

# The Eastern Atlantic Bluefin Tuna: Fast Crash and Swift Recovery for the Ferrari of the Ocean?

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SNF





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## Abstract

The Eastern Atlantic and Mediterranean Bluefin tuna tastes delicious. Naturally, the Japanese sashimi market fights over this high value fish. Unfortunately, this moneymaking resource has been overfished since the 1970s due to its' wide geographical spread and high sea open access characteristic, which means over 25 countries sought to capture it. This cumulated in near extinction of the species in the mid-2000s. The organisation in charge of managing the stock, the International Convention for the Conservation of Atlantic Tuna (ICCAT), established a fifteen-year species recovery plan starting in 2006-2007. The plan includes fishing seasons, gear restrictions, quantity control and strict monitoring of vessels. Ten years into the programme, this project sets out to assess the state of the stock. Quantitative indicators will enable assessing the health of the stock, and qualitative methods will evaluate the managerial success of the recovery programme, in terms of member compliance and caution adopted with regard to the stock. Results of the research show the stock is en-route to recovery. Population indicators are recovering faster than expected. Recommendations, such as educational courses on stock sustainability for fishermen or knowledge-access incentives to comply, will hopefully reach the ICCAT to adapt the programme for the remaining five years.

*Keywords: Bluefin tuna, overfishing, fishery, management and conservation, recovery plan, regional fishery management organisation, ICCAT*



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## LIST OF ACRONYMS

<b>BB</b>	Bait boat
<b>BFT</b>	Bluefin Tuna
<b>CP</b>	Contracting Party
<b>FAO</b>	Food and Agricultural Organisation
<b>FOC</b>	Flag of Convenience
<b>ICCAT</b>	International Commission on the Conservation of the Atlantic Tuna
<b>IUU</b>	Illegal, Unreported and Unregulated
<b>LL</b>	Long line
<b>MCS</b>	Monitoring, Control and Surveillance
<b>MEY</b>	Maximum Economic Yield
<b>MSY</b>	Maximum Sustainable Yield
<b>PS</b>	Purse Seine
<b>PA</b>	Precautionary Approach
<b>RFMO</b>	Regional Fishery Management Organisation
<b>SCRS</b>	Standing Committee on Research and Statistics
<b>SSB</b>	Spawning Stock Biomass
<b>TAC</b>	Total Allowable Catch
<b>TP</b>	Trap
<b>UNCLOS</b>	United Nations Convention on the Laws of the Sea
<b>UNFSA</b>	United Nations Fish Stock Agreement

## I: Introduction

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It was long believed that fish were an infinite resource. Thomas Huxley brought the fisheries science to public attention in his opening address of the London International Fisheries Exhibition in 1883. He underlined that fisheries supplies were of “almost unlimited extent”, but noted the lack of knowledge regarding “the habits, the food, and the mode of propagation of fishes-points” (Huxley, 1883). He questioned “whether fisheries are exhaustible; and if so, whether anything can be done to prevent their exhaustion”. The answer is quite clear nowadays; yes, fisheries are exhaustible, and yes, something can be done to avoid it. The Bluefin tuna species case, focus of this paper, will provide an answer to these questions.

The Bluefin tuna species spreads over a wide geographical area covering the Atlantic, the Pacific and the Indian Ocean. Differences are observable within stocks from different areas. The *Thynnus Thunus*, the Atlantic Bluefin tuna is the focus of this research. The fish lives in waters between four and 25 degrees Celsius. Temperature resilience explains its wide spread. The fish swim from North of Norway, deep into the Mediterranean, down the West African coast, across to the Gulf of Mexico and up to Newfoundland and Labrador waters (Fromentin & Powers, 2005). The torpedo shape of the fish, its size and muscle content makes it one of the fastest swimmers. It travels at a speed reaching 70 km per hour, earning the nickname ‘Ferrari of the ocean’ (Collette & Nauen, 1983). The Bluefin tuna is a pelagic species and migrates through the high seas towards coastal areas for the spawning season between May and July (Aranda, *et al.*, 2013).

In 1969, the International Convention on the Conservation of the Atlantic Tuna (ICCAT) was created. This regional fishery management organisation (RFMO) is responsible for research and development of management advice for the “conservation of tuna and tuna-like species in the Atlantic Ocean and adjacent seas” (ICCAT website). The organisation failed dramatically in its mission, as the stock was victim of ongoing overexploitation from the 1970s until the early 2000s (Fromentin, *et al.*, 2014). Public discontent and NGO campaigns finally turned the tide, and in 2006, the ICCAT started implementing a 15-year recovery programme. The programme included limiting fishing periods, imposing constraints on various gears, and total allowable catches (TACs) (ICCAT, 2007b).

Ten years into the Bluefin tuna recovery programme, this paper aims to assess the current situation of the stock. This research will provide a comprehensive stock update including biological, economic and social variables. The recovery programme will be analysed by pointing out successes and failures, in the hope to provide programme adaptations for the next five years. To do so, the first aim is to assess the stock numerically. Has the programme allowed the stock to rebuild? Data about spawning stock biomass (SSB), catch levels and number of vessels have been compiled and analysed. Another objective is to evaluate the ICCAT management. Is the ICCAT more or less successful than previously, and how come? The study reveals that the recovery programme has allowed the stock to rebuild. Major indicators and population calculations suggest positive trends. The ICCAT management has showed authority in the application of strict rules to conserve the species, leading to the success of the programme.

This paper is organised as follows. The next section reviews the literature and updates stock data, leading onto the third section, the qualitative evaluation of the ICCAT. The fourth section is the analysis section, putting forth recommendations for the next five years. The fifth and final section is the conclusion.

## II: Literature Analysis and Stock Update

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This section will provide an extensive literature analysis and data update. Relevant and impactful details of the literature are analysed, mainly papers from the past 10 years. The literature presents many stock performance indices along with trend predictions. The stock data have thus been integrated to the literature review, allowing a comparison to confirm or rectify estimations.

### 2.1 Methodology for Literature Review and Data Updates

The literature review is an extended search across a variety of sources which allows to locate and examine existing academic literature (Jupp, *et al.*, 2006). The initial scoping phase allowed to filter the sources and determine the extent of literature to be included (Chen, Wang, Lee, *et al.*, 2016). A synthesising exercise was then needed to sort and organise the arguments of the selected literature. Arguments were organised thematically according to main data indices.

Furthermore, as the literature was analysed, data and facts mentioned were simultaneously updated. Current data was added to compare the previous situations with the present. The data comes mainly from the ICCAT's publicly accessible database and personal correspondence with the secretariat. Superposing today's data with past trends and predictions from the literature allows a view of the evolution of the stock and management (Saunders & Rojon, 2011).

### 2.2 Atlantic Tuna Bioeconomics

*Thynnus Thunus* is a large fish which forms part of the pelagic ecosystem of the Northeast Atlantic (Fromentin & Powers, 2005). The Atlantic Bluefin Tuna has been exploited and studied for thousands of years in the East Atlantic. The first evidence of its exploitation dates back to 7,000 BCE. Even Aristotle studied the species with mentions of its seasonal migration (Aristote, 4<sup>th</sup> C. BCE).

#### a. Stock delimitation

Bluefin tuna has the widest geographical distribution of all tunas. Migration is facilitated by its endothermic capacity, which allows the tuna to adapt body temperature so it is always above water temperature (Fromentin & Powers, 2005). The species reaches maturity at four years old with an average size of

110 cm. It can grow up to three m over its 20-40 year life and can weigh over 700 kg (Fromentin & Ravier, 2005).

In a move initially made out of management convenience, the Bluefin tuna stock is legally separated into the Western and the Eastern Atlantic stocks since 1980. The separation is at 45° West, the dotted line on figure 2.1 (Standing Committee on Research and Statistics, SCRS, 1980). The stocks appear to have different spawning sites (the dark grey areas on the figure), different age-at-maturity and low intermigration (arrows on the figure) (Fromentin, n.d.). Stock delimitation is an ongoing debate. Some suggest a “collection of discrete local populations, occupying distinct and patchy suitable habitats but with a degree of demographic influence [...] through dispersal” (Kritzer & Sale, 2004). Others believe in a metapopulation due to rates of trans-Atlantic migration between 1-7% from the 1960s to the 1990s (Fromentin & Powers, 2005). This study will focus on the Eastern Atlantic and Mediterranean stock.



