

**The Caribbean Billfish Management and Conservation Plan**

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# List of Acronyms

ABNJ Areas Beyond National Jurisdictions

BMSY Biomass at the Maximum Sustainable Yield level

CARICOM Caribbean Community

CBP Caribbean Billfish Project

CBMC Consortium on Billfish Management and Conservation

CFMC Caribbean Fisheries Management Council

CLME Caribbean Large Marine Ecosystem

CPUE Catch per Unit of effort

CRFM Caribbean Regional Fisheries Mechanism

dFADs Drifting Fish Aggregating Devices

EAF Ecosystem Approach to Fisheries

EEZ Economic Exclusive Zone

EPA United States Environmental Protection Agency

FADs Fish Aggregating Devices

FAO Food and Agriculture Organization

mFADs Moored Fish Aggregating Devices

FSC Free Swimming Schools

FMSY Fishing effort at the level of the Maximum Sustainable Yield

FIRMS Fisheries and Resources Monitoring System

GEF Global Environment Facility

ICCAT International Commission for the Conservation of the Atlantic Tuna

IGFA International Game Fish Association

IUU Illegal, Unreported and Unregulated Fishing

MCS Monitoring, Control and Surveillance

NOAA National Oceanic and Atmospheric Administration

OSPESCA Central America Fisheries and Aquaculture Organization

RFB Regional Fishery Body (ies)

SAP Strategic Action Plan

SCRS Standing Committee on Research and Statistics of the ICCAT

SICA Central America Integration System

TAC Total Allowable Catch

UNCLOS United Nations Convention on the Law of the Sea

VMS Vessel Monitoring System

WECAFC Western Central Atlantic Fisheries Commission

# Executive Summary

The overall objective of this regional Billfish Management and Conservation Plan is to outline and guide the implementation of a suite of billfish management measures, over a five year period, at regional and/or sub-regional scales.

These measures seek to ensure the sustainability of billfish stocks that are providing diverse and invaluable contributions to Caribbean economies and livelihoods through commercial and recreational fisheries. Suggested measures advocate for precautionary and ecosystem based approaches to the management of billfish stocks; which typically face high levels of data uncertainty as well as ongoing signals of overfished and overfishing conditions. Multiple declining stock abundance trends for billfish are the ongoing result of concern; which have consistently implied the persistence of unsustainable fishing practices for many years. It’s believed that merging uncertainty with consistent declining abundance trends should provide sufficient impetus to implement these precautions for the long term welfare of citizens of the Caribbean; a region with a relatively high per capita reliance upon marine resources due to its island nation characteristics.

Ultimately, the sustainability of values billfish species represent to various fishery sectors and their linked livelihood is expected to be secured through adaptive implementation of the management measures proposed within this plan. Required activities are considered to fall under the plans founding specific objectives outlined below:

1. Improve fishery catch and fishing effort data collection and reporting programs for billfish in recreational and commercial fisheries.
2. Recover billfish stocks and maximize the sustainable economic value of commercial and recreational billfish fisheries by reducing, to the extent practicable, bycatch and discard mortality of billfish in all relevant Caribbean fisheries.
3. Define target and limit reference points appropriate for billfish species stocks, and establish associated harvest control rules (HCRs) to ensure they aren’t surpassed.
4. Increase the coordination, collaboration and participation in current regional governance arrangements that address Caribbean billfish management and conservation issues.
5. Combat IUU fishing by improving monitoring, control and surveillance systems of commercial and recreational fisheries targeting large pelagics, with harmonized management measures coordinated at a regional level.
6. Enhance the governance and economic performance of recreational and commercial billfish fisheries in the WECAFC region by promoting co-management and tenure based management approaches in combination with the improvement of fisheries value chains and fisher organizations social capital, organization, cohesion, leadership and entrepreneurial capacity.

# Introduction

The term “billfish” represents a group of predatory fishes characterized by a prominent rostrum, commonly referred to as a “bill”, extending from their upper jaw. Classified as highly migratory fishes, billfish species stocks do typically extend their travels beyond the Caribbean Sea and into the broader Atlantic Ocean. Billfish harvests contribute to Caribbean economies, livelihoods and the regions marine emphasized food security. Local and distant-water industrial fishing fleets capture billfish commercially, as do smaller scale commercial and artisanal fisheries. Alongside these commercial fleets, a recreational fishery sector also exists, within which billfish typically represent the most prized, and thus targeted, species group. Billfish target species within the Caribbean region include Atlantic blue marlin (*Makaira* *nigricans*), white marlin (*Kajikia* *albida[[1]](#footnote-2)*), Atlantic sailfish (*Istiophorus* *platypterus*) and spearfishes (*Tetrapturus* spp).

The recreational fishing fleet represents by far the greatest value per harvested billfish, promotes a highly capitalized tourism industry and actively encourages the release of billfish to minimize stock negative effects resulting from its’ activities. Small scale and artisanal fishery sectors are considered to provide the greatest relative livelihood support mechanism within this suite of fisheries, and are likely to have the greatest numerical participation among regional citizens. The regional introduction of Fish Aggregating Devices (FADs) is encouraging continued expansion of small scale fisheries through artificially inflating catch efficiencies; a worrying effect from an ecosystem perspective with largely unknown consequences. Large scale commercial fleets do provide employment opportunities and nutrition while supplying local and high value export markets with tuna species. However, they do simultaneously impose the greatest current mortality upon billfish stocks and classify billfish as by-catch species.

Declining population trends have been recorded in most billfish species stocks globally, and many stocks are still subject to unsustainable overfishing. The Atlantic Ocean is no exception; blue and white marlin are listed as vulnerable with declining population trends, and white marlin have been repetitively (1992, 1996, 2000, 2004) classified as overfished by ICCAT SCRS[[2]](#footnote-3). This represents a threat to commercial and recreational fisheries, as well as to the overall sustainability of their respective contributions to Caribbean economies. Concerted action by Caribbean nations to improve the regional management and conservation of billfish resources, and their collective relative influence upon decision-making at the International Commission for the Conservation of Atlantic Tunas (ICCAT) level, offer opportunities to reverse these concerning trends. Currently, no regional/sub-regional management plan is in place for billfish, or any large pelagic species in the wider Caribbean region. The present document represents an opportunity for the progressive adoption and implementation of several activities and management measures which can positively address billfish conservation and management issues in the Western Central Atlantic region.

