# The Atlantic bluefin tuna: A global perspective

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**SUMMARY –** This communication presents a global overview of Atlantic bluefin tuna biology, exploitation and management. The comparison between bluefin tuna and all other tuna species do show that this species is ranking number one among other tunas world wide in a wide range of its resources and fisheries characteristics. Bluefin tuna is for instance the gold winner in the category of fisheries (about 10,000 years of documented fisheries, the highest price in the market, the largest tuna taken), of its peculiar biology (large migration, homing, growth, etc.) and in the category of risks presently faced by the resource, because of its multiple scientific uncertainties still pending, its increasingly serious statistical problems and the heavy political context in the management of the stocks.

**Key words:** Fisheries, sustainability, overfishing, migration, life history trait.

***RESUME –*** *"Le thon rouge de l'Atlantique : Perspective globale". Cette communication présente un aperçu global de la biologie du thon rouge de l'Atlantique, de son exploitation et de sa gestion. La comparaison entre le thon rouge et toutes les autres espèces de thonidés montre que cette espèce se situe mondialement au premier rang parmi les autres thonidés pour un grand nombre de caractéristiques comme ressource et comme pêcherie. Le thon rouge détient par exemple la première place en matière de fonds de pêche (environ 10 000 années de pêche documentée, le plus haut prix du marché, le plus grand thon capturé), par sa biologie particulière (grandes migrations reproductives, croissance, etc.) et actuellement dans la catégorie des ressources à risque, en raison des multiples incertitudes scientifiques non encore résolues, des problèmes statistiques de plus en plus sérieux le concernant, et du contexte politique controversé concernant la gestion de ses stocks.*

***Mots-clés :*** *Pêche, durabilité, pêche abusive, migration, caractéristique du cycle vital.*

Bluefin tuna (BFT) is a species which has been extensively studied for centuries by multiple persons (from Aristotle to the king Don Carlos of Portugal during the nineteenth century) and international teams of scientists (e.g. Aristotle, IV$^{th}$ BC; Sella, 1929; Rodriguez-Roda, 1964; Mather *et al.*, 1995). Among other research, the very spectacular and successful recent development of archival and pop-up tags on bluefin tunas should be noted as a major progress in fishery science (e.g. Lutcavage *et al.,* 1999; Block *et al.*, 2001). Migration of the three bluefin population world wide (Atlantic BFT: *Thunnus thynnus thynnus*; Southern BFT: *Thunnus macoyii;* and Pacific BFT: *Thunnus thynnus orientalis*) are quite similar. BFT displayed very large migration patterns between small spawning strata (located in warm waters) and large feeding zones (located primarily in cold waters and reaching sub-polar areas, see e.g. Mather *et al.*, 1995; Polovina, 1996; Gunn and Block, 2001). These migration patterns probably imply a homing behaviour, allowing each individual adult bluefin to target in due time its precise spawning strata.

Surprisingly and despite of this active research, many serious mysteries remain upon this species. For instance the stock structure itself and the mixing rates between the Eastern and Western Atlantic is still poorly known or quantified (ICCAT, 2001). Furthermore, BFT migrations seem to vary between years and some fractions of the population may be quite sedentary in some areas (Block *et al.,* 2001; Fromentin, 2002a). Among the other major problems still pending for the Atlantic BFT, the once major North Sea BFT fishery as well as its sudden collapse in the 1960's still remain poorly understood (Tiews, 1978). In parallel, the BFT fishery which took large quantities of giant bluefin tunas in the warm waters of Brazil during the early sixties also remains a mystery. More recently, the surprising migration patterns off Bermuda shown by several pop-up tags were hard to understand.

Another category in which bluefin tuna is a definite winner will be of course the value of this species in the Japanese sashimi market. However, it should be kept in mind that this rocketing price of bluefin in the Japanese sashimi market has been observed only after the development of deep

freezing, e.g. during the seventies. This present high value of bluefin is an increasing problem, recently worsened by farming, as it allows the BFT fisheries to make profit in this fishery even at low levels of biomass. It term of exploitation, it appears that Atlantic BFT stocks are also probably facing nowadays the worst risk of overfishing, a risk which was already demonstrated for the Southern BFT in the 1980's. The recovery of such long lived species is slow and takes many years. Concerning bluefin tuna stocks, one should also keep in mind the potential risk of genetic erosion due to overfishing. As the stock may be built with various sub-populations (each one with its own given spawning strata and peculiar genome), the overfishing may tend to eliminate some of the more fragile (or more easily caught) populations. In such a case, the overfishing may have irreversible effects on the short term productivity of the stock.

BFT fishery has also among the longest fishery history (Doumenge, 1998). The first evidences indicated that BFT was caught in the Mediterranean Sea seven thousand years before Christ. In the Antiquity, especially during Roman time, BFT fishery was an intensive activity (the most common gears being hand line and large beach seine). At the end of the Middle-Age, the first traps appeared in the Mediterranean Sea and became progressively dominant. The analysis of the trap data from the XVI$^{th}$ to the XX$^{th}$ centuries showed that the historical total catch over the Western Mediterranean and Gibraltar area, was estimated in average about 15,000 tonnes/year (Ravier and Fromentin, 2002). Furthermore, catches displayed long-term fluctuations of about 100-120 years that were synchronous between all the different locations and countries (Ravier and Fromentin, 2001). Whatever the origin (e.g., changes in recruitment and biomass or in migration patterns), these fluctuations suggest that the size of the stock varies over time (BFT stock could be more productive in some periods than others). On a fisheries point of view, this means that the biological reference points, such as the Maximum Sustainable Yield, and so the quotas, should also change over time in relation to the productivity of the stock (Ravier and Fromentin, 2001).