**Figure 2.1:** Atlantic Bluefin tuna Spatial Distribution (Fromentin & Powers, 2005)

### *b. Capital theory*

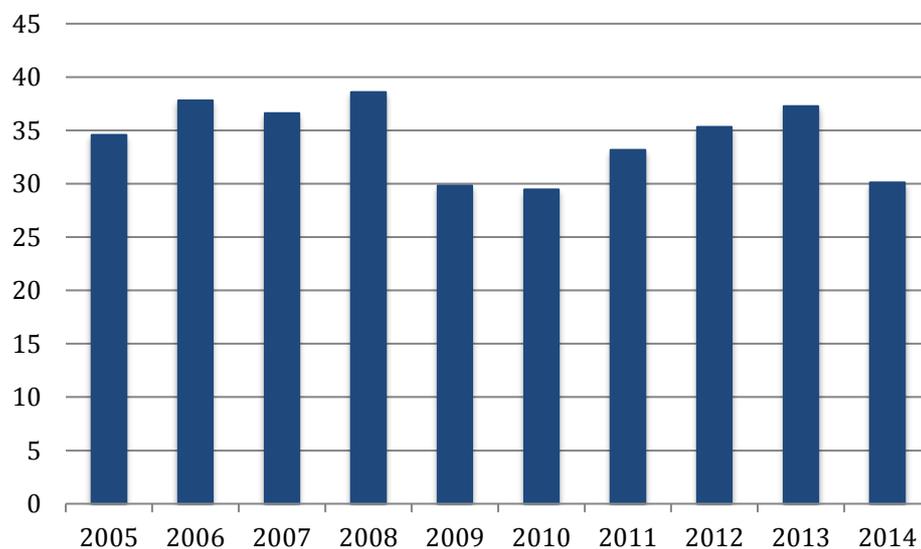
Scott (1955) was the first to apply capital theory to natural resource management. A fish stock is natural capital facing problems of management over time. Fish stocks of the high seas, defined as open waters that are not within any country’s Exclusive Economic Zone, are subject to pure open access making them the world’s biggest common resource. Competition leads to stock depletion and overallocation of resources with a short term focus, regardless of ecological limits (Bjørndal & Munro, 2012). Upon experiencing a reduction of Southern Bluefin tuna catch in the 1980s, the Japanese sashimi

market turned to Northeast Bluefin, increasing demand dramatically. This has made it one of the most valuable species (Fromentin, 2013). The constant quest to maximise surplus value has led to the development of new fishing methods (Samuel, 2013). Capital and technology intensive methods such as radars, sounders, sonars, planes and deep-freezing vessels have resulted in many socio-ecological contradictions. Though profit is momentarily increased, negative impacts can be seen on the marine environment overall.

Ackley (1978) differentiated the notion of *stock*, the optimal stock of capital over time, from *investment*, the optimal rate or flow at which the stock is built up (quoted in Bjørndal & Munro, 2012). With regard to fish, it is the biomass target, set on the basis of dynamic optimisation, and how quickly one should approach it. This is the base to any fishery management programme.

### c. Tuna prices

Bjørndal and Brasao (2006) noticed an increasing tuna price over time. This was explained by the worldwide decline in Bluefin tuna catches. Bluefin tuna price varies with fish size but also gear used to catch it, and the quality measured by fat to weight ratio. Unfortunately, price data publicly available was very limited, so this section should be taken as a case study rather than a general rule. Figure 2.2 shows the average annual price for Bluefin tuna. The price is that of Spanish farmed Bluefin tuna sold in Japan (Globefish, 2016).



**Figure 2.2:** Average Japanese price of Spanish farmed Bluefin tuna in USD per kilo (Source: Globefish, Commodity Update p.9, 2016)

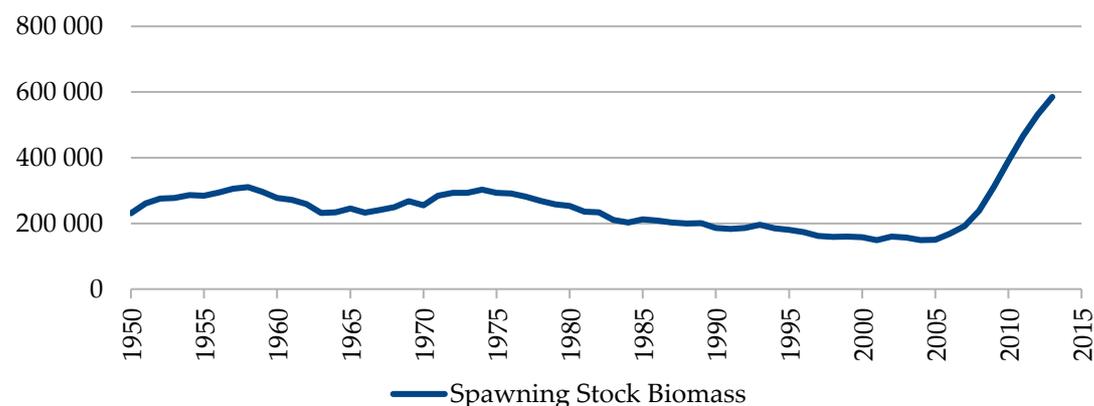
The minimum price for the period is 29.4\$/kg in 2010 and the maximum 38.5\$/kg in 2008. The overall price increase is explained by the recovery programme regulations. With increasing quota restrictions, the fish is more

rare on the market. One of the possible explanations for the 09-10 price drop is the 2009 nomination for listing by Convention on International Trade in Endangered Species (CITES). The listing would have dramatically damaged Bluefin tuna trade, so it is possible that buyers wanted to show detachment. Another potential explanation is the financial crisis. Japan, the main Bluefin tuna market, was severely impacted by the global turmoil. This may have reduced consumer demand. The more recent drop (2014) may be explained by the signs of stock recovery that triggered hope and loosened the market, though the regulations have remained strict.

## 2.3 Stock Evolution

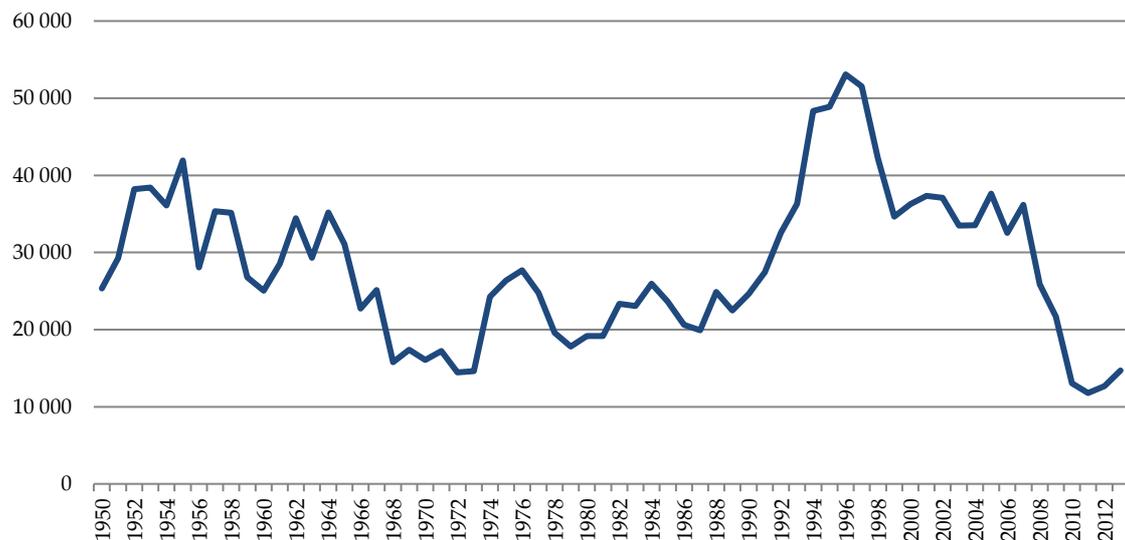
### a. Stock development: overexploitation and recovery

In the early 2000s, the stock was close to collapse. The stock peaked at 300,000 tonnes (T) in both the 1950s and 70s, but witnessed a constant decline to 150,000T since. This is illustrated by figure 2.3 (Bonhommeau & Porch, 2014). The lowest population estimated was 148,995T in 2001. The Prince Albert II of Monaco Foundation, in an attempt to list the species on the CITES in 2009, underlined a 74.3% decline in total biomass over the period 1970-2007 (Fondation Prince Albert II, 2009). Though CITES did not ultimately list the species as endangered, the International Union for Conservation of Nature (IUNC) did in 2011, putting the Atlantic Bluefin tuna on the Red List of 'Threatened Species' (Collette, *et al.*, 2011). The optimal stock level has been determined to stand between 500,000-800,000T (Bjørndal & Brasão, 2006). In 2013, SSB stood at 585,193T, showing significant improvement on the 2006 situation. Though this seems promising, high levels of uncertainty introduce doubt at all levels.