This plan results from implementation of one of the activities under Component 2 “Strengthening regional billfish management and conservation planning” of the GEF/ World Bank funded Caribbean Billfish project GCP/SLC/001/WBK, for which the WECAFC/FAO is the executing agency. Plan development has benefitted from partnership approaches and communication structures established within the Consortium on Billfish Management and Conservation (CBMC), the WECAFC membership, and the Interim Coordination Arrangement for Sustainable Fisheries among FAO, CRFM and OSPESCA in the Caribbean under the Caribbean Large Marine Ecosystem (CLME+) project. The Plan also considers the Strategic Action Programme (SAP) of the CLME, which was endorsed by more than 25 governments in 2013, and in particular the strategy (5B) “Enhance the governance arrangements for implementing an ecosystem approach for large pelagics fisheries”.

The preparation process of the plan started in 2015 by conducting several desk and field studies, under Components 1 and 2 of the Caribbean Billfish project. These provided background information on the status of billfish resources, potential right based management approaches, an estimation of the value of commercial and recreational fisheries and a diagnosis of the Caribbean national legal and institutional fisheries framework[[3]](#footnote-4). Additional information about each species stock status, IUCN listing, biology and fisheries history is also available online[[4]](#footnote-5). A primary outline of the table of contents and a first proposal of regional management measures was presented at the 2nd Regional Workshop on Billfish Management and Conservation held in Panama in November 2015. A first draft was prepared in March 2016 which followed a consultation process with the assistance of the Consortium members and the WECAFC/ OSPESCA/ CRFM/ CFMC Working Group on Recreational Fisheries.

This document seeks to be the second regional management plan prepared and adopted under WECAFC (the first one for queen conch *Strombus gigas*). Other already adopted subregional management plans are the CRFM Subregional Fisheries Management Plan for Flying fish (*Hirundichthys affinis*) in the Eastern Caribbean and the OSPESCA Subregional Management Plan for Caribbean Spiny Lobster *Panulirus argus* in SICA countries. This plan is divided in 10 chapters, presenting what are considered attainable actions and objectives that can be realistically implemented over a five year period following plan adoption. Chapter 2 presents a summary of basic fisheries legislation and organizational arrangements in the Caribbean. Chapter 3 provides an overview of billfish fisheries and resource status’. Chapter 4 describes the main challenges regarding Caribbean billfish governance and potential solutions. Chapters 5 and 6 outline the principles, objectives and agreed management measures available to address billfish sustainability concerns; with a logical framework to guide implementation within the WECAFC region. Chapter 7 explains the adaptive and precautionary management mechanisms available for implementing and reviewing this management plan as an evolving document. Chapter 8 provides a list of social, legal and biological research projects identified as priorities to improve the assessment and management of commercial and recreational billfish fisheries in the WECAFC region. Chapter 9 includes a glossary and finally Chapter 10 provides a list of literature where additional background information about billfish species can be obtained.

The plan seeks to be practical, straightforward and adaptive through stakeholder consultation. As an adaptive plan, different activities or management measures can be added, eliminated or adapted during implementation according to management effectiveness assessments. The plan seeks to guide and strengthen regional management arrangements to improve the status of commercial and recreational billfish fisheries in the WECAFC region, their long-term sustainability, and their contribution to food security, poverty alleviation and the wellbeing of coastal communities by promoting adoption of an ecosystem approach to fisheries (EAF), as recommended by FAO (FAO, 2003)[[5]](#footnote-6). The plan will create a platform through which harvest reporting is improved with the inclusion of a recreational fishery database at a regional level. The plan also expects to promote enhanced involvement and cooperation among Caribbean States, particularly under establishment of the Interim Coordination Arrangement for Sustainable Fisheries among FAO/WECAFC, OSPESCA and CRFM under the CLME+ project, and with the International Commission for the Conservation of Atlantic Tunas (ICCAT). It is also expected that the plan will foster management and conservation alternatives to reduce by-catch and by-catch mortality, increase regional management measures effectiveness and help optimize socio-economic returns.

The emphasis of this plan is on specifically formalizing billfish conscious fisheries management with a regional perspective, orientation and spatial coverage. This is particularly important with the consideration that bycatch and recreational fisheries management measures are not currently in place in many Caribbean countries. By regional perspective, it is meant the WECAFC region, and maximizing spatial coverage of this plan is considered important with recognition of billfish species extensive spatial ranges and distributions.

# Caribbean fisheries institutional and legal frameworks[[6]](#footnote-7)

The WECAFC region includes many sub-regions including Brazil, the United States of America, numerous Caribbean Small Island Development States (SIDS) and overseas territories, and Areas Beyond National Jurisdiction (ABNJ). As the region is a complex patchwork of countries, the methods of drafting and adopting legislation may vary considerably from one country to another. Due to the nature of highly migratory species and resultant implications for their management, there are four legal international instruments to be referred to in the Caribbean region: the first is the United Nations Convention on the Law of the Sea[[7]](#footnote-8), followed by the UN Fish Stocks Agreement[[8]](#footnote-9), the Compliance Agreement[[9]](#footnote-10) and the Port State Measures Agreement (PSMA)[[10]](#footnote-11).

In the Caribbean there is only one regional fishery management organization: the International Commission for the Conservation of Atlantic Tunas (ICCAT[[11]](#footnote-12)), with 17 contracting parties and two cooperating non-contracting parties from the WECAFC region. ICCAT is an inter-governmental fishery organization responsible for the conservation of tunas and tuna-like species, including billfish, in the Atlantic Ocean and its adjacent seas. The Commission compiles fishery statistics from its members and from all entities fishing for these species in the Atlantic Ocean, coordinates research including stock assessments, develops scientific-based management advice, provides a mechanism for Contracting Parties to agree on management measures, and produces relevant publications.