Considering the Atlantic BFT, two major events occur during the last two centuries. Firstly the appearance of a baitboat fishery in the Bay of Biscay in the mid-XIX$^{th}$ century. Secondly the development of long liner and purse seiner fisheries, in the North Atlantic and the Mediterranean Sea during the second part of the XX$^{th}$ century (e.g. Farrugio, 1981). In the last decade, catches reached an historical level of about 50,000 tonnes, which is about two to three times larger than catches taken by the trap fisheries or the Nordic fisheries (ICCAT, 1999). Despite various uncertainties that we mentioned before, ICCAT scientists have concluded, on the basis of modelling studies, that these large catches are not sustainable (ICCAT, 1999). To understand better this diagnosis, it is worthwhile to look at two other gold medals: one related to BFT life history and the other to the political context.

Atlantic BFT is indeed an impressive fish in size (larger than 3 m and 600 kg), in longevity (can live over 20 years) and in fecundity (up to 45,000,000 eggs/female). It has among the most efficient endothermy and can keep its body temperature around 20-25°C within a wide range of water temperatures (between 5°C and 30°C). It is also an impressive swimmer that can cross the Atlantic within 50 days (Lutcavage *et al.*, 2000). However, BFT life history has also some weak points. The major ones are: a late age-at-maturity, a short spawning season and a relative slow juvenile growth (Fromentin and Fonteneau, 2001). This is very different from the life history traits of a tropical tuna, such as the skipjack, which is small, has an early age-at-maturity, a continuous spawning all over the year and a rapid growth. These differences make BFT more fragile to exploitation than tropical tunas (Fromentin and Fonteneau, 2001). Because short live species (tropical tunas) are more productive and have a higher population turn-over, they are indeed more resistant to exploitation than long-lived species (BFT). Furthermore, the long-term fluctuations in BFT stock and yields make more difficult to detect overfishing and depletion risks. Finally, the occurrence of fishing on juveniles also reinforces the fragility of BFT to exploitation because it greatly increases the risk of recruitment overfishing (Fromentin and Fonteneau, 2001). Fishing BFT juveniles is thus a bad strategy, on both a fisheries (i.e. less productive) and conservation viewpoints and current measures on size limit should be better controlled and reinforced.

The second gold medal that makes bluefin more fragile to exploitation is related to the fact that bluefin is an emblematic example of a shared stock and this creates a tricky political context (Fromentin, 2002b). Along its yearly migration pattern, a bluefin tuna can be caught by many different fisheries, such as the Canadian, Croatian, French, Greek, Italian, Japanese, Libyan, Moroccan, Portuguese, Spanish, Tunisian, Turkish and US fleets. Because of this highly migratory pattern, bluefin assessment and management cannot be local or even regional. It can only be made at the

scale of the whole North Atlantic (including the Mediterranean Sea), so at an international level. This is actually done by ICCAT and its scientific committee that evaluates the bluefin tuna stock every 2 years since the late seventies. The assessment is based on an age-structure population model, which uses catch and fishing effort data from all the countries to estimate the whole population size. Then, the committee evaluates whether the present stock size is upper or under the sustainable level (see ICCAT, 1999). If it is under, then a catch limit is recommended and the commission implements a TAC, which is the case since 1996. Other management measures have been also implemented, such as a size limit (at 6.4 kg, i.e. 2 years), a closure season and a measure about the planes used to locate tuna schools.

However, the scientific committee has serious concerns about the quality of the official catch data (ICCAT, 2001). Firstly, because of the poor reporting by the non-ICCAT member countries and of the illegal fishing (concerning mainly very young fish, <1 year old). Secondly, because of the increasing under-reporting of the ICCAT-members. The situation of 1998 perfectly illustrated this problem. At this time, the European Community became a contracting party of ICCAT. The new and old European members asked for a revision of the statistics. This request was actually due to the implementation of a TAC two years before and to the fact that the quotas are proportional to the historical catches. Not surprisingly, this revision lead to an 20% increase of the total catches, demonstrating that the official statistics of the contracting parties were and/or are doubtful (Fromentin, 2002b). The present situation has not been improved and the official catches reported to ICCAT (especially those of the three last years) are likely to be widely underestimated (ICCAT, 2001). Furthermore, some information has been recently lost due to the caging system, because the number, size, weight and origin of fish going into cages are rarely transmitted to ICCAT.

In conclusion, BFT is a fascinating animal and this is really the fish of all the awards. However, we still lack a sufficient knowledge about some major biological and ecological processes. Therefore, there is an urgent need of more active international scientific research programs, such as large-scale tagging experiments, modelling works, scientific surveys, studies on genetic, fingerprint and about the impact of the environmental variations. However, the main challenge for the conservation and management of this stock is nowadays more political than scientific. The priority is indeed to get accurate and trustworthy fisheries information and a real control of the statistics and the current management measures.

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