**Figure 2.3:** Historical Spawning Stock Biomass from 1950-2013 in tonnes (*data from personal communication with Sylvain Bonhommeau from ICCAT VPA runs*)

The ever-increasing level of fishing since the late 1960s came to an alarming and unsustainable level in the 1990s, as figure 2.4 shows. The level of Bluefin tuna stock was affected by all the characteristics of overfishing, namely overcapacity of vessels, open access in international waters, vast geographical expansion of the fishery, high market value and deficient governance (Fromentin, Bonhommeau, Arrizabalaga, *et al.*, 2014). Overfishing is the act of destroying a stock due to excessive fishing.

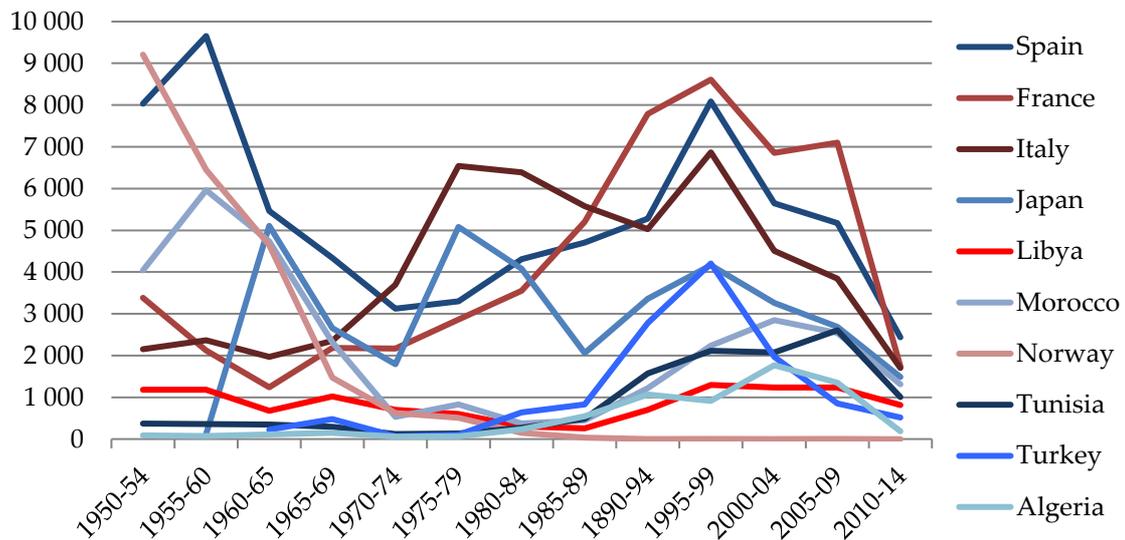


**Figure 2.4:** Reported Catch of Eastern Atlantic and Mediterranean Bluefin tuna in tonnes from 1950-2013 (*ICCAT Statistical Bulletin, Volume 42 (2), 2015*)

Figure 2.5 is a breakdown of reported catch by flag. It is important to notice that these figures are ‘reported’ catch data rather than total catch. The data collected was amassed by the ICCAT via a formal documentation process, eliminating tracks of illegal, unreported and unregulated (IUU) catches.

The reason for the stock collapse can be traced back to the overcapacity of fleets and the economic incentives created from it to continue exploitation. The exponential growth in vessel size, number, and high mechanisation due to subsidies have harmed the stock (Heffernan, 2014). Domestic fleets cannot be sustained by stringent fishing restrictions, as large vessels become unprofitable if they capture less than 50T per season. For example Turkey in 2013 had 302 Bluefin tuna fishing vessels for a national quota of only 557T (Pfyffer, 2013). On paper, 293 vessels were ‘assisting’ the nine fishing vessels. Irony also emerges in the Tunisian case. There are 21 Bluefin tuna fishing boats with permits for 50T catches each. Nets can catch 100-200T in one throw. Though ICCAT encourages to throwback overcatch in the sea, the author claims such behaviour is ‘very unlikely’ (Pfyffer, 2013).

Surprisingly, it is mainly the biggest European countries France, Spain, and Italy, that have tipped into overfishing. This is a result of EU subsidies they benefit from. Figure 2.5 shows that before the ICCAT enforced strict management rules in 2006, France caught 8,801T of Bluefin tuna (BFT), Spain and Italy both close to 5,000T each. The three countries fished a total of 18,310T, more than half the total 32,500 fished that year.



**Figure 2.5:** Reported catch by top 10 countries in tonnes by five year periods (*ICCAT Statistical Bulletin Volume, 43 (1), 2016*)

### *b. Farming*

Farming activities have developed over the past 10 years, adding a layer of difficulty to population statistics. Farming consists in capturing and fattening fish for a certain period before slaughter, in order to increase weight and fat content (Shamshak & Anderson, 2009). Farming ensures better quality meat according to Japanese standards, as it allows monitoring fat content. These high quality products are sold at higher prices on the market. In 2010 it was estimated that 99% of purse seine catches were dedicated to farming operations (Mylonas, *et al.*, 2010). Farming makes the determination of overall stock biomass more complicated. Although the fish are held captive, they are not simultaneously harvested. However, this means that they do not appear in landing documentation immediately, although they have been removed from the eco-system.

## 2.4 Management

### *a. International Framework*

Various frameworks determine the management of the Bluefin tuna. The UN Convention on the Law of the Sea (UNCLOS, 1994), defines correct international conduct in oceans, and gives environmental guidelines for marine resource businesses. The UN Fish Stock Agreement (UNFSA, 1995) determines the role of RFMOs. RFMOs, aimed at establishing conservation and management measures, serve as hubs for nations “to pursue cooperation in relation to straddling fish stocks and highly migratory fish stocks” (United Nations, 1995, Part III Article 8). Operating since 1969, the ICCAT is the RMFO dedicated to the Atlantic Bluefin tuna and 30 other species. The ICCAT conducts biological research, provides statistical data and sets management recommendations (ICCAT Website, 2016).

Heffernan (2014, p.84) denounces the “plethora of parallel and hierarchically related treaties” managing the Bluefin tuna. Despite the intersecting and overlapping responsibilities of the institutions, shortcomings and inefficiencies are proved by facts of overexploitation. Vessels flying Flags of Convenience (FOCs) and vessels from states that are not part of RFMOs are hardly punishable, as they do not have to abide to any rules.

The prevalence of IUU fishing reveals the many loopholes surrounding fishery management. Furthermore, stock management within the organisation is problematic due to the highly politicised nature of the stock. The “political authority does not correspond to the underlying ecological reality” so conservation goals are harder to reach (Samuel, 2013, p.31).

