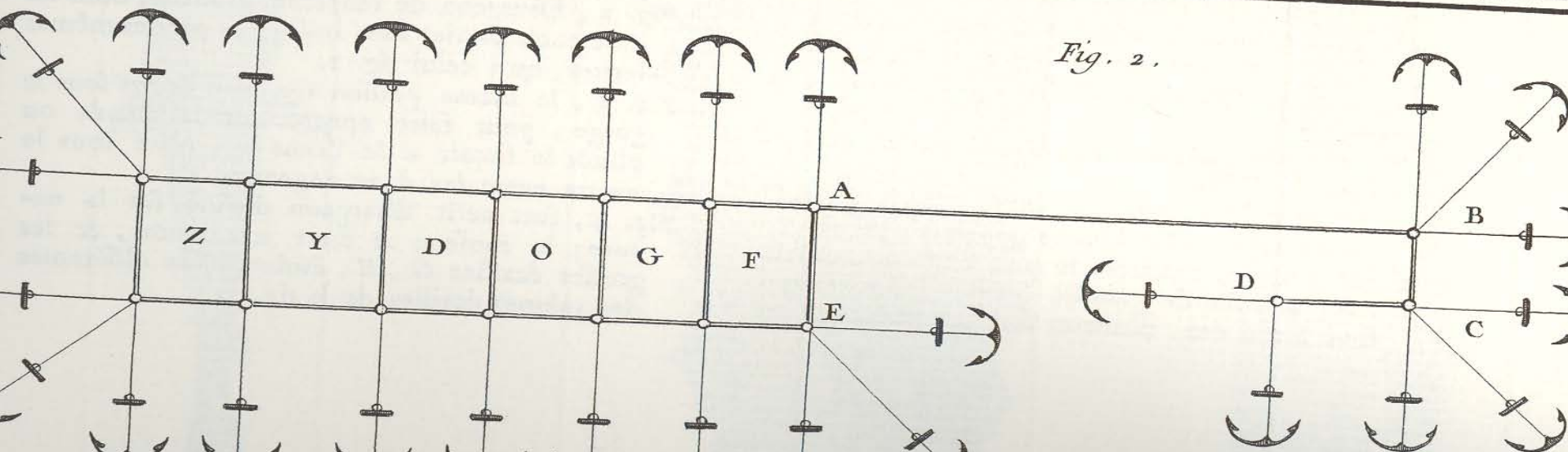
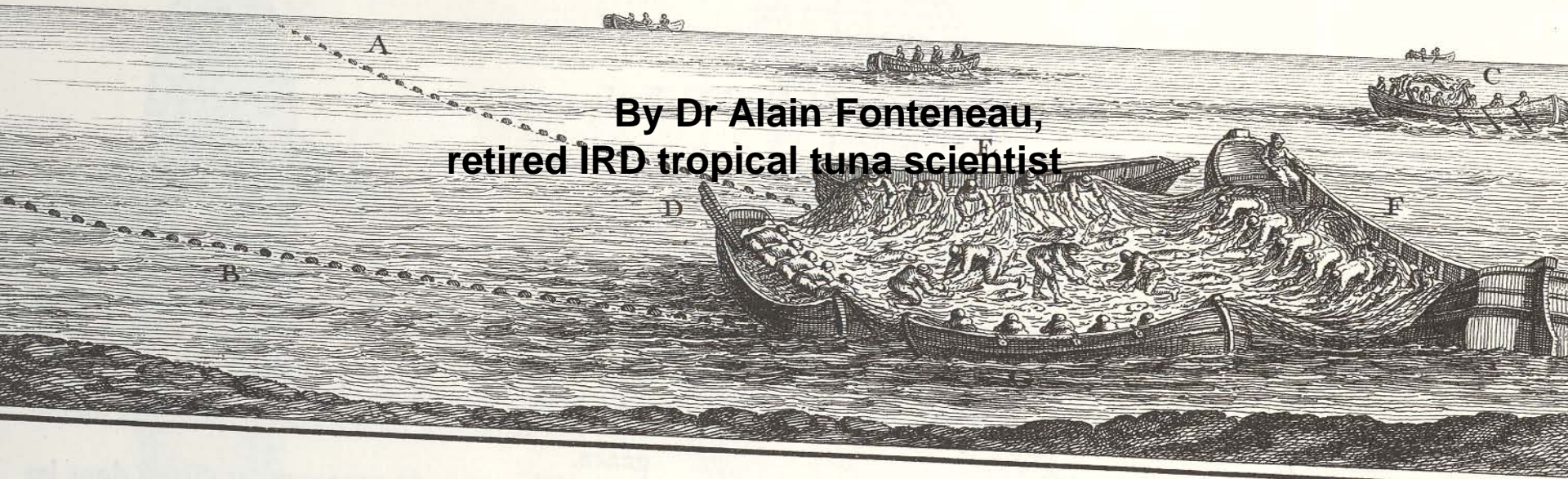


**"Mediterranean traps in the 21st century:  
research tools for the conservation of bluefin tunas «**

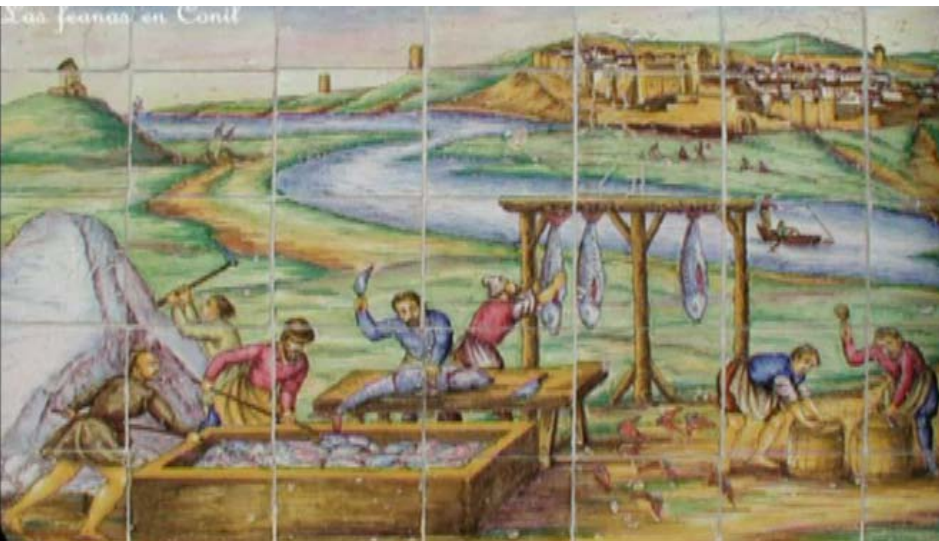
**By Dr Alain Fonteneau,  
retired IRD tropical tuna scientist**