Besides ICCAT, some countries also belong to other Regional Fishery Bodies (RFBs) such as the Caribbean Regional Fisheries Mechanisms (CRFM) of the Caribbean Community (CARICOM) and the Central America Fisheries and Aquaculture Organization (OSPESCA) of the Central America Integration System (SICA). In the case of the United States, the Caribbean Fishery Management Council (CFMC) is one of eight regional fishery management councils, which includes the Commonwealth of Puerto Rico and the United States Virgin Islands.

All countries have legislation governing fisheries, but few have provisions specific to large pelagics, billfish or sport/recreational fisheries. Although the complexity of these laws varies from one country to another, certain broadly shared themes emerge in terms of their objectives and scope. Many of the legislations and management systems in place are based on the FAO Code of Conduct for Responsible Fisheries[[12]](#footnote-13) and include both legal and administrative frameworks, but the legal framework appears to be limited and often does not specify a formal management process with identified roles, responsibilities, information needs, and time frames for activity completion and evaluation.

All countries have an authority in charge of fisheries and aquaculture, which in most cases is part of the Ministry of Agriculture. In a few cases, the fishery authority is independent and acts as a Ministry of Fisheries. Most of the recently enacted laws provide for a Fishery Advisory Body or Committee, though in practice these appear to not be active in a number of countries. Stakeholder identification and participation in the management process is not a formal requirement in all countries, but most countries do promote co-management approaches via open meetings and the provision of opportunity for public comments. However, government do still retain the major responsibility for management in most cases.

Different types of governance instruments and regimes may be found to varying degrees in laws and regulations across the region for all fisheries, including: (i) spatial restrictions; (ii) temporal restrictions; (iii) gear restrictions; (iv) rights and participatory restrictions; and (v) catch and size restrictions. Also, there are provisions for the development of management plans with co-management approaches (e.g. the Ecosystem Approach to Fisheries –EAF), but it is noted that not all the countries have prepared or are implementing management plans. It’s is also pertinent that very few recreational fisheries have such plans.

Regarding specific legislation for commercial billfish fisheries, recreational billfish fisheries and the use of Fish Aggregating Devices (FADs), most of the countries do not have specific legislation and regulations in place. In most countries, general fishery laws include some reference to sport/recreational fishing, but there tends to be limited structure or formal direction outlined to manage them effectively. In the Central American region, some countries include legislation that allows the capture of billfish species only for sport/recreational purposes.

At the sub-regional level, a management plan for moored FAD fisheries in Eastern Caribbean countries is expected to be adopted and implemented by the CRFM, to effectively address the lack of legislative or policy recognition of these fishery tools; which continue to gain prevalence in the region.

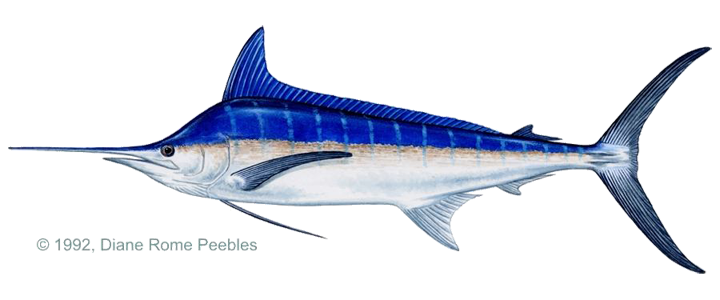
# 3 Fisheries

## 3.1 Description of billfish species which are captured in the Caribbean

Istiophorid billfish species (marlins, sailfish and spearfishes) are classified as large pelagic fishery resources and are oceanic species which migrate over great distances within distributions that extend beyond the WECAFC region. Their classification remains unsettled in terms of sub-order, genera, and species, and, according to some scholars, billfishes are genetically and morphologically distinct from tuna and tuna-like species. The species are characterized by a bill, a lateral line retained throughout life, elongate pelvic fins, a dorsal fin with a very long base that is sometimes sail-like and is depressible into a groove, and a caudal peduncle in the adult with two keels on each side. Other characteristics are scales present in the adult and jaws with small teeth in the adult. The members of this family share several characteristics with the swordfish; including an elongate rostrum in adults, dorsal fin origin over back of head, pectorals low on body, and first dorsal fin lacking true spines.

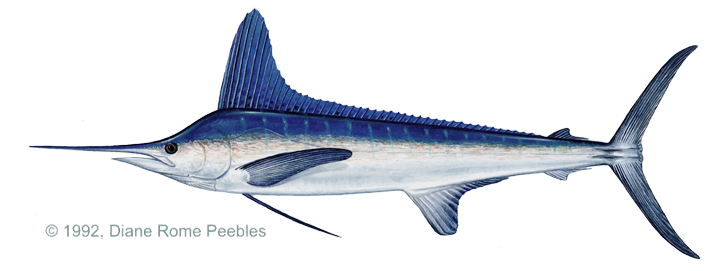
The following billfish species are considered in this management and conservation plan: Atlantic blue marlin (*Makaira nigricans*), white marlin (*Kajikia albida*), Atlantic sailfish (*Istiophorus albicans*), the longbill spearfish (*Tetrapturus pfluegeri*) and the roundscale spearfish (*Tetrapturus georgii* ).

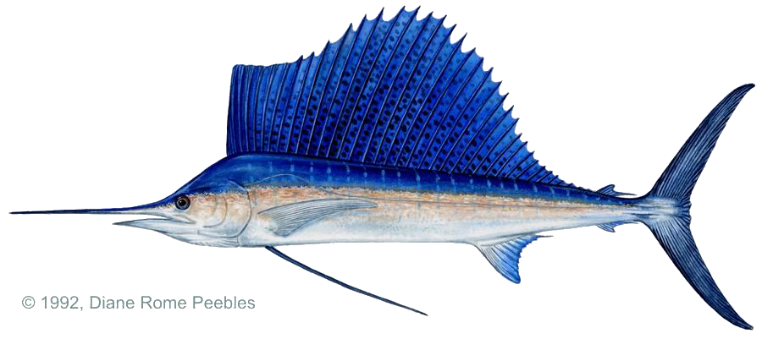
**Atlantic Blue Marlin**(*Makaira nigricans*) – Blue marlin are found throughout the world’s oceans in tropical, subtropical, and temperate waters. The blue marlin is notably the largest of billfish species captured in Caribbean waters, making it the prime target in the regions recreational fisheries. It is characterized by a cylindrical body shape, two dorsal fins (one with a steep slope and one smaller toward the posterior of the organism), and unlike the black marlin the pectoral fins are not rigid. They are named for their cobalt blue dorsal coloration, which fades into a silvery white below. Keels on the caudal peduncle of blue marlin make it an exceptionally strong and fast swimmer, a trait also attractive to recreational anglers. Blue Marlin display sexual dimorphism, with giant marlins all being females and male blue marlin rarely exceeding 300lb (136 kg). This biological characteristic emphasizes a need to protect large highly fecund individuals.