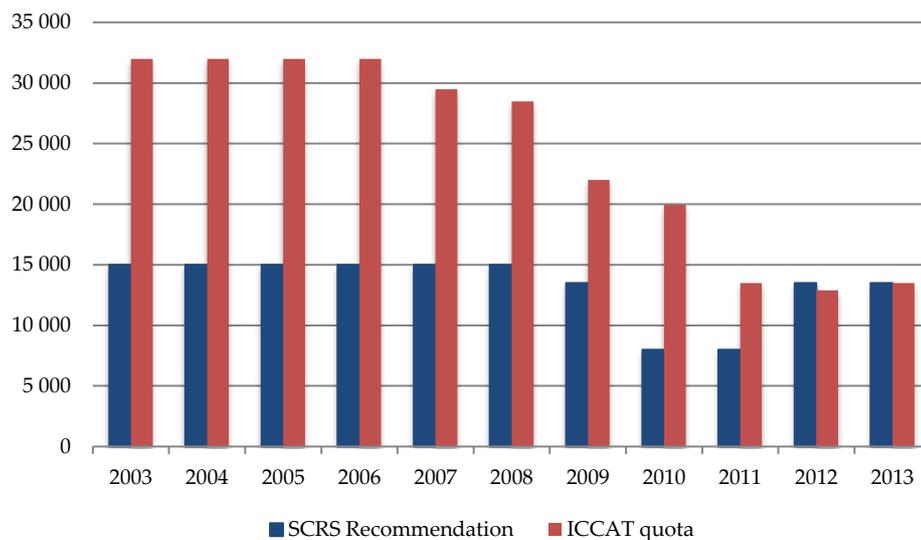
### *b. The ICCAT*

The ICCAT’s first regulation for the protection of the Eastern Atlantic Bluefin tuna was set in 1974 (Fromentin, 2013). The stock now has extensive catch documentation, landing reports, an IUU vessel blacklist, and 100% coverage of Mediterranean purse seine vessels (Samuel, 2013). Despite this accumulation of safeguards, the Economist wrote that “if EVER there were a graphic illustration of the tragedy of the commons, it is the plummeting of the world’s stocks of Bluefin tunas” (The Economist online, 2008). Tuna expert Fromentin said that it is the “archetype of mismanagement of world fisheries” (Mediterranean Science Commission Conference; 2013).<sup>1</sup>

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<sup>1</sup> CIESM video of Fromentin on YouTube, [https://www.youtube.com/watch?v=wag0t\\_6zxKc](https://www.youtube.com/watch?v=wag0t_6zxKc)

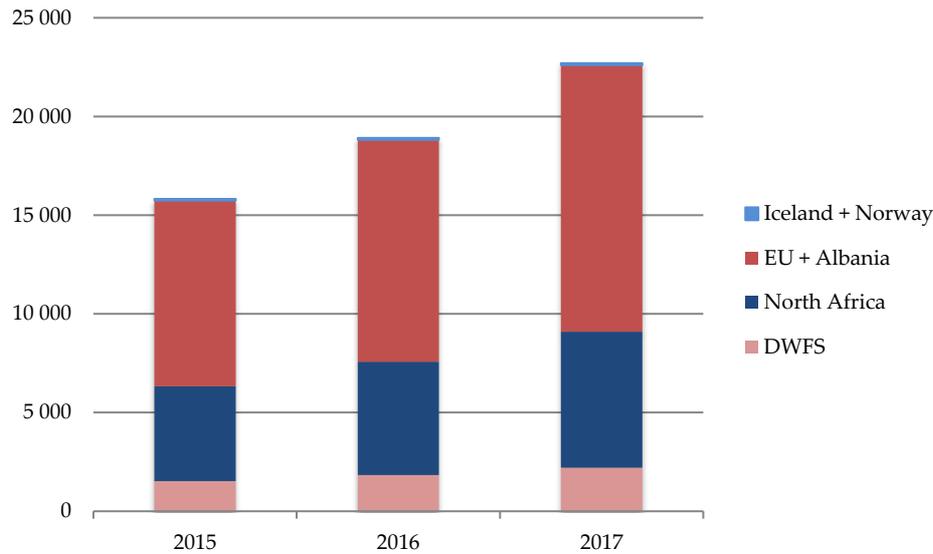
Samuel looked at the list of tools used by the ICCAT over time to manage the stock. Of the 13 tools assessed, which includes minimum catch-size, seasonal restrictions, effort reductions, documentation registration, observer coverage and blacklists, only two were successful. Though quotas were put in place in 1999, the quotas exceeded scientific recommendations, and the lack of monitoring, control and surveillance (MCS) facilitated a substantial illegal catch (figure 2.6). In 2006, total catch including predicted IUU catches was estimated at 50,000T, three times the scientific catch recommendation for the year.



**Figure 2.6:** SCRS Recommendation and Adopted TAC in tonnes for Atlantic and Mediterranean Bluefin Tuna from 2003-2013 (*Sumaila & Huang, 2012*)

The ICCAT failure was symbolised by the nickname “International Conspiracy to Catch All the Tuna” (Heffernan, 2014). Between the early 1990s and 2007, the ICCAT consistently ignored the recommendations of the SCRS, its own scientific body (Webster, 2011). This is shown in figure 2.6. From 2003-2007 the ICCAT consistently set a quota of 32,000T, more than twice the scientific recommendation of 15,000T (Sumaila & Huang, 2012). 2013 was the first year the ICCAT’s quota was in line with the SCRS recommendations.

TACs are currently used to curb fishing. They are distributed to members that have geographical proximity, corresponding gear technology and consumer demand. The ICCAT distributes quota quantities after analysing various factors including local, artisanal interest and national needs (ICCAT, 2015c). For 2015-2017, the ICCAT allocated quotas to 15 members, with the EU counting as one (figure 2.7). Having such a large number of countries involved with the highly migratory stock is one of the ICCAT’s main challenges.



**Figure 2.7:** ICCAT TACs for the years 2015-2017 (*ICCAT Recommendation 14-04, 2014*)

The failure of the ICCAT is often blamed on its multilateral aspect, as the organisation is only as strong as its contracting parties (CPs). CPs are the fishing states that create the harm in the first place (Fromentin, *et al.*, 2014). By 2006, the Bluefin stock was at its lowest, and criticism of management at the highest. Conservation bodies around the world expressed their disapproval at the behaviour of the ICCAT members. Civil society raised its voice when Greenpeace began a campaign against overfishing with the Bluefin tuna as main symbol. MacKenzie (2009) criticises the ICCAT recovery plans that are based on official reported catches. A higher, more realistic catch figure should include unreported and illegal catches. By 2009, due to eternally delaying fishing caution, the “single most effective measure available” was the “immediate cessation of fishing” (Mackenzie, Mosegaard & Rosenberg, 2009, p.32).

The ICCAT finally started a population-rebuilding plan in 2007. The discourse between the SCRS and the CPs turned in favour of the scientific body. The effort was sustained because members wanted to avoid being listed by CITES in 2009 (Webster, 2011). After the nomination of the Eastern Atlantic stock, CPs defended that the ICCAT was conducting appropriate management considering possible actions. Such listing would have dramatically reduced trade and damaged reputation.

### **III: Qualitative Evaluation of the ICCAT**

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The ICCAT was created in 1966 in Rio, when the original text was written. It was ratified and formally established in 1969. In 1967, the ICCAT had three members, the United States, Japan and Australia, and it grew to 50 contracting parties in 2014 (ICCAT website, 2014).

This section will evaluate the ICCAT with regard to its behaviour change towards science and conservation. It will assess the evolution of science and recommendations, geared towards the ultimate goal of fish stock health. The first part of this section will look at the first years of the organisation. The second part will review the changes made since 2007-2008. That year marked the beginning of the Bluefin tuna recovery programme and the publishing of an independent review on the organisation (Hurry, Hayashi & Maguire, 2008). The third part presents the results of interviews conducted with fishery experts.

#### **3.1 Methodology for Qualitative Evaluation**

This section first includes a historical analysis. Of the original aim and methods of the ICCAT, what is left today? This will allow to establish a background against which the contemporary study can be compared (Jupp, 2006). It will help assess the trends of continuity or change, set a chronology and a periodization.

Then, experts were interviewed. Of the conversations, we hope to get an impression of their view of the ICCAT and forecasts for the stock. The semi-structured interview (SSI) format cedes some level of control to the interviewee who can steer the discussion towards knowledgeable grounds. Common themes will allow comparison between experts, while open-ended responses will grant access to anecdotal depth. Impartiality is an important consideration about this method. To reach impartiality, the questions were inspired from Zino's (2007) list of 57 questions in *A Critique of the Criteria Used to Review the Performance of RFMO*. The questions were adapted and words were carefully chosen as to provide a lexical field as impartial as possible.

#### **3.2 Historical Retrospective**

This part will look at the original text, the provisions put in place to operate the RFMO and the initial aims of the organisation. The ICCAT cannot be analysed without drawing a parallel to both the UNCLOS and the UNFSA

(1995). These international treaties defined the rules of the international management of highly migratory fish species.

