

## MEDITERRANEAN TRAPS IN THE 21<sup>ST</sup> CENTURY: RESEARCH TOOLS FOR THE CONSERVATION OF BLUEFIN TUNA

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### SUMMARY

*This paper discusses the interest which bluefin traps offer to provide scientific information used by ICCAT scientists. There is no doubt that the historical activities of traps have been providing during centuries a wide range of valuable scientific data on the variability of the biological productivity of the stock, on its migration routes and dates, on its spawning seasons and locations, etc. As most of the traps have been targeting bluefin tuna during their migration towards and from their spawning strata, they have been providing valuable information on the various components of the bluefin stocks that are permanently migrating or/and resident in the Mediterranean Sea. This question of the Mediterranean stock structure is considered to be of major potential importance for the conservation of the bluefin stock. However, it appears today that these traps may soon be vanishing because of their high operating costs and their low total allowable catches. The paper concludes that the ICCAT and its member countries should find efficient ways to maintain fully active traps and to transform them in scientific bluefin observatories.*

### RÉSUMÉ

*Cet article se penche sur l'intérêt qu'offrent les madragues de thon rouge pour fournir des informations scientifiques utiles aux scientifiques de l'ICCAT. Il n'y a pas de doutes que les activités historiques des madragues ont déjà fourni un grand nombre d'informations scientifiques de grande valeur, sur la variabilité de la productivité biologique du stock, sur ses voies migratoires et ses dates de migrations, sur les dates et les saisons de ponte, etc. Comme la plupart des madragues ciblaient les thons rouges pendant leurs migrations de ponte, elles ont fourni des informations intéressantes sur les diverses fractions de stock de thons rouges résidentes en Méditerranée, et celles qui migrent en permanence. Cette question relative à la structure du stock de thon rouge méditerranéen est sans doute d'une grande importance potentielle pour la conservation de la ressource. Toutefois, il apparaît qu'aujourd'hui ces madragues risquent de disparaître sous peu, victimes de leurs coûts élevés et de leurs faibles prises autorisées. Cet article conclut que l'ICCAT et ses pays membres devraient trouver des moyens efficaces pour maintenir des madragues pleinement actives et les transformer en observatoires scientifiques du thon rouge.*

### RESUMEN

*Este documento debate el interés de las almadrabas de atún rojo a la hora de proporcionar información científica útil para los científicos de ICCAT. No hay duda de que las actividades históricas de las almadrabas han estado facilitando durante siglos una amplia gama de datos científicos valiosos sobre la variabilidad de la productividad biológica del stock, sobre sus rutas y fechas de migración, sobre sus temporadas y zonas de desove, etc. Dado que la mayoría de las almadrabas se han dirigido al atún rojo durante su migración hacia y desde sus estratos de desove, han estado facilitando información valiosa sobre los diversos componentes de los stocks de atún rojo que permanentemente migran hacia el Mediterráneo o residen en él. Este tema de la estructura del stock del Mediterráneo se considera de gran importancia para la conservación del stock de atún rojo. Sin embargo, actualmente parece que estas almadrabas podrían desaparecer pronto debido a sus elevados costes operativos y a su escaso total admisible de capturas. Este documento concluye que ICCAT y sus países miembros deberían encontrar formas eficaces de mantener las almadrabas plenamente activas y transformarlas en observatorios científicos de atún rojo.*

### KEYWORDS

*Bluefin, traps fishing, fisheries, population structure*

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## 1. Introduction

This paper is a summary of the overview conference presented at the ICCAT Tanger symposium on traps discussing the scientific interest of traps for the assessment and monitoring of bluefin resources in the North Atlantic and Mediterranean Sea. There has been a very long history, more than 2 millenia, of coastal fishing activities actively targeting bluefin tunas by beach nets and traps. These coastal fishing activities of bluefin have been also well studied by scientists during thousands of years and fruitful active scientific investigations have been conducted on bluefin caught by traps during centuries in Italy, Spain, Portugal, Morocco, etc...Recent historical analysis also made of valuable data recovery and synthesis of these trap fisheries and their use for science.

However, now in 2011 traps are an « endangered gear »: because of their high operational cost and to their low bluefin catches, due to a combination of reduced stock and to their reduced total allowable catches (TAC) recently fixed by ICCAT. Traps have been catching during centuries a high level of bluefin catches between 10000 and 20000 tons yearly, and their catches are now steadily declining (**Figure 1**).