While the blue marlin is one of the most sought-after species by recreational anglers, it is not as abundant as other billfish, a typical trait for such a large top predator. Near-surface pelagic fishes such as mackerels, tunas, and [dolphin](http://www.flmnh.ufl.edu/fish/Gallery/Descript/Dolphin/Dolphin.html) are primary prey of the blue marlin. Overharvesting of these species, that are highly valued by fisheries in their own right, will therefore have negative food chain effects upon blue marlin stocks; thus highlighting the need for a precautionary and ecosystem based approach to effective fisheries management for billfish stock sustainability.

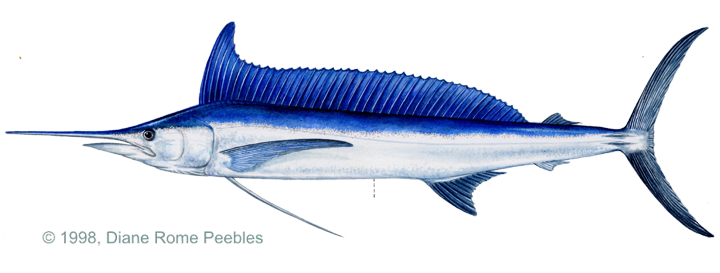
The blue marlin is found in the Atlantic Ocean from 45°N to 35°S and is less abundant in the eastern portion of this ocean. In the northern Gulf of Mexico its’ movements appear associated with an extension of the Caribbean Current, termed the Loop Current. Seasonal blue marlin concentrations do occur in the southwest Atlantic (5°-30°S) from January to April and in the northwest Atlantic (10°-35°N) from June to October. Such congregations should be investigated for targeted protection in pursuit of regional socio-economic benefits from the stock.

**White Marlin**(*Kajikia albida*) – White marlin are found in deep tropical and warm temperate waters throughout the Atlantic Ocean including the Gulf of Mexico, the Caribbean Sea, and the Western Mediterranean. Stray specimens have been recorded beyond this range. Though this species is usually found in deep pelagic waters, it is relatively frequently encountered close to shore where waters are not much deeper than eight fathoms.

This species most characteristic feature is the rounded, rather than pointed, tips of the pectoral fins, first dorsal fin and first anal fin. The anal fin is more consistently rounded than in other billfish species, but similarity to the roundscale spearfish is remarkable. The maximum height of the largest lobe on the first dorsal fin is greater than the depth of the body. The coloration of the white marlin is a dorsal dark blue fading downwards into a silver-white with brown spots. Spots also are present on the first dorsal fin of the fish. Another distinctive feature is that both dorsal fin margins are convex. The flat, mobile pectoral fins can be easily folded flush against the sides of the body. The lateral line is visible and straight and the diet consists of various pelagic baitfish species and squid..

**Atlantic Sailfish***(Istiophorus albicans)* **–**Sailfish are one of the most iconic billfish, and are easily recognizable through the presence of an extremely large and colorful tall dorsal fin. The second dorsal fin is very small. The coloration of sailfish is considered capable of changing more extensively than for other billfish species; in accordance with their level of excitement. Typically, the sailfish’ body is dark blue dorsally and white with brown spots ventrally. About 20 bars, each consisting of many light blue dots, are present on each side of the fish. The fins are all generally blackish blue when the fish is not excited or agitated. The primary diet consists of various cephalopods and bony fishes such as needlefish, mackerels, tunas, and jacks.

Sailfish inhabit tropical and subtropical waters, typically near land masses and usually in depths over 6 fathoms, but this species is also caught in lesser depths. They appear to feed mostly in midwater along the edges of reefs or current eddies.

**Spearfish** (*Tetrapturus pfluegeri*) – This section focusses upon the longbill spearfish, with the round-scale spearfish considered most similar to white marlin and therefore grouped with that species (see Figure 11). The spearfish species group is considered cosmopolitan within tropical and subtropical deep waters, but they are typically rare. The longbill spearfish is known to occur in the northwest Atlantic from New Jersey to Venezuela, including the Gulf of Mexico. Japanese longliners have also recorded its’ occurrence in the north central Atlantic, in the south Atlantic, and off South Africa. The spearfish has a dorsal fin similar to that of the sailfish but this lacks the sailfish’s dorsal height and length. The bill of the longbill spearfish is about twice the length of the lower jaw, which is still short relative to other billfish species. Spearfish feed near the surface on small fish including dolphin, flying fish, needlefish and squid. The spearfishes are considered cosmopolitan species, but nowhere are they abundant.

## 3.2 Overview of billfish fisheries and landings

In many Caribbean countries, commercial and recreational fisheries target large pelagic fishery resources. Fishing vessels for large pelagics in CARICOM countries can be divided into five categories: a) open outboard trolling and longline boats, b) open outboard gillnetters, c) decked inboard trolling and gillnet vessels, d) medium sized longliners and e) large longliners. The majority of vessels used in this region are open outboard powered ones typical for small-scale fisheries. Larger decked vessels, mainly medium sized longliners, were introduced when regional governments developed the Caribbean regions fishing industries capacity to harvest large pelagic species. There are also foreign-flagged vessels which target large pelagic species in the region, and these are typically larger than those within the national fleets.

Billfish species are mostly harvested as bycatch in commercial fisheries targeting tunas, particularly longline vessels. They are also captured in directed coastal artisanal and small scale commercial fisheries. Billfish are also very popular target species in sport/recreational fisheries where a multimillion-dollar recreational fishing industry has evolved and continues to develop on regional and global scales. A tag and release ethos, particularly focused on billfish species, seeks to minimize the stock influence that recreational fisheries have upon these highly valued species through mortalities. Release efforts have been remarkably successful within recreational fisheries, displaying a high level of peer influence among this sectors participants.