*a. Analysing the articles*

The original text was published on May 14<sup>th</sup> 1966. Cooperation among members to maintain the population of tuna fish at levels which permit the MSY, was stated as the aim (ICCAT, 2007a)<sup>2</sup>. Many RFMOs, including the ICCAT were created in a post-war effort for cooperation, to avoid another war. The idea was to share fish resources in a diplomatic and peaceful manner, with advice from an impartial organisation.

The convention of 1972 was amended in 1977, 1985, 2003, and 2005. Of the 14 initial articles, less than half concern the activity of the RFMO, while the others focus on setting up the structure. Most articles tackle the structure of the organisation and procedures, underlining the complexity of the organisation. The little attention provided to the actual activity of conservation and management is apparent, foreshadowing how the ICCAT would act.

*b. Analysing the words*

Going further into detail of the Basic Texts, all articles were analysed. Words included are from the text of the *Conference of Plenipotentiaries on the Conservation of Atlantic Tunas*, its two annexes and the *Financial Regulations, Agreement on Seat between the Spanish State and the ICCAT*, and *Agreement between the FAO of the UN and the ICCAT*, dated May 1966 in Rio de Janeiro.

The results suggest a strong emphasis on organisational words evident by the use of 'contracting', 'executive', 'meeting', 'parties' and 'vote' used between 80 and 40 times each, highlighted in red. The second most present lexical field is that of money, highlighted in blue. With 30 mentions each, 'financial', 'funds', 'budget', and 'contributions', are clearly a priority. Surprisingly, scientific vocabulary, highlighted in green, is rare. 'Scientific', 'statistics' and 'expert' are mentioned less than ten times. Technical words relating to fishery science are even less frequent; 'weight' and 'harvest' can be counted on one hand. 'Monitor', 'surveillance', 'conservation measures', and 'biology', words you would expect from a science-based organisation, are missing. This underlines the organisational character of the convention. It did not plan out

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<sup>2</sup> All mentions of the basic text are referenced to 2007, the date of the latest update. The document encloses past clauses.

actions based on science. The ICCAT aimed at organising *meetings* (used 82 times) between *members* (used 92 times) having to abide to *rules* (40 times).

*c. Where is the science?*

Focusing on the scientific aspect, the original convention does mention the necessity of research on ‘the abundance, biometry and ecology of the fishes; the oceanography of their environment; and the effects of natural and human factors upon their abundance’ (Article IV). The role of the SCRS was set to ‘develop and recommend [...] policies and procedures in the collection, compilation, analysis and dissemination of fishery statistics’. The formulation suggests quite a passive role with the indirect action of ‘developing procedures’, leaving open the possibility for the ICCAT to dismiss SCRS recommendations. This hierarchy explains the Commission’s apparent ignorance of SCRS recommendations. The scientific standard for species protection and measures for their conservation was only established when the UNCLOS was applied in 1982.

### **3.3 Regulation and Compliance**

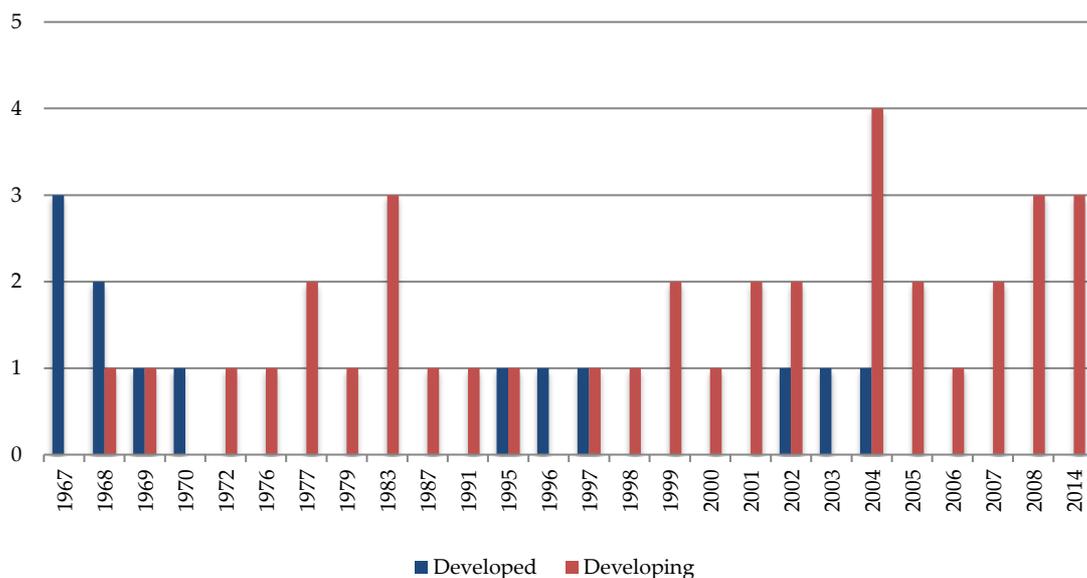
In 2008, as a response to the 2007 annual meeting request for a performance review, an extensive evaluation (from now ‘Independent Review’) of the ICCAT was conducted (Hurry, Hayashi & Maguire, 2008). The Independent Review based its criteria on Lodge’s (2007) *Recommended Best Practices for Regional Fishery Management Organisations* along with ICCAT guidelines. Though it is referred to as the Independent Review, it was to some extent linked to the ICCAT. The evaluation criteria were partially set by the ICCAT. The terms of reference are however universal, taken from the January 2007 Kobe joint meeting for Tuna RFMOs.

This section will pick up from the results of the performance review, which concluded that the ICCAT was ‘let down’ by its CPs and see what has changed since the 2008 publication. Has the ICCAT dealt with the highlighted issues?

*a. Issues that have been solved*

The Independent Review noted “some but not adequate” provision for MCS enforcement, decision-making structures and special requirements for developing states. Looking at ICCAT recommendations and resolutions shows that positive changes have been implemented since the review.

- MCS is tackled in recommendation 10-10 which details the role, objectives and procedures of observer programmes (ICCAT, 2010). Nowadays, Mediterranean purse seiners are subject to 100% observer coverage. As purse seiners represent the largest proportion of all Bluefin tuna catches overall, making this observer programme one of the largest deployed.
- Recommendation 11-13 describes distinctive management actions to pursue in light of different stocks characterisation situation, 'overfished' or 'overfishing', and Kobe plot quadrants (ICCAT, 2011).
- ICCAT has worked towards special requirements for developing countries. As Figure 3.2 suggests, the ICCAT was initially dominated by developed economies. Nonetheless the membership list in 2014 shows that 68% (34 of 50) of members were qualified as developing states according to International Monetary Fund (IMF) standards (IMF, 2015; ICCAT website – see Annex).



**Figure 3.2:** ICCAT Membership Growth (*ICCAT Website, 2014*)

Furthermore the 13-19 recommendation launched the Scientific Capacity Building Fund, directed at the provision of training for scientists from developing states to increase knowledge about science and methods used (ICCAT, 2013). 2014 saw a revision of the 11-26 recommendation to increase the budget of the Meeting Participation Fund, helping developing states representatives to attend panel and commission meetings (ICCAT, 2014).

The Independent Review highlighted the fact that there were inadequate measures concerning ecosystems approach, precautionary approach, fishing allocations and opportunities. The ICCAT has made a tremendous effort in these domains as they are now covered on paper.

- The ecosystems approach was tackled in recommendation 15-11. The ecosystems approach is defined by considering “the interdependence of species belonging to the same ecosystem, [...] the impacts of fishing and environmental factors on target stocks, non-target species and species associated” (ICCAT, 2015a, p.1).
- Though some elements of the precautionary approach were briefly mentioned in resolutions 09-12 and 11-14, it was fully addressed in the recommendation 15-07, *The Use of Precautionary Approach in Implementing ICCAT Conservation and Management Measures*. It set out to “exercise caution when scientific information is uncertain, unreliable or inadequate, [...] determine stock specific limit reference points, [...] not to use the absence of adequate scientific information as a reason to postpone or not to take conservation and management actions, [...] when limit reference points are approached, they will not be exceeded” (ICCAT, 2015b, p.1).
- Finally when it comes to fishing allocations and opportunities, the ICCAT, has stepped up its game with recommendation 15-13. The resolution maps out the qualifying and quantifying criteria.