The goal of the conference was to discuss why bluefin scientists and ICCAT should maintain trap fisheries in the future, because they are a very safe and ideal gear to monitor the bluefin stock.

## 2. Bluefin tuna: complex and variable movement patterns, between Mediterranean Sea and North Atlantic

All stock assessment analysis conducted today by SCRS scientists are based on the hypothesis of a unique and totally mixing stock of bluefin in the Eastern Atlantic and Mediterranean Sea. However, this hypothesis of a fully mixing stock is quite questionable; when some components of this stock are clearly “highly migratory” and permanently moving between the North Atlantic and Mediterranean Sea, large fractions of the stock are probably viscous ones, being plus or minus permanently resident in the Mediterranean Sea. In this hypothesis, large fractions of the adult stock would be more or less permanently resident in given areas, or doing very limited movements in areas such as Libya, Corsica or the Eastern basin of the Mediterranean Sea. 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.

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.

The immediate interest of trap fisheries is that, during centuries, and still today, they have been probably targeting both fractions of the bluefin stock: viscous and migrating ones. Consequently they are, at least potentially, a major source of scientific information in order to better analyse this major heterogeneity in the bluefin stock structure.

In fact, this rather “strange” mixture of highly viscous and highly migratory bluefin tunas in the Mediterranean Sea has been widely envisaged and well accepted by many scientists for centuries, inter alia by Cetti who concluded in 1777 that some bluefin stay all year round in the Med. , and spawning off Sardinia (»Golfitani »). Similar conclusion was reached by Pavesi 1897, when he concluded that some spawners spend all year round in deep Mediterranean waters. Ninni in 1922 also accepted the idea that adult bluefin were staying and deep diving in the Mediterranean Sea during winter (Tyrrhenian bluefin being independent of the Adriatic ones and from the Aegean Sea). Roule 1924 as well as Sella 1927 and Scordia 1938 also accepted this same type of bluefin structure hypothesis with various fractions of viscous bluefin stocks living plus or minus permanently in the Mediterranean Sea.

It appears nowadays that this complex stock structure in the Mediterranean Sea has been also well confirmed by electronic tagging: 12 years ago on 84 adult bluefin tuna tagged by De Metrio et al 2002 and following tagging cruises in several places of the Mediterranean and just off the Strait of Gibraltar, 69.6% of the detected tags surfaced in the Mediterranean Sea whereas 30.4% surfaced in the eastern Atlantic Ocean. More recently Fromentin 2009 obtained similar results from his electronic tagging results.

This complex and heterogeneous stock structure has been also confirmed to some extent by Carlsson et al 2004 and his work in genetics suggesting the possibility of a genetically discrete sub population of bluefin tuna in the eastern basin of the Mediterranean Sea.

In such scientific context, the following conclusion developed by B. Block 2005 would be fully valid today at the scales of the Mediterranean Sea and eastern Atlantic:

*« 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). »*

However and on the other side, there is no doubt that large fractions of the bluefin stock are also moving each year in and out the Mediterranean Sea by the Gibraltar straight: juvenile bluefin moving out the Mediterranean Sea and adult bluefin doing yearly spawning migration towards and from the Med. This typical yearly migration of these adult bluefin has been exploited by various coastal fisheries and by some traps during millenniums (since the Phoenician times, several centuries before JC). These bluefin migrations are also visible in the seasonal catches taken by traps outside the Med (in Morocco, Portugal and Spain), and inside the Mediterranean Sea. The trap data strongly show the entry of spawning bluefin in the Med in May, and the output from the Med of post spawning bluefin in July and early August (**Figure 2**).

This migration has been also well tracked to some extent during at least the last 20 years by Japanese longliners, see figure 2: adult Bluefin tuna migrating seasonally from the Mediterranean Sea and « migrating » in the North Atlantic are permanently followed and targeted by Japanese longliners, and apparently following a stable migratory pathway since the early nineties.