The total landings of tuna, small tunas, and billfish by oceans reached slightly over 7 million metric tons in 2012 (Fig. 1). An apparent correspondence is noted between ranked ocean habitat compression indices and the production of these large pelagic species in the different oceans. Habitat compression occurs when large areas of cold, low-oxygen water develop as distinct strata which restrict the depth distribution of tropical pelagic billfish and tunas. This vertically compresses the acceptable physical habitat for billfish, while simultaneously influencing other species upon which they feed.

Landings of large pelagic species in the Atlantic reached only 9% of the total tuna, tuna-like species, and billfish species recorded worldwide in 2012. A slight decreasing trend in landings after 1995 is observed overall in the Atlantic Ocean (Fig. 1).

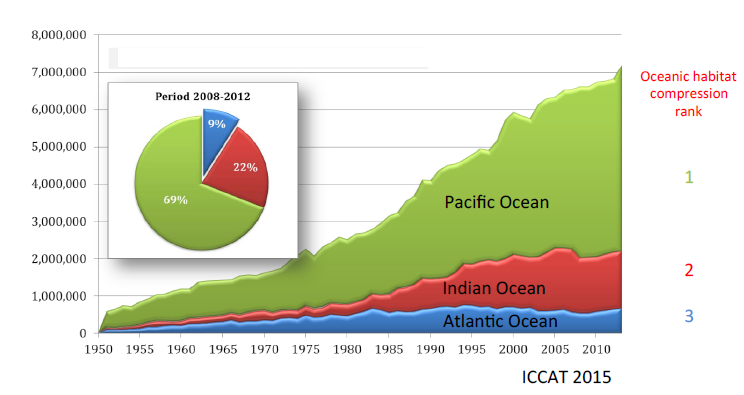


Figure 1: Landings in metric tons of tunas, small tunas and billfish[[13]](#footnote-14)

In the Atlantic Ocean, billfish species represent 0.76% of the reported combined tunas, swordfish and billfish species landings (Fig. 2). Sailfish and white marlin are almost undetectable in the statistics and blue marlin appears as the main billfish species reported in those statistics. This is in contrast to abundance expectations for these species noted through other fisheries and their biological abundance expectations. The fact that billfish species comprise a very low percentage as by-catch in the landings of major tuna fisheries represents a significant impediment to objectively collecting billfish stock assessment data through formal fishery statistical systems. This represents a challenge to the integration of billfish stock assessment data. Assessments of billfish are carried out periodically by scientists from member nations within ICCAT, but data deficient analyses are the norm.

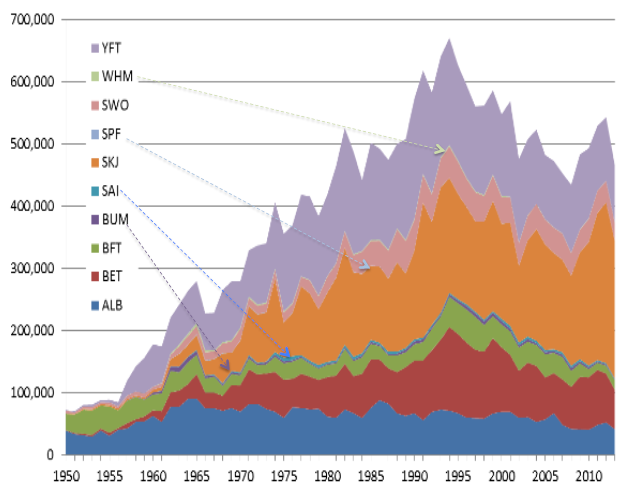


Figure 2: Landings in metric tons of major tuna species, billfishes and swordfish from the ICCAT convention area . YFT= yellowfin tuna, WHM= white marlin, SWO= swordfish, SPF= spearfish, SKJ= skipjack tuna, SAI= sailfish, BUM= blue marlin, BFT= Bluefin tuna, BET= bigeye tuna, ALB= albacore tuna 18

ICCAT has defined general areas of the Atlantic Ocean to demark managerial billfish units of stocks. There is a north and south Atlantic stock division for marlins and an east and west demarcation for sailfish and spearfish (Fig. 3). The WECAFC region comprises fractions of these areas (Fig. 3) and this plan therefore only applies to this region and not the Atlantic as whole.

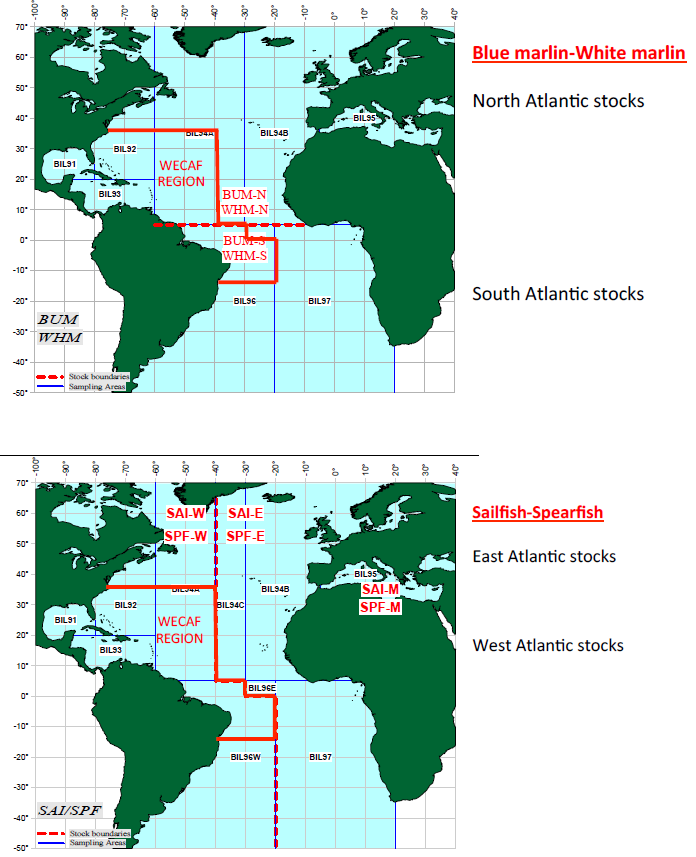


Figure 3: Boundaries for billfish stock definitions in the ICCAT Convention area showing (in red) the WECAFC boundary region. BUM= blue marlin, WHM= white marlin, SAI= sailfish, SPF= spearfish. N= north, W= west, E= east, S=south, M= Mediterranean.