*b. Issues that have improved*

The Independent Review also mentioned RFMO cooperation and compliance as inadequate. Though they have evolved in the past few years, efforts should continue.

- Cooperation with other RFMOs was mentioned as an area under-developed within the ICCAT. Cooperation with other RFMOs have proven successful since the ad hoc working group with the General Fisheries Commission for the Mediterranean in 2007-2008. The two RFMOs cooperated in 2008 concerning the Mediterranean swordfish, in 2010 on thresher sharks and 2011 on by-catch of seabirds (GFCM, 2015).
- Few are the members who comply perfectly with their reporting obligations. The 2016 list of Reporting Requirements, published by ICCAT, includes 30 general requirements, and another 33 specific to

the Bluefin tuna (ICCAT, 2016b). The 2014-2015 Compliance Summary tables shows that 33 countries had at least one instance of non-compliance for only 16 that fully complied (ICCAT, 2016a). As the Chairman Mr. Tsamenyi mentioned at the Biennial meeting there “continues to be a significant number of late or incomplete submissions from CPs” (ICCAT, 2016a, p.407). The Commission reacted by sending letters to 21 members highlighting non-timely and incomplete submissions. Rules are in most cases respected; only reporting is delayed.

*d. Issues that still have a long way to go*

The Independent Review also covered broad issues touching upon many domains that are in situations difficult to assess. Even with high levels of attention, only little can be done to improve these issues.

- A point was made about data inaccuracy introduced by large uncertainties. An NGO representative expert in fishery science mentioned that the last stock update was filled with uncertainty and divided the scientific community.
- Finally, the ICCAT website suggests that 10 stocks are overfished and five still face overfishing. The East Atlantic and Mediterranean Bluefin tuna is not subject to overfishing according to the latest stock assessment. The fish stock’s overfished status is uncertain though, dependent on the recruitment scenario. A low or medium recruitment scenario suggests the stock is not overfished, while a high recruitment scenario does.

### **3.4 Interviews**

*a. Methodology*

Though the ICCAT has stepped up its game since the 2007 Independent Review in terms of resolutions and recommendations, one can question the actual changes made in day-to-day activities. Interviewing experts will provide insight on their personal impressions of the ICCAT and the recovery programme. What do those that have worked alongside the ICCAT, for the ICCAT or against the ICCAT think of it? We will seek to find out what the ICCAT looks like from close-up and how our experts look at the successes and limitations of the organisation.

The interview data consists of six semi-structured interviews (SSI) with members of five different parties. Overall, 22 experts and organisations were contacted as relevant to the study from their qualifications, previous roles and current positions. Half of the respondents answered, and six accepted the interview. The data provided in this section “must be understood in the context of its production”, as only those willing to talk accepted to be interviewed, introducing some biases (Anderson, 2010, p.4).

The interviewees represented a private consultancy company, a national research laboratory, two RFMOs, an NGO, and a federal agency. All are experts in the field of fisheries, and were deemed to have sufficient knowledge about the Bluefin tuna to answer the questions. Participants gave oral consent for the use of the information for this project. Some requested anonymity. In order to provide levelled information about all participants, they will be referred to as ‘NGO 1’, ‘Research Laboratory 1’, ‘Federal Agency 1’, ‘RFMO 1’, ‘RFMO 2’ and ‘Consultant 1’.

The interviews covered the themes of stock status and future trends, environmental pollution of fishing, regulations and efficiency of the secretariat, and socio-economic impacts.

*b. Stock science*

The first section of the interview covered the stock status and scientific input. All interviewees agreed the indices available showed that the stock was on the way to recovery.

Question	Answers
Does the ICCAT receive appropriate scientific advice?	<b>Overall:</b> Yes, the ICCAT science is very thorough.
	<b>Research Lab 1:</b> “One of the best scientifically followed stocks in the world”.
	<b>NGO 1:</b> Promising aspect of using scientifically determined harvest strategies for all ICCAT species by 2020.
	<b>Federal Agency 1:</b> There has been issues due to historical data accuracy. Reporting was at times inflated in order to get bigger TAC allocations, and sometimes underreported to avoid non-compliance warnings. Today’s stock assessment still suffers from the bad quality historical data, thus scientific data cannot be accurate.
Has the ICCAT adopted long-term management and conservation plans for the BFT? Does it apply a PA?	<b>Overall:</b> Yes, or at least it is trying.
	<b>Federal Agency 1:</b> Precautionary Approach (PA) in the past was left to open interpretation. However in 2006 “the EU finally woke up” and implemented PA to stock management.
	<b>NGO 1:</b> Even though the ICCAT claims it is applying a PA, it does not really. In order to achieve a PA they need to implement a harvest strategy, still unachieved.
The stock size is increasing. Do you think we can expect it to pursue this trajectory?	<b>Overall:</b> All emphasized the problem of uncertainty.
	<b>Research Laboratory 1:</b> Unfortunately, data is fully dependent on catch and effort; indices invented and put in place by us humans.
	<b>NGO 1:</b> The rate of increase is still questioned, as the precise trajectory is unknown. “We should not get too excited” as pressure to increase TACs appears as soon as stock rebuilds.
	<b>Federal Agency 1:</b> The trajectory is hopeful. The aim to attain stock recovery with 60% certitude is quite a low ambition. Why not bump it up?
	<b>RFMO 2:</b> The TAC was increased last year, which means the ICCAT is confident enough in the recovery. However, the stock is very vulnerable and if restriction efforts were to stop, the whole stock would be gone within two weeks.

All experts interviewed praised the scientific research behind the decisions of stock management. Despite managerial efforts, uncertainties in data remain an issue. Uncertainties in fish biology, environmental impacts and stock size can potentially reduce all efforts to nothing. Models far off the ocean reality will offer inadequate solutions.

*c. Environmental consideration*

The second section of the interview questioned the experts about the RFMO’s research and measures for the environment. It opened the conversation to the

ICCAT in general rather than Bluefin tuna only anecdotes. Though it was still the most common example, other measures and species in ICCATs reach were discussed.

Questions	Answers
Has the ICCAT researched the effects of fishing target stocks on the marine environment?	<b>Overall:</b> By-catch is the main problem, little concerns for other issues.
	<b>Consultant 1:</b> The purse seine net technology allows releasing by-catch before even bringing it on board so the problem is limited.
	<b>Research Laboratory 1:</b> A more pressing issue is the accumulation of contaminants in tunas.
	<b>Federal Agency 1:</b> The SCRS is currently researching ecosystems impacts of fishery activity, specifically turtles and birds.
How does the ICCAT handle pollution, waste, lost gear and discards linked to fishery activities?	<b>RFMO 2:</b> The ICCAT has a panel looking into environmental issues. But these issues take a backseat to Bluefin tuna concerns.
	<b>Overall:</b> The issue was regarded as unimportant as RFMO interest in pollution is clearly low.
	<b>Consultant 1:</b> Purse seiners, the largest scale of fishing, are only allowed to fish one month per year, and realistically catch their quota within a few days, so the polluting impact is limited. However, MCS on the issue is underdeveloped.
	<b>Federal Agency 1:</b> The tonnage of Bluefin tuna catch is minimal in comparison to other ICCAT stocks. This reduced the potential for pollution.
	<b>RFMO 2:</b> The stock is very vulnerable, climate change or pollution effects could wipe out the stock in no time.

Environmental research outside of the stock per se is quite limited. By-catch is not a big issue when fishing the Bluefin tuna, and other issues are often disregarded. The limited outlook on environmental issues is probably due to the urgency and necessity of dealing with Bluefin tuna stock recovery.

*d. ICCAT secretariat and structures*

Moving from stock to management discussions, the following section concerns the secretariat and structure of the ICCAT. These questions ask for judgement of the ICCAT organisation. This section was slightly more sensible as our experts have a professional role to fulfil. Some of the experts that work directly with or for ICCAT were not able to comment on this section.