### **3. Major scientific results already obtained on bluefin by Mediterranean traps (and associated coastal nets used in historical times)**

The analysis of historical trap data has been already highly positive in term of its scientific outputs. Among the most valuable results of these analyses, the following two are noteworthy:

- Studies of historical traps by Ravier and Fromentin 2002: Their very successful data mining allowing to recover and to analyze centuries of yearly catches from multiple Mediterranean traps. This analysis has been showing significant natural variation in the abundance of the Mediterranean bluefin stock, their conclusion being that the bluefin stock productivity and its corresponding virgin biomass are variable over time, being driven by environmental cycles.
- 1898 investigations by Don Carlos de Braganza, King of Portugal on the Algarve traps. These investigations were mainly based on a detailed analysis of the daily catches taken by the 18 Algarve traps then active in Portugal, traps that were fishing bluefin entering to spawn in the Mediterranean Sea (mainly in May) and bluefin going out from the Med. (mainly in July). This analysis has been showing the detailed movement patterns, dates and trajectories of these 2 migration flows of bluefin. The average duration of the spawning migration was estimated at 52 days. These conclusions have been widely reinforced by the recovery and the analysis of the daily data recovered by King Don Carlos during the years 1898-1900 (**Figure 3**). Further data mining of historical daily catch and effort data from traps should be widely promoted by the ICCAT, as these results obtained in the nineteenth century would be still today of major scientific interest.

Trap fisheries located west of Gibraltar and in the Mediterranean Sea could easily be the ideal tools allowing to sample these various subpopulations of viscous and migratory bluefin. A quantitatively good knowledge of this migrating fraction of stock would be very important to better model and to manage Mediterranean bluefin, since this migrating fraction of the bluefin stock may well correspond to distinct sub populations. 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.

- Trap fisheries should also allow conducting a biological sampling of adult bluefin migrating towards and from the Med: genetics, condition factors, Mediterranean pollutants, spawning potential, etc. Traps should also be very useful allowing tagging adult bluefin with electronic tags during their migration towards the Atlantic (Cort).

#### 4. Future of bluefin traps?

Taking these facts into account: (1) that traps are only a minor source of fishing mortality (compared to purse seiners) on the bluefin stock, (2) that this gear is mainly catching the adult bluefin, i.e. at ideal sizes in term of yield per recruit) and (3) that this gear can provide a wide range of scientific data allowing to better model and manage the resource, it should be concluded that it is essential for ICCAT work that some Mediterranean traps remain fully active allowing to monitor (1) traps and the details on their functioning and (2) indirectly Mediterranean bluefin stock(s) size.

It would be a disgrace for ICCAT and for its concerned member countries to put an end to trap fisheries, after several centuries of activities. Furthermore, if the ICCAT want to obtain the best scientific results and best monitoring of the migrating bluefin, the ICCAT should find ways to maintain the activity of traps during their entire fishing seasons, independently of their TACs. A priority could be given to traps that are able to catch bluefin during their migration towards and from the Mediterranean Sea, as they provide additional information on the migratory fraction of the stock (exploited in the North Atlantic). These selected traps should work in cooperation with a team of tuna scientists working in conjunction with ICCAT program & targeting SCRS investigations: collecting very detailed statistics, doing active biological sampling, tissue collection for various analyses (genetics, condition factors, content of pollutants, lipids, gonads), and tagging bluefin with electronic tags. These traps could also be equipped with underwater cameras and « ICCAT ROVs », counting & measuring swimming bluefin 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 bluefin 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 and from the concerned fishing nations, a significant additional TAC, part of it being used by scientists (for tagging & other scientific sampling), the other part being used by the traps as a compensation for their scientific effort. It should easily be considered that today, Mediterranean traps are the only case where « peculiar subsidies to a fishery » would be totally legitimate in order to keep them fully active as ICCAT scientific “bluefin observatories”.

#### 5. Conclusion

It is now very important and urgent for ICCAT to:

- 1) Ensure a durable exploitation of bluefin by traps inside and outside the Mediterranean Sea; and
- 2) Plan and organize a durable ICCAT research program on the bluefin caught by these fantastic « scientific observatories ». These results would be of invaluable scientific interest, especially to estimate what fractions of the bluefin stock are resident in the Mediterranean Sea and/or spending only 52 days of their yearly spawning migration in this area. This uncertainty in the bluefin stock structure has never been envisaged by the ICCAT scientists in their stock assessment models, when this question could be of major importance in the conservation of the resource.

The ICCAT member countries concerned by these prospects (mainly Italy, Spain, Morocco, Tunisia and Portugal) and the ICCAT (SCRS and Commission) should urgently take all the necessary actions ensuring the maintenance of traps and ensuring their full scientific efficiency and the full access of these data to ICCAT scientists.