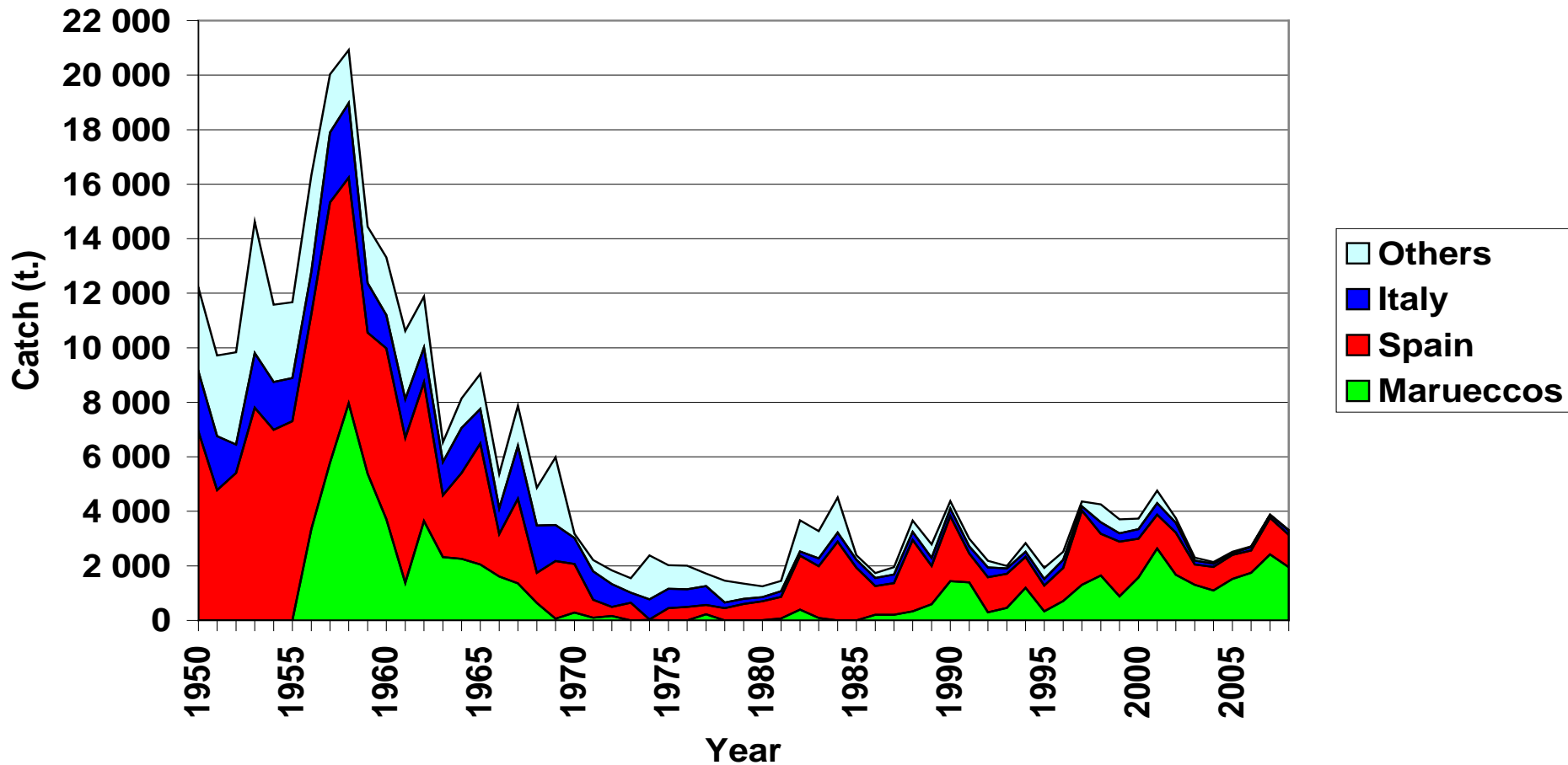
# Bluefin Mediterranean traps

- A long history of coastal fishing activities by beach nets and traps, thousands of years, and of fruitful scientific investigations during centuries: 18th and 19th centuries (King of Portugal 1898), the entire 20th century, recent historical analysis by Ravier & Fromentin and various recent archival tagging, etc..