Questions	Answers
<p>What do you make of the large number of members?</p>	<p><b>Overall:</b> The more members the better for the organisation.</p>
	<p><b>RFMO 1:</b> Membership is the first step towards standardising and contributing to data. Even if the members do not comply, at least the database is wider.</p>
	<p><b>NGO 1:</b> Large membership is an issue when you look at today's consensus system. Moving towards a voting system would make decision making easier.</p>
	<p><b>Federal Agency 1:</b> Voting is last resort mechanism that has barely ever been used. Everyone's interests are covered 99% of the time.</p>
	<p><b>RFMO 2:</b> On one hand, the ICCAT gets more engagements, budgets, political power and research. The issue is that though the number of members increases, the TACs do not.</p>
<p>Compared to other RFMOs, how does ICCATs MCS compare?</p>	<p><b>Overall:</b> Very elaborate MCS structures that are relatively well implemented when compared to other vulnerable stocks.</p>
	<p><b>Research Laboratory 1:</b> The BFT is one of few fisheries with successful implementation of MCS programmes making it hard to cheat on a large scale.</p>
	<p><b>Consultant 1:</b> Mediterranean PS activity is subject to 100% coverage. An observer on each vessel collects potential non-compliance and sends a report summary to the flag state during the season or to ICCAT post-season. The BFT also has the first electronic catch documentation. CPs reveal various levels of willingness to act depending on the reactions to observers.</p>
<p><b>RFMO 2:</b> The MCS of BFT is facilitated by the almost 'mono-market'. In Japan, all fish sold require extensive documentation signed by the capture country.</p>	
<p>Are decision-making mechanisms strong enough for such large membership?</p>	<p><b>Overall:</b> There was no general consensus on this question.</p>
	<p><b>Research Laboratory 1:</b> In 2006, when the stock was at its historical low, the ICCAT was in serious crisis. Member states and the SCRS were in confrontation but "finally, the SCRS took the front stage".</p>
	<p><b>Federal Agency 1:</b> Just a handful of delegates drive the majority. The "EU, US, Canada and Japan were previously referred to as <i>The Big Four</i>". Recently, states that have historically had less power due to poor organisation and smaller funding have created regional groups to promote their interests. The ATLAFCO aims at cooperation among African states bordering the Atlantic Ocean.</p>
<p><b>NGO 1:</b> Power is held by countries with bigger fleets, or if the fish is in a member's national water.</p>	

	<p><b>RFMO 1:</b> Unofficially, “the [members that are] more informed, with the more resources to do so, will have more power”. Basically those with strong policy making and sophisticated research programmes are the ones that are listened to as they bring in results.</p>
	<p><b>RFMO 2:</b> On paper, one flag gets one vote. But developed countries have stronger science, communication and control. Many of the developing country scientists seem to be witnessing rather than contributing to panels. On the quota day though, everyone is present and has something to say.</p>
<p>What about economic and social factors?</p>	<p><b>Overall:</b> Member states take into account economic considerations a bit too much, the ICCAT not enough.</p>
	<p><b>NGO 1:</b> There will always be a tension here to pursue economic profit. Fishermen seeking livelihood have progressively encouraged the politicisation of the science.</p>
	<p><b>Research Laboratory 1:</b> “Now that the fish are coming back, how do you share the cake for the fishermen coming back?” A new issue is born out of the recovery. Cut-off fishermen will reclaim their right to fish. Licenses need to be issued, but the slow process is likely to entail cheating and overfishing.</p>
	<p><b>Federal Agency 1:</b> The ICCAT lacks research in the economic domain. “As we know, more fish doesn’t always mean more money”, and the ICCAT could better use economics to engage in conservation and management.</p>

The ICCAT has long been controlled by political interest. There is a lag between the ICCAT that looks at science and the members that rule by economic incentives. Economic powerhouses still have more impact within the organisation than developing countries.

*e. Improvements*

Finally, interviewees were asked what they would improve about the ICCAT. Changes were classified in conservation measures, management measures, and overall vision for the future.

Themes	Changes	Why and How
Conservation Measures	Independent Science	<b>NGO 1:</b> Science currently comes from member countries, which introduces some level of bias. Making sure science gains more independence is crucial.
	Harvest Strategy	<b>NGO 1:</b> Emphasise the rolling out of the harvest strategy process that has been promised.
Management Measures	Observer Programme	<b>RFMO 1:</b> Make sure the observers, that today only summarise the observation of non-compliance, submit all their findings and have more power to react immediately.
	Shark Responsibility	<b>NGO 1:</b> Clear out the responsibility for shark species: determine which organisation takes care of it, and how ICCAT can help.
	Member Support	<b>Federal Agency 1:</b> Developing countries should be provided with further assistance for positive long-term change. This comes mainly through capacity building.
<b>Regional Organisation 1:</b> The ICCAT needs to work more on levelling its' members. In order to transfer knowledge efficiently, collaboration with research institutes, university partnerships and joint programmes should be encouraged.		
Vision	Incentives	<b>Federal Agency 1:</b> Members' pursuit of interests is the definition of the tragedy of the commons. Members have as an objective "resource defending", reached by following an agenda of TAC maximisation and cost minimisation. Instead, members should strive to manage with long-term considerations for ecosystems. Members need to change their perspective on the role of the organisation: rather than resource splitting it should be solely about protecting. A brighter future includes space to use "both sticks and carrots": driven by commonly desired conservation goals, and punished when seeking resource exploitation.
	Strategy	<b>Regional Organisation 1:</b> The ICCAT needs to work on long-term strategy. Along the lines of the UN Sustainable Development Goals, it should look 20 years ahead and determine aims and objectives, rather than work on short-term delays.

Before giving potential changes, experts explained that the possible improvements depend on which authority within the ICCAT they would hold. The secretariat does not hold much power; the Chair acts as a coordinator. Really, the members are king.

This section has revealed the managerial issues of the ICCAT. Despite an initial aim of resource sharing, the ICCAT now seems to be more focused on conservation issues. Experts view and encourage this positive change. The next section will pick up on the main issues of the ICCAT revealed through Sections III and IV and suggest changes for better management.

## IV: Analysis

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At the term of the historical retrospective, recommendations evolution review and interviews, this section reveals a few fundamental issues with the ICCAT. The section will outline the issues on a large scale, and put forth recommendation to solve them. These recommendations are expressed with the aim to reach the ICCAT secretariat, but also for those interested in RFMO management more generally.

### 4.1 ICCAT Acolytes: UNFSA and UNCLOS

The first concern is that the ICCAT's convention was created too early to include relevant fishery science to establish RFMO structures. The UNCLOS and UNFSA, part of international law contribute almost as much details about the role, rules and procedure of the ICCAT than the ICCAT convention itself. These laws provide internationally reliable standards and set frameworks globally. It also means that they are too large to be tailored to particular cases. The existence and presence of these frameworks allows the ICCAT to rely on these externally established rules and put in less effort itself.

**Recommendation:** A revision of the ICCAT convention should include details about Bluefin tuna science, conservation goals and ways to achieve them. The UN could establish a mechanism to ensure that RFMOs do not take UNFSA and UNCLOS for granted but rather use them as a starting point to develop more adapted rules. Such a mechanism could require RFMOs to propose adaptation clauses tailored towards the species they cover or areas they operate in. Article II of the ICCAT text mentions briefly respecting international law. This section could be expanded to refer specifically to the UNCLOS and UNFSA sections and clauses that are applied in the ICCAT scenario.

### 4.2 Structure versus Science

The second concern has to do with the structure of the ICCAT. The convention was created as an organising centre for members fishing the tuna rather than an entity with the aim to protect fish. An international gathering to share the resource is no longer appropriate, and the organisation should indefinitely turn towards resource protection.

**Recommendation:** For this organisation to become action oriented and future driven rather than constrained by politics, science needs to take over from all aspects indefinitely. Again, this will happen mainly through the update of the

convention. Article VIII should be revised. It explains the process for the Commission to produce recommendations for members “on the basis of scientific evidence”. A preamble should detail the process from the SCRS to the Commission. The adaptation of science should be direct, automatic and transparent.

### 4.3 Limited Ambition

A third issue is that the ICCATs work can only go as far as member states want to. Biennial commission decisions can be rejected and scientific research is only pursued following the request of the Commission, i.e. members. Rather than having countries at the service of the ICCAT, it seems that ICCAT accommodates what has been put forth by states.