Industrial long line fisheries targeting Atlantic tuna resources prominently operate over the central equatorial Atlantic, as well as in the eastern Caribbean Sea (Fig.4), followed by areas in the northern Gulf of Mexico, the southwest Atlantic off the southern Brazilian and Uruguayan coasts, and off equatorial Africa. Longline fishing effort increased steadily from the 1950s until 2000, when over 475 million hooks were operated by all fleets fishing in the Atlantic (Fig. 4). However, there has been a noticeable decrease in the amount of longline effort in the Atlantic due to removal of effort by some of the largest longline fishing countries (e.g. Japan; Taiwan, province of China, and Korea). These fleets choosing to remove fishing effort from Atlantic waters should be considered a worrying sign for national fleets, which may not have this future travel option.

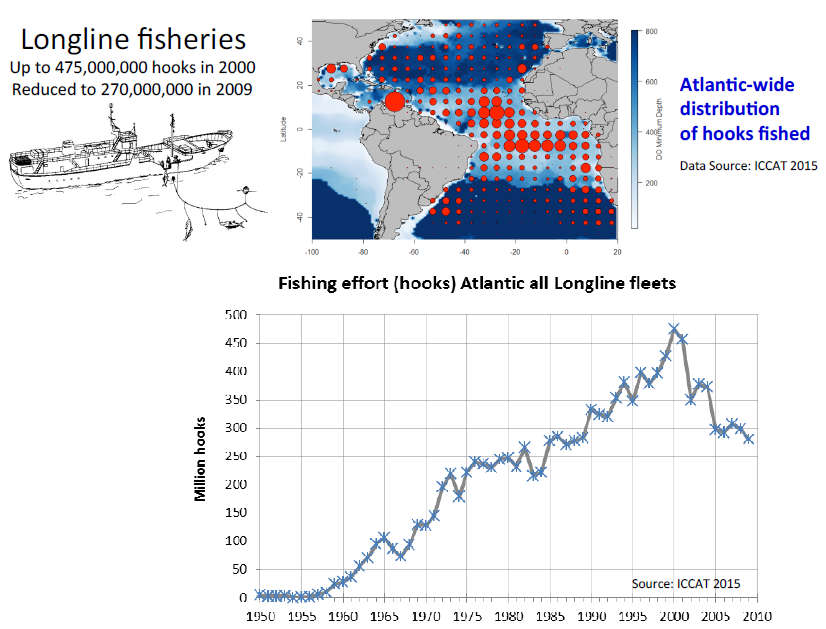


Figure 4: Longline gear operational characteristics (upper left), spatial distribution of overall longline fishing effort in the Atlantic (upper right) and historic trend of longline fishing effort in the Atlantic in millions of hooks (Lower panel)(Data sources: ICCAT) 18

The tuna purse seine fisheries in the Atlantic operate conspicuously in areas of West Africa, particularly in the Gulf of Guinea (Fig.5). Purse seine nets may be as deep as 250-300 meters. Since the 1980’s, a significant development that transformed tuna purse seining was in the introduction of Fish Aggregating Devices (FADs[[14]](#footnote-15)). There is extensive literature on the ecological, fishing efficiency and environmental impacts caused by these FADs, with results summarized below:

1. Smaller sized tunas occur under FADs, which are less valuable to the fishery and are significantly discarded. This can therefore cause growth overfishing for other fleets.
2. Purse seines lead to increased bycatch, which is mostly wasted due to the aforementioned value discrepancies.
3. Increased competition for fishing grounds between artisanal, small scale, commercial and recreational fishers.
4. Free FADs that drift away from tuna fishing grounds can create issues of non-operational derelict FADs. They can create, for example, navigational hazards that have not been quantified.
5. Coastal environmental impacts are expected but not yet evaluated given the washing ashore of non-operational drifting FADs.
6. Massive drifting FAD densities are thought to impact, in a yet unknown way, the population dynamics of fishes in the large pelagic marine ecosystem.
7. Changes in fishing efficiency and the selectivity of tuna purse seiners fishing with FADs has put in doubt the usefulness of catch per unit effort (CPUE), as an abundance index to carry out robust stock assessments. This results from the hyper stability of CPUE, with the value remaining stable because FADs continue to attract and condense fish beneath them, even though population abundances may be decreasing due to population over-exploitation. The same happens with other fishing gears used on moored FADs. Overall, CPUE indices from fisheries utilizing FADs are considered likely to provide a skewed perspective of stock abundance due to their ongoing aggregation mechanisms promoting artificially inflated catch rates, even within biologically compromised and/or declining stocks. FAD use essentially represents anthropogenic promotion of primary habitat or basin effects of concern to fisheries managers.

Currently, there are 107 large purse seine vessels operating in the Atlantic with a hold carrying capacity of 100,000 metric tons. Their fishing activities are concentrated in the eastern Atlantic (Fig.5) and may not have a direct impact on the fisheries in the WECAFC region. Nevertheless, billfish by-catch will affect Atlantic stocks and trans-oceanic journeys have been recorded in Atlantic billfish species to display potential linkages.