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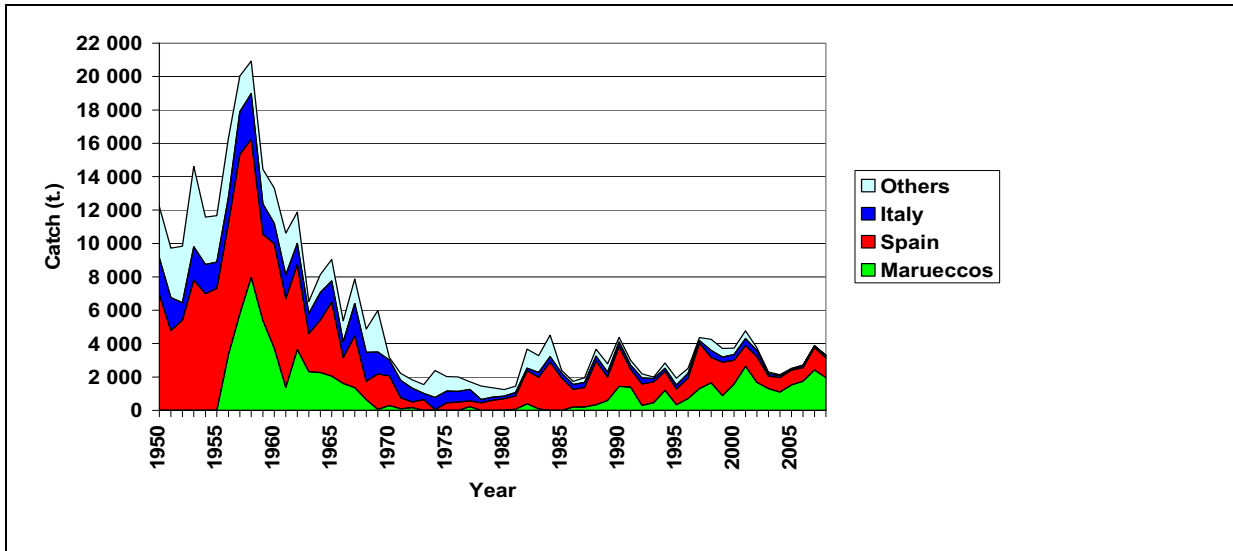


Figure 1. Yearly catches of bluefin by traps, by country, since 1950.