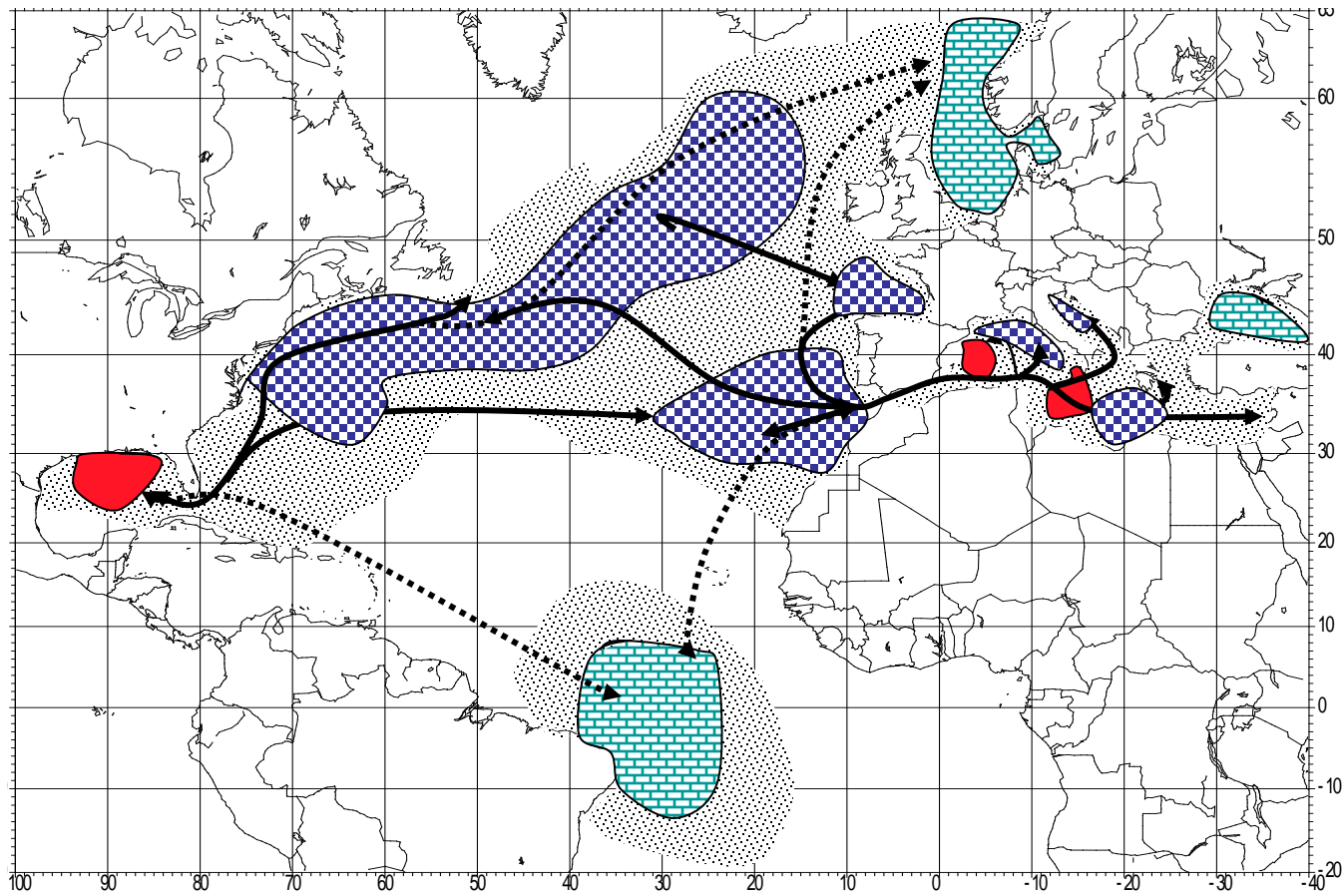


Now in 2011: traps are an « endangered gear », due to their high operational cost and to their low BFT catches, due to a combination of reduced stock and reduced TAC sizes







But there is a major scientific interest to keep fully active traps in the future.



Yearly catches by Medit traps since 1950



## Bluefin tuna migrations, *Yesterday & today*

-  Distribution area
-  Spawning areas
-  Present feeding zones
-  Historical feeding areas
-  Present migration
-  Historical migration

**Bluefin tuna:**  
**Complex and variable movement patterns,**  
**between Mediterranean Sea and North Atlantic**

# What potential past & future scientific role of Mediterranean traps?

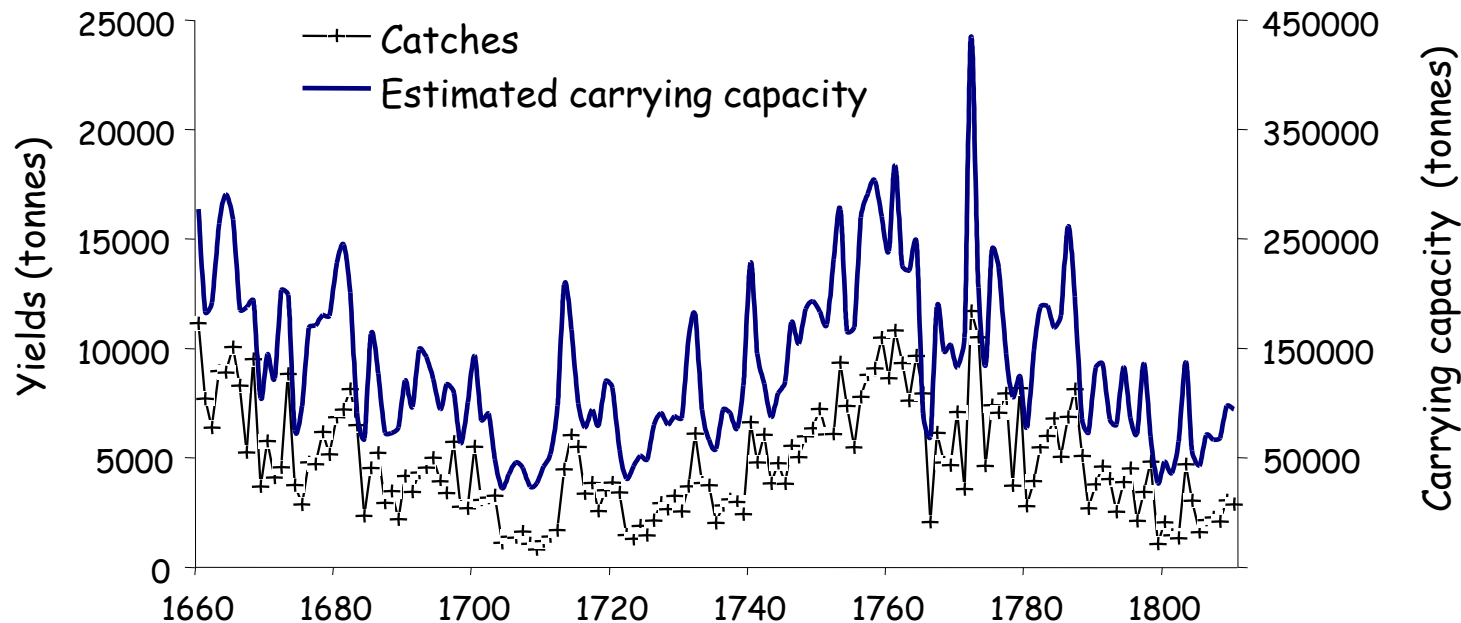
- Seasonal and yearly historical catch at size: CPUEs of the traps measuring spawning biomass of BFT? Being very careful with many bias!
- And fine scale migratory behavior of pre & post spawning BFT
- Traps allowing to evaluate environmental impact of environment on tuna stocks
- Allowing a biological sampling of adult BFT: genetics, condition factors, mediterranean pollutants, spawning conditions, etc...
- Traps: possibility to tag BFT with electronic tags (Cort)



Photo Barbaroux IFREMER

# Studies of historical traps by JM Fromentin & C. Ravier

- A very successful data mining, allowing to recover & to analyze centuries of yearly catches from multiple Mediterranean traps
- An analysis showing significant natural variation in abundance implies that the stock productivity and its corresponding **virgin biomass varies over time**





# 1898: intensive & successful investigations by Don Carlos, King of Portugal on the Algarve traps

- Mainly based on a detailed analysis of the daily catches taken by the 19 Algarve traps then active in Portugal
- These traps were fishing BFT entering to spawn in the Mediterranean Sea (May and 1st half of June) and BFT going out from the Med. mainly in July





## Bluefin tunas



***Migration trajectories of pre spawning BFT entering in the Mediterranean Sea were different from trajectories of post spawning BFT moving out from the Med. As they have been estimated by king Don Carlos of Portugal These results obtained in the nineteth century are still today of major scientific interest!***