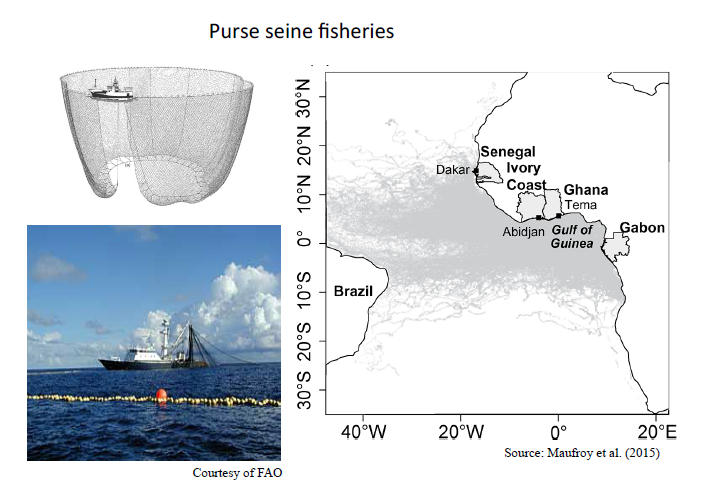


Figure 5: Atlantic purse seiners and areas of the tropical Atlantic marked by drifting FAD tracks. 18

Tuna and billfish are also targeted by gillnet fleets in Venezuela, Ghana, and in the southwest Atlantic. Venezuelan gillnetters operate in the eastern Caribbean Sea and offshore of the Guyana-Surinam region (Fig. 6; left figure). Figure 6 illustrates that these gillnetters capture blue marlin in greater relative proportions than their co-analyzed longline fleets, which have capture rates more aligned with these species natural abundance expectations.

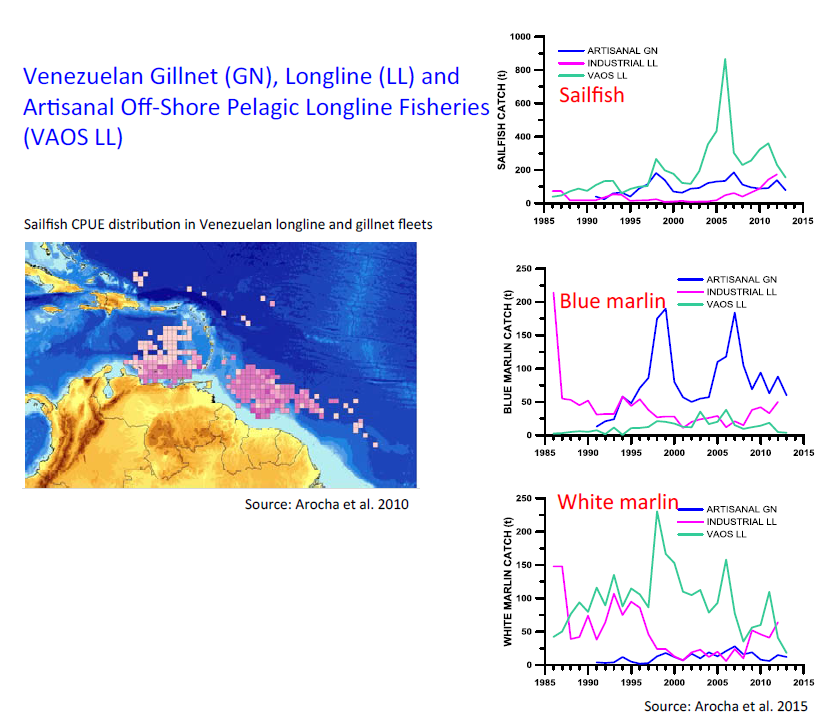


Figure 6: Area of operation and landings of Venezuelan gillnet and longline fleets. 18

Recreational fisheries targeting billfish developed in the United States during the early 1930’s, and have since extended in correspondence to tourism expansion throughout many WECAFC countries/territories, particularly in small island states. The social and economic contributions provided by billfish through recreational fisheries are most visible during tourism inducing recreational fisheries tournaments, for which large registration entry fees and awards generate incentives for catching billfishes. The vast majority of these tournaments in the region, and now globally, are catch-and-release in nature regarding billfish, with tournament points allocated according to the numbers of billfish caught and successfully released. This system is generally verified by on board observers or with video evidence. The overall emphasis upon the numbers of billfish caught and released, highlights the importance of maintaining billfish abundances above threshold values required to attract tourist anglers in future. The catch and release nature of recreational fishing for billfish encourages a non-extractive ethos within this fishery sector that contributes to the conservation of these valuable stocks.

In 2015, more than 215 billfish tournaments took place in several localities throughout the WECAFC region (Fig. 7). Many of these annual tournaments occurred in the United States, Puerto Rico, British and US Virgin Islands, and various small island states. Some examples of nations recognizing the valuable revenues recreational fishing fleets can create include billfish in the USA being protected by the Billfish Conservation Act and the federal fishery management plan of Puerto Rico prohibiting the sale of four billfish species that are reserved for recreational use only[[15]](#footnote-16)

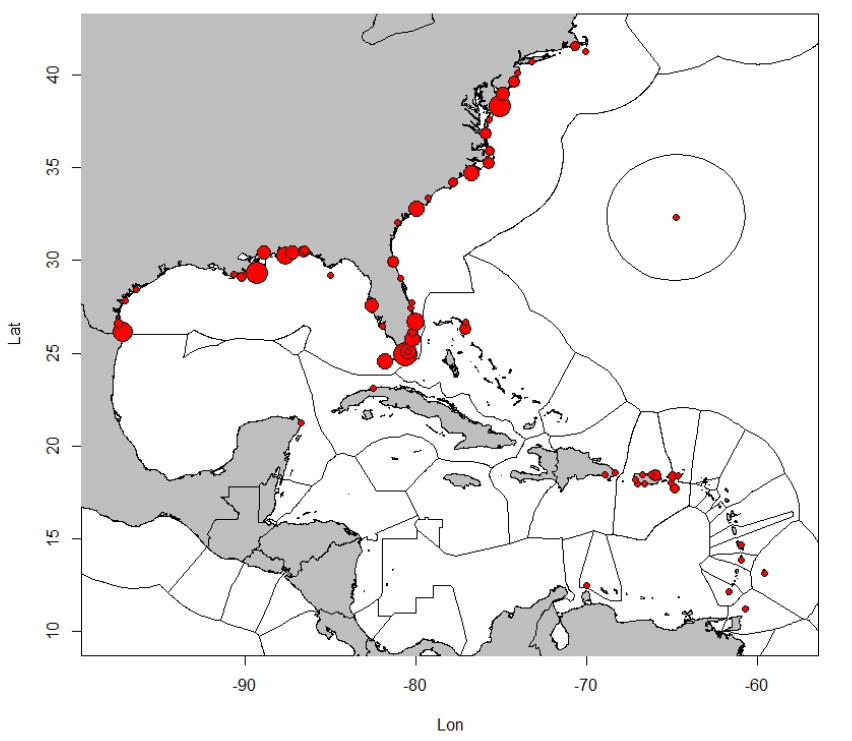


Figure 7: Distribution and density (circle size) of recreational billfish tournaments within the WECAFC region. 18

