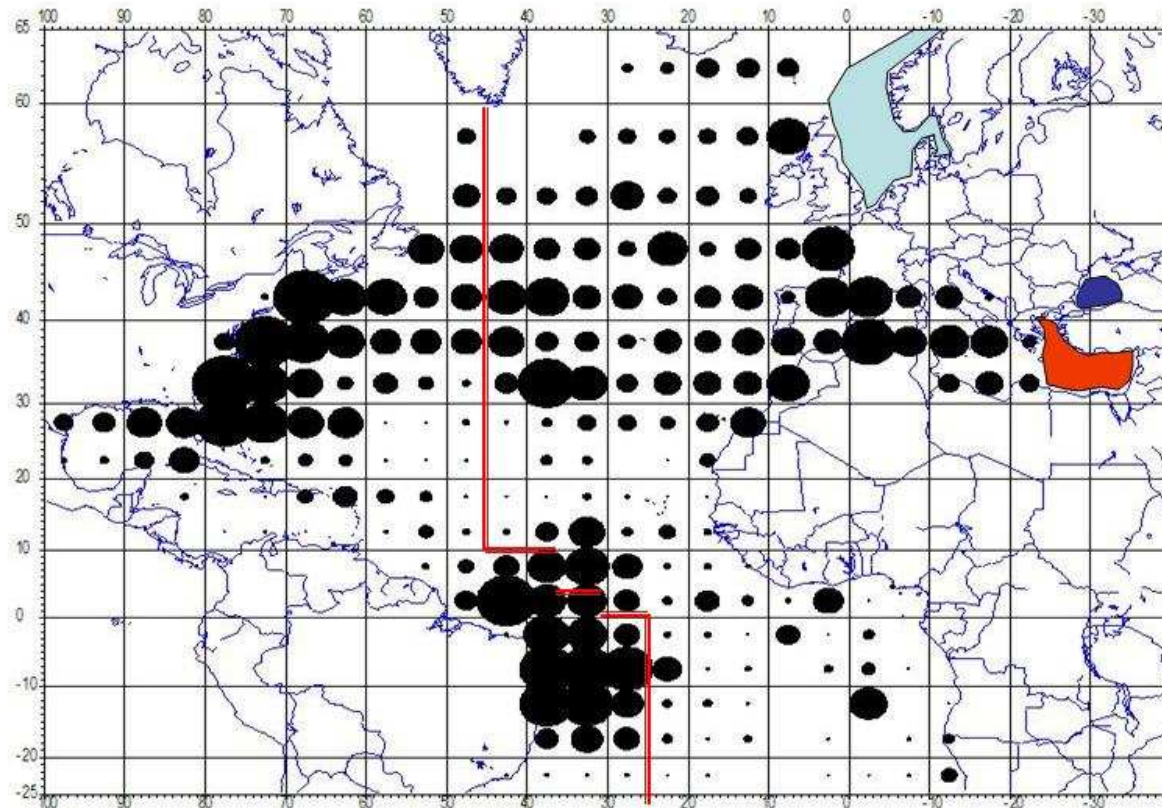
- **Part of this variability can be explained by environmental fluctuations and long term biomass cycles**
- **As these environmental factors widely condition (1) bluefin spawning strata, (2) its feeding strata, and (3) the overall levels of bluefin biomass**
- **But many of the observed changes in fisheries and fishing zones remain difficult to fully explain: North Sea, Brasil, Bermuda, more recently vanishing bluefin in the US coast and in the Baleares fishing grounds, in the traps fisheries, and others...**
- **The increasing effects of increasing overfishing and of declining stock biomass are logical and clear in some cases, but much less in others.**
- **Local declines of the bluefin favourite preys may also partly explain some local declines: US coast, Norway, Trebeurden Bay**

## 2 bluefin stocks in the western and eastern Atlantic?

- The ICCAT frontier between 2 western and eastern stocks was mainly administrative:
- Established by the ICCAT Commission in 1981, it was not based on SCRS recommendations
- This frontier was mainly linked with active presence of Japanese longliners targeting bluefin along the US coast.



Monthly bluefin catches by Japanese longliners in the Gulf of Mexico



- This political decision was de facto accepted by SCRS in its later work, but without analyzing & explaining to the Commission the potential dangers of such decision
- Bluefin biomass in the Western Atlantic is possibly driven more by catches in the Eastern Atlantic (From Brazil, Norway, Iceland, Bay of Biscaye & Med.), than by the local minor catches of bluefin in the Western Atlantic
- This ICCAT frontier remains weakly justified by the fishery, environmental data, or by tagging results
- It may be misleading and dangerous for the conservation of Atlantic bluefin population to use it as a strict assessment and management frontier



# An overview upon bluefin variability

- Bluefin a typical temperate species, but living in a wide range of ecosystems
- But a great variability of time and area strata « exploited by bluefin tunas » for its spawning and feeding.
- Long term cycles of bluefin abundance well shown by centuries of trap data (Fromentin and Ravier)
- Major fishing zones of bluefin have been always highly variable, due to changes in bluefin feeding and spawning zones
- Adult Bluefin tuna are highly vulnerable during their very small, fixed and well identified spawning strata
- Probably a bluefin strict homing behavior: very small birth strata!
- Spawning strata are possibly showing some variability: for instance due to environment (Medit. Sea) and/or to overfishing (end of Balears spawning?) and possible genetic erosion of sub-populations

# Conclusion

- Bluefin is probably the best example of "highly migratory species" exploiting a very wide range of ecosystems
- The time and space variability of its biomass this species is clearly a major one, but still poorly understood, unexplained and it remain impossible to model, due to this great & unexplained variability.
- These major uncertainties could be partly solved:
  - Obtaining 100% of perfect TASK2 statistics: C/E and sizes. A fishing fleet that is not providing to ICCAT 100% of this TASK2 should not be allowed to fish!
  - by an improved biological research on spawning and feeding bluefin tunas, their feeding, behavior and migration as a function of the environment
  - by an intensive wide scale tagging program: tagging all sizes and in all the main fishing zones, using dart tags, archival and pop up tags.