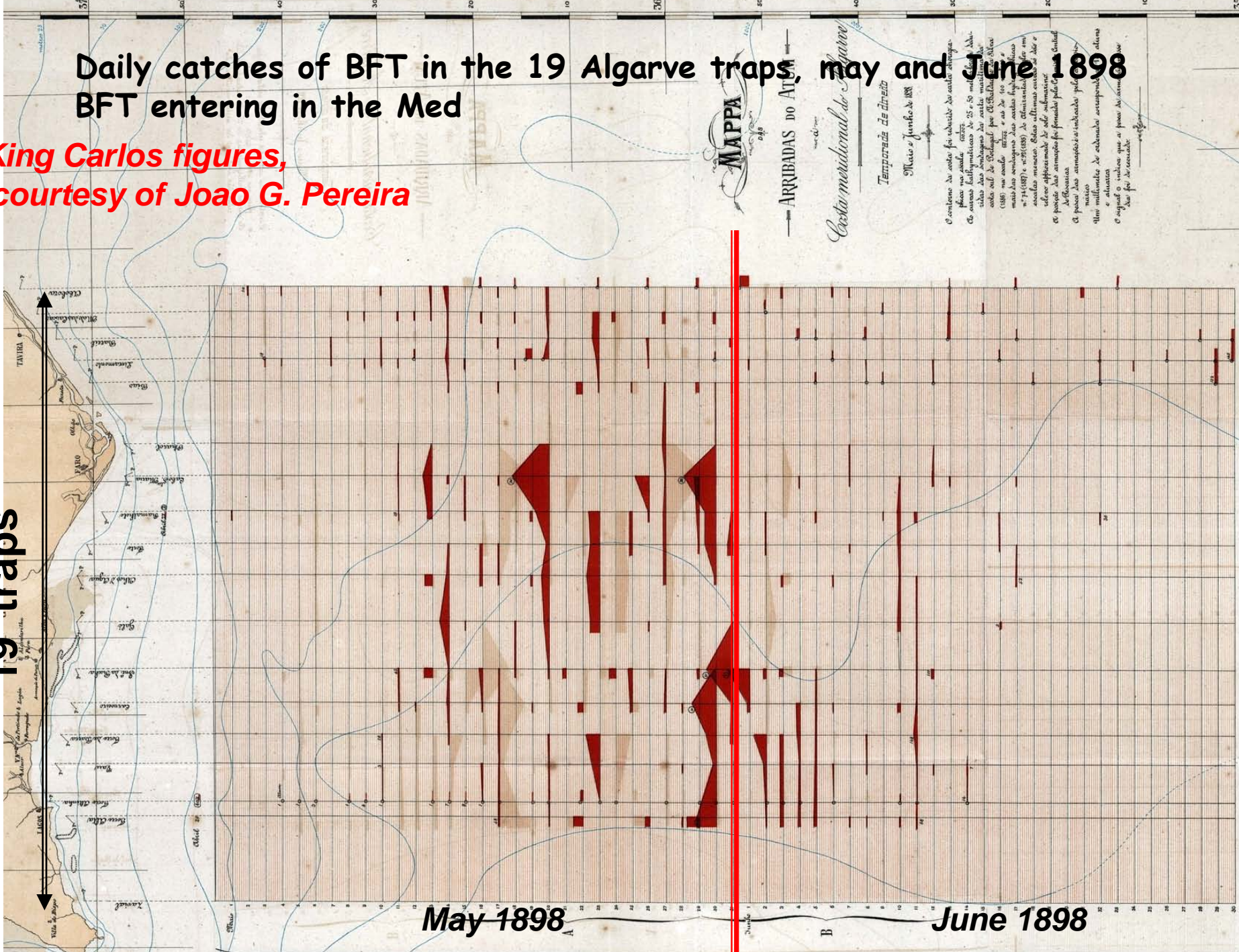


# Daily catches of BFT in the 19 Algarve traps, may and June 1898

## BFT entering in the Med

King Carlos figures,  
courtesy of Joao G. Pereira

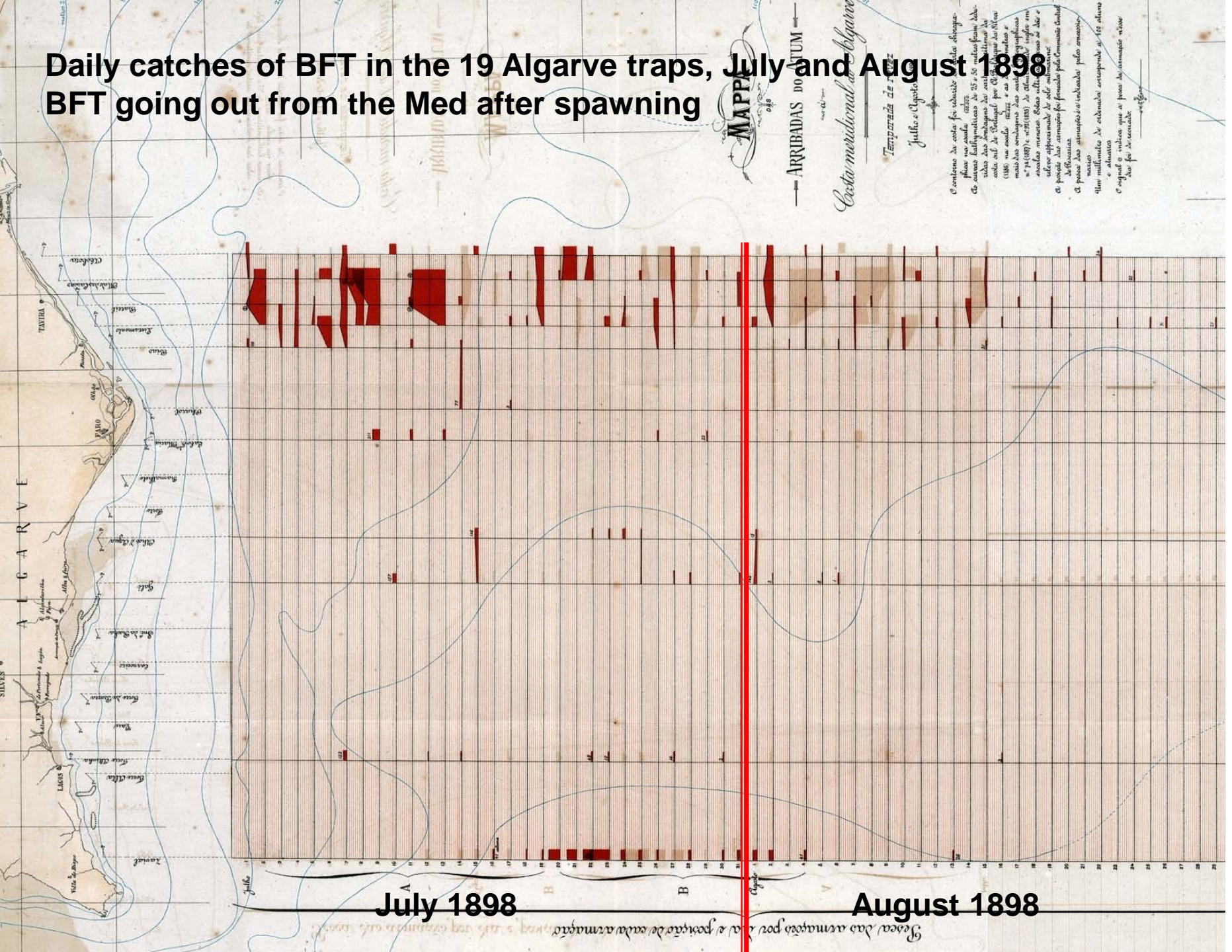
19 traps



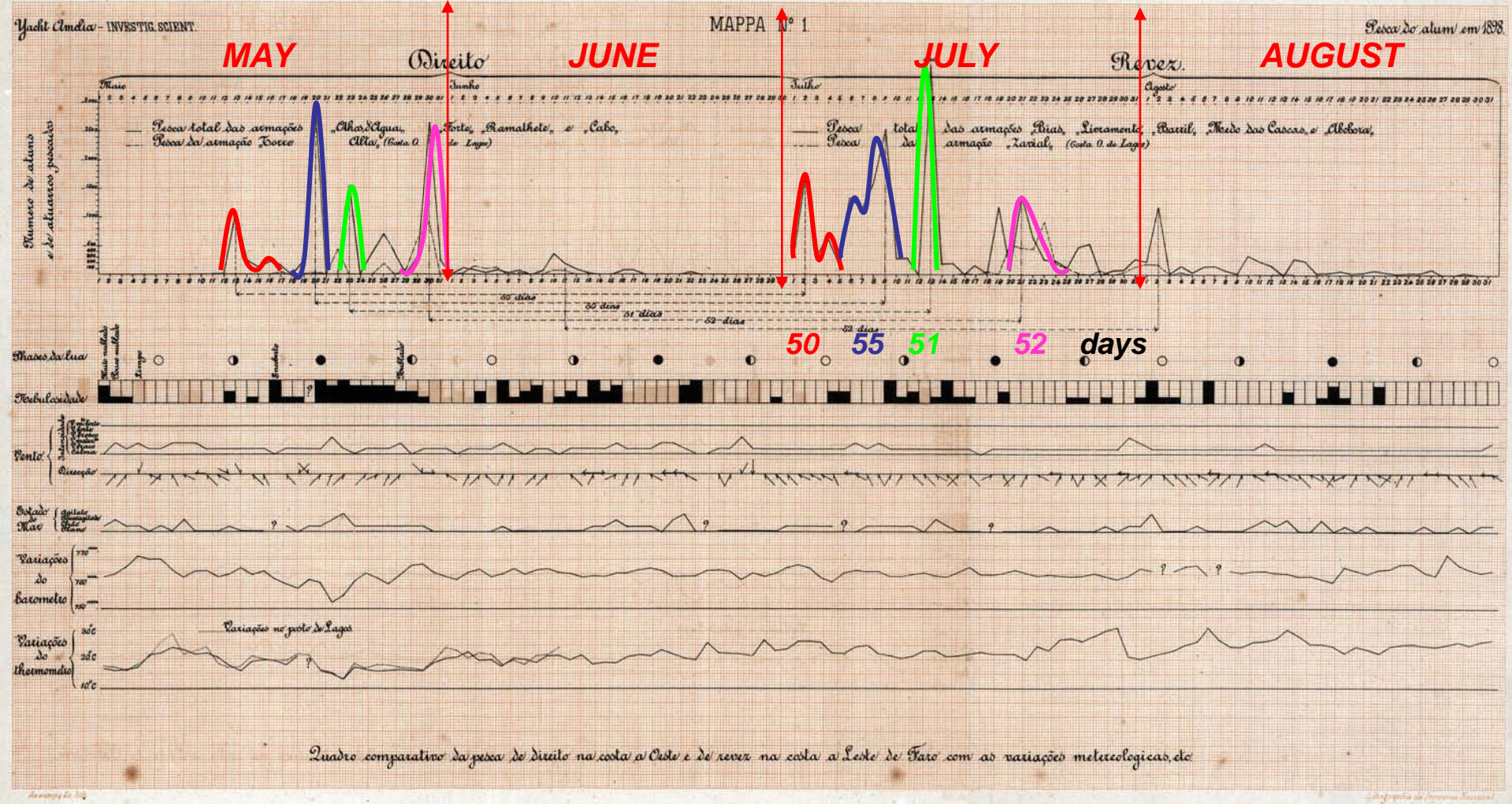