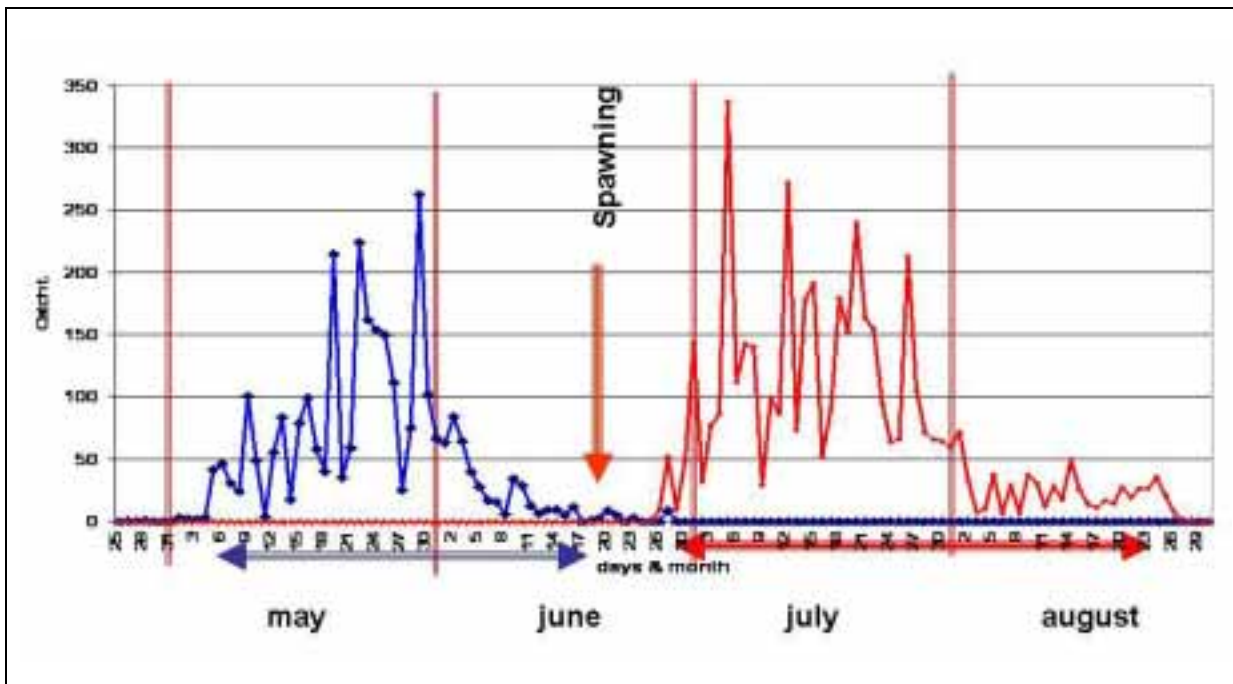
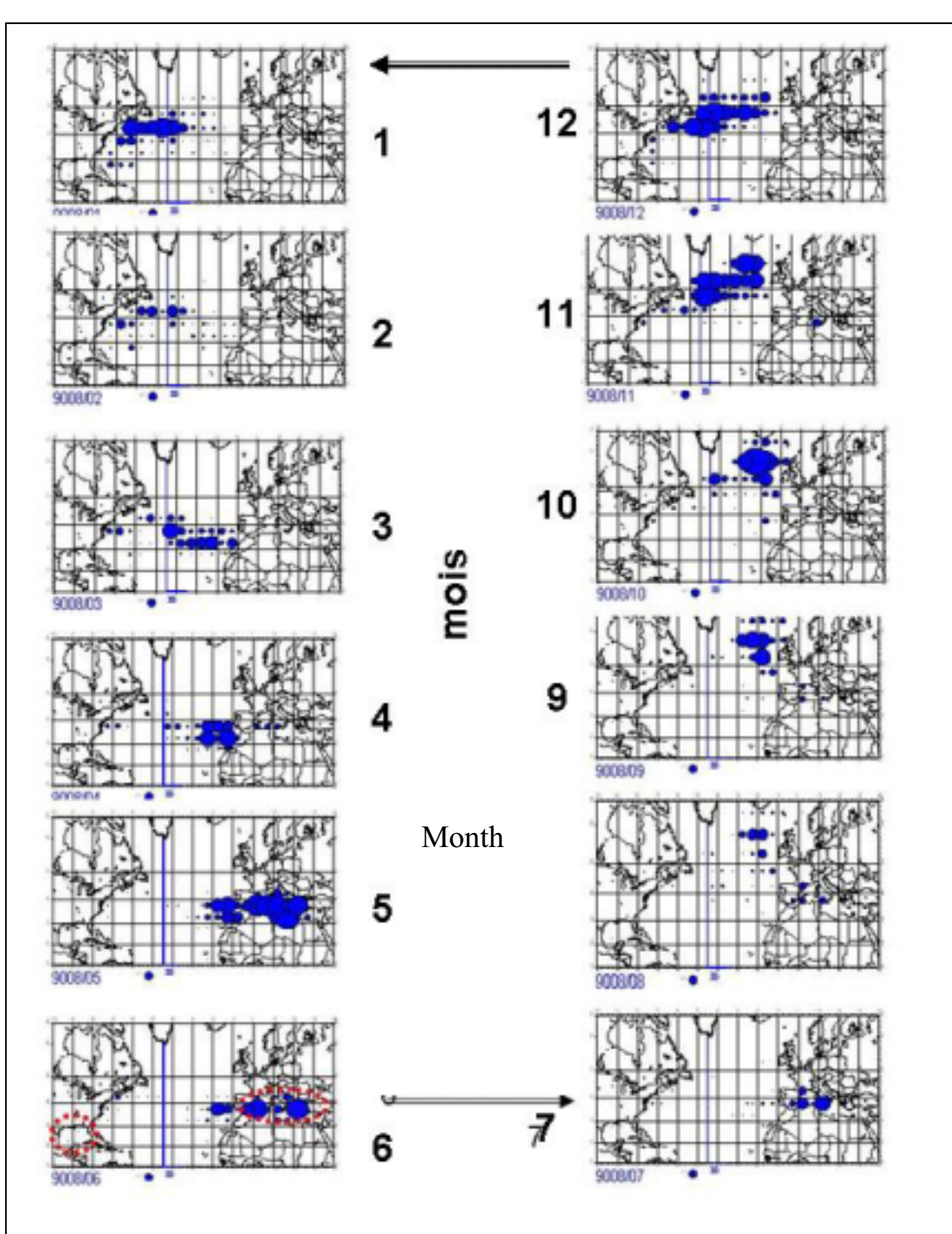


Figure 2. Daily catches observed in the Algarve traps during the 1898-1900 period, taken on bluefin migrating toward the Mediterranean Sea and from the Mediterranean Sea.



**Figure 3.** Average monthly catches of bluefin by Japanese longliners in the Atlantic and Mediterranean Sea during the 1990-2008 period.



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