**Recommendation:** Two pathways can be pursued to solve this issue. The ICCAT Secretariat in Madrid should increase its independent voice and determine a more demanding agenda in accordance with the SCRS. The second solution is normative. Member states need to realise the resource stake that is at play and push themselves further. This process can only happen through education and giving up the idea of resource exploitation. The EU adopted this position in the 2006 Bluefin tuna stock crisis and should encourage other members to take on the same perspective of caution. The former pathway ensures immediate action; however, members’ opposition to the Secretariat might become an issue and freeze ICCAT operations. CPs are ultimately the owners of the organisation. The latter pathway includes a behavioural change, so offers a long-term solution but it will be harder to implement and needs more adaptation time before the effects can be seen.

### 4.4 Lack of Implementation

Implementation of new recommendations is not efficient. When the ICCAT publishes a recommendation, whether concerning TAC levels, documentation or science, some members reject it openly. Others accept it but do not attempt to comply, and finally some simply fail to comply even if the necessary will is present. A system to ensure implementation is necessary.

**Recommendation:** The ICCAT needs to make its resolutions and recommendations binding, and compliance advantageous. Compliance can be incentivised by access to scientific development, information about the fishery, access to certain tools and financial help. Refusal of a TAC allocation or non-compliance to MCS measures would result in losing specific privileges linked to the offense.

Another way for the ICCAT to make sure policies are implemented is to normalise behaviour beforehand. As shown by the progressive development of cooperation with other RFMOs, 'learning by doing' can be a good alternative to imposing a resolution. It means the ICCAT has to set up working groups in advance to develop the idea and make sure members assimilate it.

Finally, the ICCAT, along with the help of the WTO, can impose economic sanctions on members who free ride. Though an advocate of free trade, the WTO has clauses regarding environmental cases and endangered species. In order to protect the stock, trade embargoes aimed at fish imports and exports can target non-compliant parties.

#### 4.5 Social Welfare Concerns

Tension between 'fish welfare' and social welfare has not found a solution so far. Up to 2006, the game had favoured high fishing rates to allow prosperous economic and social welfare. Only when the fish biomass became precariously low and threatened the stability of income to fishermen did the trend change. Since 2006, the welfare of the fish has been prioritised, limiting the number of fishermen and leaving many redundant. Bjørndal and Brasao (2006) forecasted the exit of fishermen that would come with fishing regulation. However, if the stock is managed in an optimal way, it will increase overall catch in the long term.

**Recommendation:** While the ICCAT manages the science and fish conservation, member states need to help those affected by the measures. Financial compensation is one way of helping the deprived fishermen but not necessarily the only way. Educational programmes could shape fishermen perspective and correct fishing behaviour. Fishery experts and industrial partners could develop a programme to explain conservation considerations and investment in the stock. It would allow fishermen to increase their knowledge on ecosystem services, marine environment, and legal issues in order to fish responsibly. With new perceptions on stock status and population reconstruction, and with a new outlook on their personal future benefits, fishermen will act differently during fishing years.

This section has provided recommendations, and potential solutions, for the ICCAT to adjust its' management and Bluefin tuna recovery programme. The next section will summarise the project.

## V: Conclusion

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This paper aimed to evaluate the Eastern Atlantic and Mediterranean Bluefin tuna stock. Reviewing the literature revealed strong pessimism about the stock among scientists and academics of the fishery sector. In 2006, the stock was at its worst, and deemed irrecoverable by some. The literature underlined the importance of uncertainties within stock assessments, making it impossible to determine exactly the current state of the Bluefin tuna population. The paper simultaneously assessed major stock indices. Stock biomass, total catches and allowable catches were studied. Analysing the evolution of these factors over the past 10 to 15 years allows one to conclude that the stock has been recovering at a seemingly fast pace. The project then adopted a more qualitative turn going over the ICCATs managerial history. History proved that the ICCAT was initially focused on resource sharing between members, rather than conservation. Efforts in the past 10 years have reversed the trend to the benefit of the scientific committee. Finally, the paper asked fishery experts about their take on the stock, its recovery and the ICCAT programme. Most of the experts were optimistic about the stock. Again, high levels of uncertainty induced a common worry as experts underlined the necessity of continued research and attention. The ICCAT has room for improvement in terms of applying a precautionary approach to stock management, increasing the support system for developing members, making sure that the science is fully independent from the nations submitting it and reinforcing the observer programme.

The paper has some limitations that should be considered. Most of the limitations came from conducting SSIs. First of all, insight was gained only from those who agreed to be interviewed. The experts all had something to say and were happy to share. More than half of those contacted refused to be interviewed, which underlines either a purposeful rejection or simply lack of incentive. Secondly, even within the interviews, some information was restricted due to professional duties. Understandably, the experts sometimes held back on certain topics because it was confidential information. Another issue was the lack of contact with the ICCAT. The ICCAT was very responsive and helpful when it came to providing me with stock data. However, the interview request fell on deaf ears, and was not passed on to members.

Basing the assessment of stock indicators on Bjørndal and Brasao (2006), price data was on the list of indicators. Nonetheless, no coherent data was found on the price over the past 10 years. Similarly, information on effort, truly relevant

to explaining the recovery programme was incoherent and varied from one source to the other. To avoid these data limitations, effort and price were excluded.

This paper will contribute to the field of fishery science, RFMO practices and Bluefin tuna species. It regroups and analyses the available information on the stock as of August 2016. A detail picked up from the interview with the Federal Agency engages for a debate. The ICCAT members' interests in the organisation need to be changed for a more sustainable perspective. A study on the members would reveal their interest in the resource rent and motivations. Such a study would aim to find out how the incentives of membership at the ICCAT can be changed in time. The data and results found in this study, along with updated price, cost and effort data would allow re-running the analyses presented in Bjørndal and Brasao (2006) and Bjørndal and Munro (2012), and result in an updated optimisation of stock management.

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## Annex

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### List of members by year (developing countries highlighted)

United States	1967	Trinidad E Tobago	1999
Japan	1967	Namibia	1999
South Africa	1967	Barbados	2000
Ghana	1968	Honduras	2001
Canada	1968	Algeria	2001
France	1968	Mexico	2002
Brazil	1969	Vanuatu	2002
Morocco	1969	Iceland	2002
South Korea	1970	Turkey	2003
Ivory Coast	1972	Philippines	2004
Angola	1976	Norway	2004
Russia	1977	Nicaragua	2004
Gabon	1977	Guatemala	2004
Cape Verde	1979	Senegal	2004
Uruguay	1983	Belize	2005
Sao Tome E Principe	1983	Syria	2005
Venezuela	1983	St Vincent & the Grenadines	2006
Equatorial Guinea	1987	Nigeria	2007
Guinea	1991	Egypt	2007
United Kingdom	1995	Albania	2008
Libya	1995	Sierra Leone	2008
China	1996	Mauritania	2008
European Union	1997	Curacao	2014
Tunisia	1997	Liberia	2014
Panama	1998	El Salvador	2014
<b>Total Number of Members</b>			<b>50</b>
<b>Developing States</b>			<b>35</b>
<b>Developed States</b>			<b>15</b>

Source: IMF World Economic Outlook, 2015



The Eastern Atlantic and Mediterranean Bluefin tuna tastes delicious. Naturally, the Japanese sashimi market fights over this high value fish. Unfortunately, this money-making resource has been overfished since the 1970s due to its' wide geographical spread and high sea open access characteristic, which means over 25 countries sought to capture it. This cumulated in near extinction of the species in the mid-2000s. The organisation in charge of managing the stock, the International Convention for the Conservation of Atlantic Tuna (ICCAT), established a fifteen-year species recovery plan starting in 2006-2007. The plan includes fishing seasons, gear restrictions, quantity control and strict monitoring of vessels. Ten years into the programme, this project sets out to assess the state of the stock. Quantitative indicators will enable assessing the health of the stock, and qualitative methods will evaluate the managerial success of the recovery programme, in terms of member compliance and caution adopted with regard to the stock. Results of the research show the stock is en-route to recovery. Population indicators are recovering faster than expected. Recommendations, such as educational courses on stock sustainability for fishermen or knowledge access incentives to comply, will hopefully reach the ICCAT to adapt the programme for the remaining five years.

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