# Daily catches of BFT in the 19 Algarve traps, July and August 1898

## BFT going out from the Med after spawning







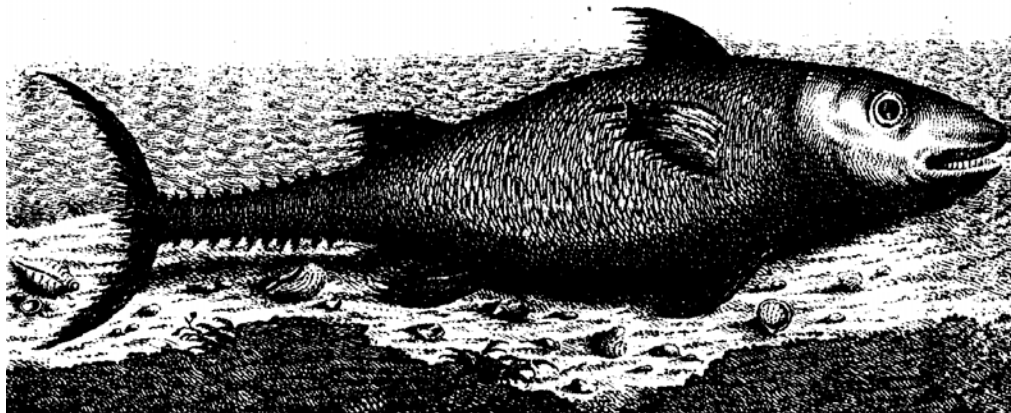
Each group of entering BFT has been identified in its migration IN&Out the Med:  
The average duration of the spawning migration was estimated at 52 days.

These valuable scientific trap data collected by King Don Carlos are still kept in Lisbon: Comprehensive data mining of this data set will be done by Fonteneau in June 2011



# Stock structure of Mediterranean Bluefin: a highly migratory, but also a viscous stock (probably) !

- Bluefin tuna: a paradox of an highly migratory species, moving within only one month between the Med and Norway, but also and surprisingly, probably a highly viscous resource...
- Large fractions of the adult stock would be + or - permanently resident in given areas, or doing very limited movements in areas such as Libya, Corsica or the Eastern basin of the Mediterranean Sea.
- Such concept of viscosity is the opposite of an highly migratory stock, but it seems to be a valid one for bluefin; keeping in mind, of course, that other fractions of stocks are doing large scale geographical migrations, for instance towards the North Sea and Norway, North America or Iceland.
- If this concept that significant fractions of stock are resident in the Mediterranean sea, for instance off Libya, there is a serious risk that such « cryptic biomass » of adults, now vanishing, have been playing in the past an important role in the success of bluefin reproduction.



This mixture of highly viscous and highly migratory bluefin tunas in the Mediterranean Sea has been envisaged & accepted by scientists for centuries



Photos Barbaroux IFREMER

# A complex stock structure of Mediterranean bluefin that has been well accepted by scientists for centuries

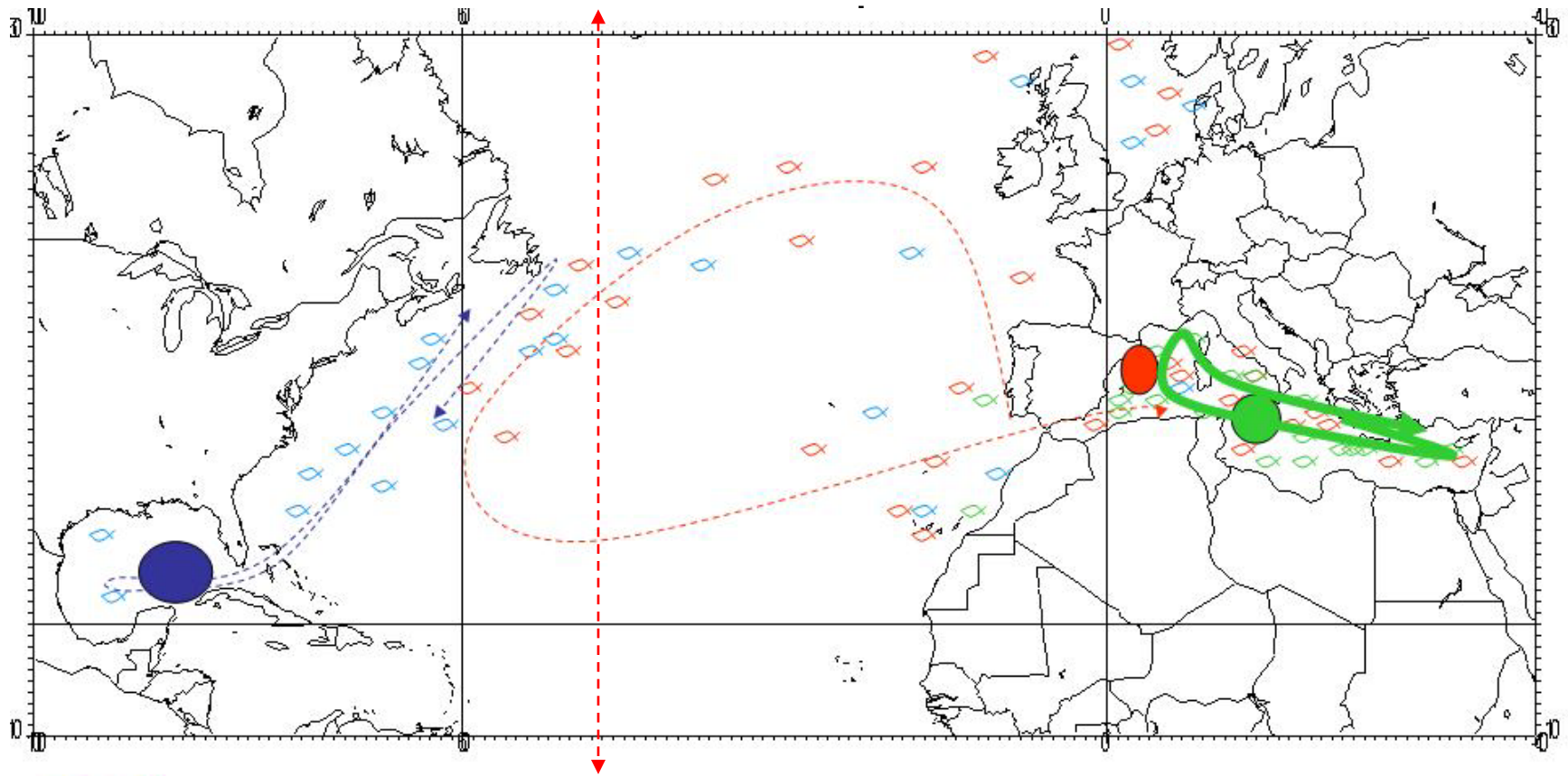
- 1777: Cetti identifies BFT spawning off Sardinia and concluded that some BFT stay all year round in the Med. »Golfitani «
- 1887: Pavesi also concluded that some spawners spend all year round in deep Mediterranean waters
- 1922 Ninni made intensive studies of BFT stock structure in the Med. He believes that the Tyrrhenian BFT were independent of the Adriatic ones., and from the Aegean sea: sub populations? Sub stocks? Also accepts the idea of BFT deep diving during winter.
- 1924: Roule follows the same type of BFT structure hypothesis.
- 1927: Sella doing extensive study of the complex BFT movement
- 1938: Scordia identifies an independent Tyrrheno-Ionian stock, fishes that remain at deep layers after spawning: the sedentary BFT theory
- 1973: Sara sees BFT as being essentially migratory, but that medium BFT would tend to be sedentary for considerable periods & in their own basins



*Greek hook used to catch large BFT 4000 years ago;  
Tuna caught with « lost » hooks have been used by  
scientists in the early twentieth century to study movements*



# Atlantic bluefin: its spawning areas, sub populations, movements and



-  In&Out BFT
-  W BFT
-  Med BFT

North Atlantic BFT

A complex stock structure, Potentially showing various independent subpopulation of tunas



*Fraction of Med stock*

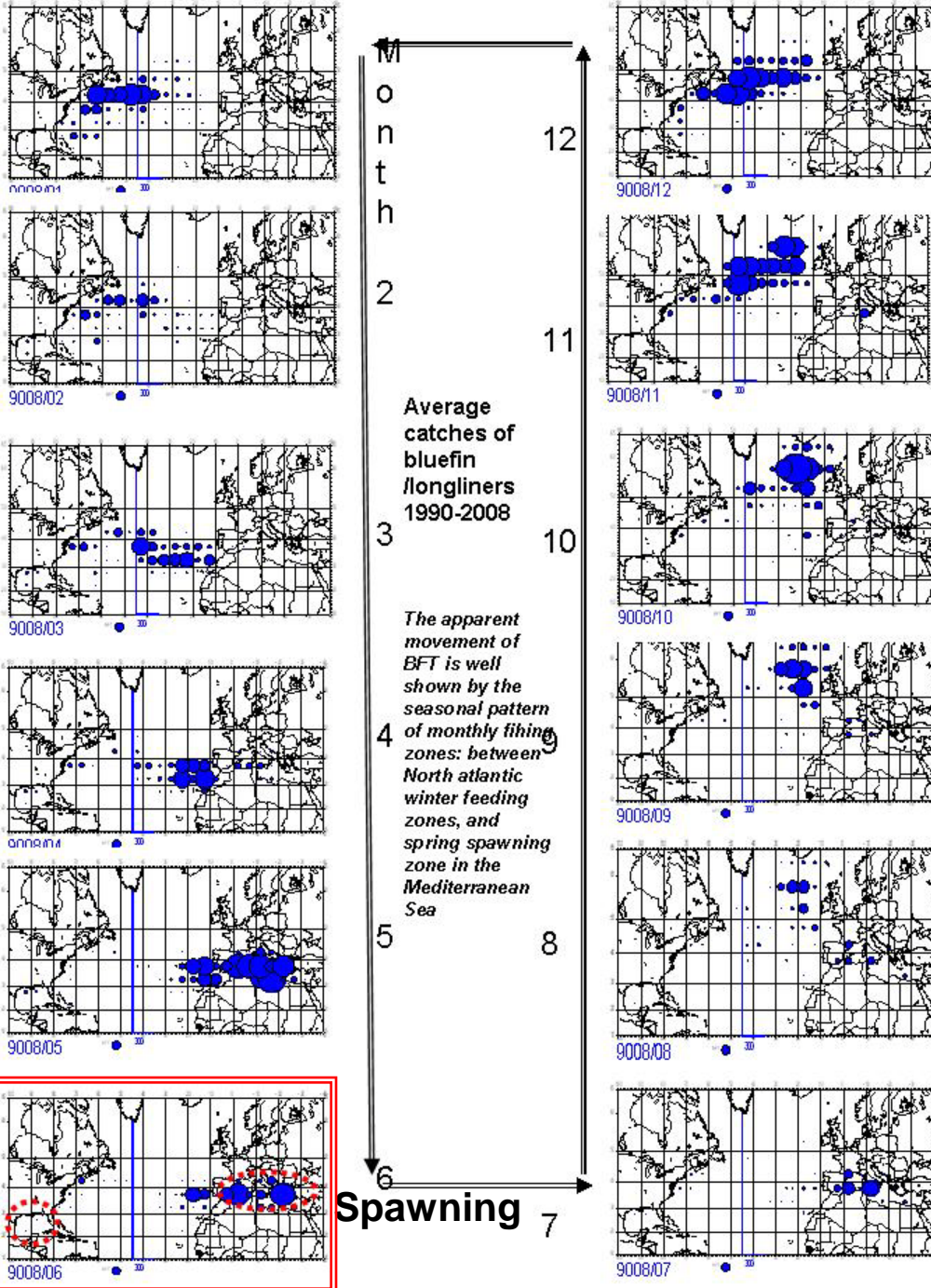
Bluefin tuna migrating seasonally from the Mediterranean Sea and « circulating » in the North Atlantic: permanently followed and targeted by Japanese longliners

A striking monthly migration pattern of the fishery probably corresponding to a real movements of BFT?

Showing:

- the entry of spawning BFT in the Med in April & May
- The output from the Med of post spawning BFT in July and August

*Average monthly catches of BFT by japanese LL 1990-2008*



*A complex stock structure in the Med., well confirmed by recent investigations from electronic tagging: G. Demetrio*

- Obtained 10 years ago on 84 adult bluefin tuna tagged in several places of the Mediterranean and just off the Strait of Gibraltar, between June 1998 and August 2000.
- Detections of the tags occurred in the Mediterranean and eastern Atlantic, with an overall return rate of 32.1%. Among detected tags, 69.6% surfaced in the Mediterranean Sea whereas 30.4% surfaced in the eastern Atlantic Ocean. No transatlantic movements were observed.
- Most bluefin tagged in the area of Corsica, ranging between 40-100 kg, were detected in the western Mediterranean and Tyrrhenian Sea. On the contrary, most of the large bluefin tuna with weight above 150 kg migrated into the Atlantic,
- And also very similar results obtained by Fromentin from his electronic tagging results presented at SCRS 2009.



## A complex and heterogeneous stock structure also confirmed by genetics: Carlsson et al 2004

- Genetic variation was surveyed at nine microsatellite loci and the mitochondrial control region (868 bp) to test for the presence of genetic stock structure in young-of-the-year Atlantic bluefin tuna (*Thunnus thynnus thynnus*) from the Mediterranean Sea.
- Bluefin tuna were sampled over a period of 5 years from the Balearic and Tyrrhenian seas in the western basin of the Mediterranean Sea, and from the southern Ionian Sea in the eastern basin of the Mediterranean Sea.
- Analyses of multilocus microsatellite genotypes and mitochondrial control region sequences revealed no significant heterogeneity among collections taken from the same location in different years;
- Significant spatial genetic heterogeneity was observed across all samples for both microsatellite markers and mitochondrial control region sequences ( $F_{ST} = 0.0023$ ,  $P = 0.038$  and  $\Phi_{ST} = 0.0233$ ,  $P = 0.000$ , respectively).
- Significant genetic differentiation between the Tyrrhenian and Ionian collections was found for both microsatellite and mitochondrial markers ( $F_{ST} = 0.0087$ ,  $P = 0.015$  and  $\Phi_{ST} = 0.0367$ ,  $P = 0.030$ , respectively).
- These results suggest the possibility of a genetically discrete population in the eastern basin of the Mediterranean Sea.

# Studies of Mediterranean contaminants that are typical from the Med can allow to identify BFT from the Med.

Dickhut concluded that:

- Mediterranean Sea is a quite highly contaminated Sea where high densities of pollutants have been accumulating & they will later be accumulated and kept as tracers in the flesh of Medit. BFT
- Organochlorine pesticides and polychlorinated biphenyls (PCBs) can be used as tracers of bluefin tuna foraging grounds in the North Atlantic and confirm that stock mixing of juvenile tuna within the U.S. Mid Atlantic Bight is indeed high (33-83% eastern origin).
- a way to distinguish BFT tunas that are doing 50 days trip >10% of the Mediterranean population is migratory, young bluefin tuna migrating from the Mediterranean to western Atlantic foraging grounds as early as age 1, and then return to the Mediterranean Sea as young as age 5, presumably to breed.
- This method provides a means for distinguishing bluefin tuna populations and ontogenetic shifts in migration in the North Atlantic.
- It could also offers a way to distinguish between adult BFT doing a short spawning trip in&out the Med., from BFT tunas that are + or- permanently resident in the Med.
- Also a potential to update and to validate the historical study by Calaprice 1985 of tuna mixing based on the microcomponents contained in their bones: Strontium and O18

## A logical conclusion by B. Block 2005, still valid today

- « Collaborative studies that combine electronic tagging data, otoliths, microchemistry and genetics should provide a method for validating and quantifying the extent of mixing between the putative stocks (*or sub populations*). »
- Spanish and Moroccan traps could offer ideal tools to develop these investigations (already + or - planned in the present GBYP?), because they offer a unique way to sample BFT that belong to the unknown fraction of stock migrating yearly between the Atlantic and the Mediterranean Sea.
- A quantitatively good knowledge of this migrating fraction of stock is very important to model and to manage Medit BFT since this migrating fraction of the BFT stock may well correspond to a distinct sub population. This migrating fraction of stock would be facing exploitation rates by fisheries that are probably distinct from the viscous stock fraction + or - anchored in the Med.





# Additional scientific quotas given to Traps working as BFT laboratories?

- **It is now essential for tuna science that some Mediterranean traps remain fully active** allowing to monitor (1) traps and the details on their functioning and (2) indirectly Medit BFT stock(s) size:
- **Mediterranean traps** today they are the only case where « peculiar subsidies to a fishery » would be **totally legitimate**.
- With a priority for traps that are able to catch In&Out BFTs from the Mediterranean Sea
- These selected traps should work with a team of **ICCAT tuna scientists working in conjunction with ICCAT program & targeting SCRS investigations**.
- Collecting very detailed statistics, active biological sampling, tissue collection for various analyses (genetics, condition factors, content of pollutants, lipids, gonads), tagging In&Out BFT with electronic tags
- Traps with « ICCAT ROVs » counting & measuring swimming BFT in traps.
- This routine scientific work in traps would help; *inter alia*, to measure the **flow of tuna migrating** from the Med in relation to BFT that are mainly resident in the Med and to analyse all **details in trap functioning**
- In exchange to this new role of « **tuna laboratories & observatories** », the selected traps should obtain from the ICCAT Commission a significant **additional TAC**, part of it being used by scientists (tagging & al), the other part being used by the traps as a compensation for their scientific effort

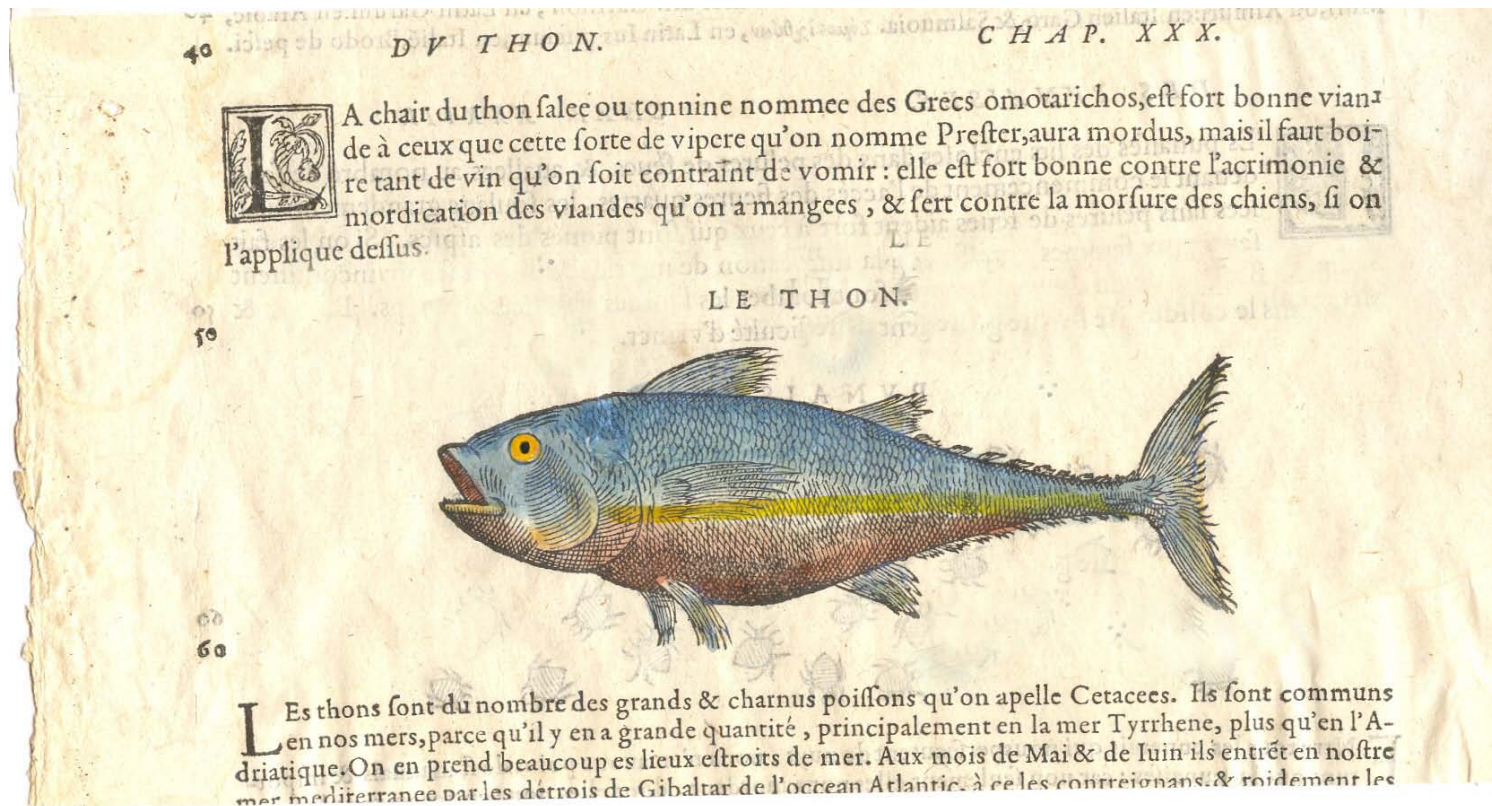
# Conclusion

It is now very important & urgent for ICCAT:

(1) to ensure a durable exploitation of BFT by Medit traps

&

(2) to plan and to organize a durable research program on the BFT caught by these fantastic « scientific observatories »



*Thank you for your attention*