## 3.2.1 Resource status and current management

ICCAT is responsible for the research and management of tunas and billfish in the Atlantic Ocean. The main constraints to ICCAT stock assessment for billfishes include a lack of data standardization, the hyper-stability of CPUE estimations, as well as insufficient data regarding billfish landings and growth rates22. The CPUE standardization problem originates from fishing power differences among fleets and fishing gears, which in turn vary among countries, regions, and seasons. Fishing intensity (fishing effort per unit of area) changes according to seasonal migrations and the resultant geographic availabilities of tunas. Environmental and trophic linkages between tunas and billfish do suggest that migration interlinkages between these species groups do exist, thus fishing intensity is likely to also show some interlinkage with the geographic availabilities of billfish.

Billfish catch rates and landings vary in time and space among nations in the WECAFC region and can reflect the size and linked effort placed upon billfish by national fisheries. This information is however influenced by each nations actual reporting of landings for these bycatch species. Similarly, recreational fleet sizes vary within the region, in time and space, in accordance with the availability of billfish and required facilities18. Catches obtained around drifting and moored FADs represent a challenge to quantify CPUE as an unbiased index of relative billfish stock abundance. As previously stated, aggregation-based fisheries, such as those targeting tuna and billfish around FADs, can exhibit hyper-stability, in which CPUE remains elevated despite stock abundance declines. Scientists are aware that CPUE data must be used with caution and, in consequence, have highlighted the difficulties and risk in assessing tuna stocks (and by consequence billfish stocks) based on fishery-related data collected exclusively around FADs. In addition to the hyper-stability problem, the incidental (bycatch) nature of billfish catches in tuna fisheries further complicates the accurate and representative collection of billfish catch and biological data (size and weight) aboard fishing vessels. Effective data collection for billfish species is simply not a priority among fisheries for which these species are classified as bycatch.

Several major efforts and investments to improve billfish stock assessment databases have been conducted by ICCAT. Billfish stock assessment results suggest significantly decreasing trends in abundance of the three main billfish species of the Caribbean: blue marlin, white marlin and sailfish. In 1997, the Commission made its’ first binding recommendation for Atlantic blue and white marlin, requiring reductions in landings and noting the need for improvements in billfish fisheries monitoring. In November 2000, ICCAT adopted a two-phased marlin rebuilding program that required, among other things, that countries reduce white marlin and blue marlin landings.

The 2011 ICCATs Standing Committee on Research and Statistics (SCRS) stock assessment indicated that the blue marlin stock is below BMSY (the stock is overfished because the current biomass is below the biomass at the maximum sustainable yield level) and that fishing mortality is above FMSY (overfishing is occurring because current fishing mortality is over the fishing mortality at the maximum sustainable yield level) and that only catch levels of 2,000 tonnes or less would prevent further stock decline.[[16]](#footnote-17) The SCRS expressed concern with the significant increase in blue marlin harvest contributions from non-industrial fisheries, that landings from these fisheries are not fully accounted for in the ICCAT database and recommended that it is imperative to develop CPUE indices for all fleets that have substantial landings of blue marlin. ICCAT further noted that results of the 2012 white marlin assessment indicated that the stock was overfished, while highlighting significant uncertainty associated with this species composition in the historical time series of catch (white marlin vs. spearfish); as well as the actual magnitude of the catch due to the underreporting of discards. The Commission also acknowledged SCRS advice that, at a minimum, white marlin catches should be limited to less than 400 tonnes. Another observed signal indicating the bad state of billfish stocks is the broadly reported decline in trophy size noted among many sport fisheries over time.

In 2015, the Commission recommended an annual limit of 2,000 tonnes for blue marlin and 400 tonnes for white marlin/spearfish for these stocks, for 2016, 2017 and 2018. Current conservation and management recommendations include a mixture of total allowable catches, sharing arrangements for member countries, minimum size limits, effort controls, time and/or area closures, trade measures, and monitoring and inspection programmes. These actions do reflect broad scale recognition of the unsustainable effects that commercial fleets are currently having upon Atlantic billfish stocks, with an overlay of concerning stock signals within the typically fragmented data being captured. However, converting such recommendations into tangible and enforceable actions largely remains as an ongoing challenge for billfish species.

Atlantic blue marlin are considered over fished and currently subject to overfishing[[17]](#footnote-18). Figure 8 illustrates the decline in standardized CPUE indices for this species since the 1950s.

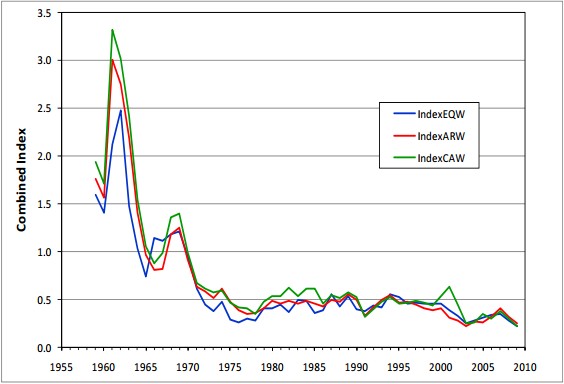


Figure 8: Blue marlin standardized combined CPUE indices estimated using equal weighting for all CPUE series (EQW), weighting the CPUE series by area (ARW) and by catch (CAW)14.

White marlin are considered overfished, and overfishing could be occurring if catches are under reported[[18]](#footnote-19). Figure 9 illustrates the temporal variability of catch for this species, which is typical for highly migratory billfish, but also clearly shows an overall decline in abundance. The previously mentioned ICCAT concern of underreporting discards of this species and the likely misidentification with roundscale spearfish should also be considered with reference to the below graph.

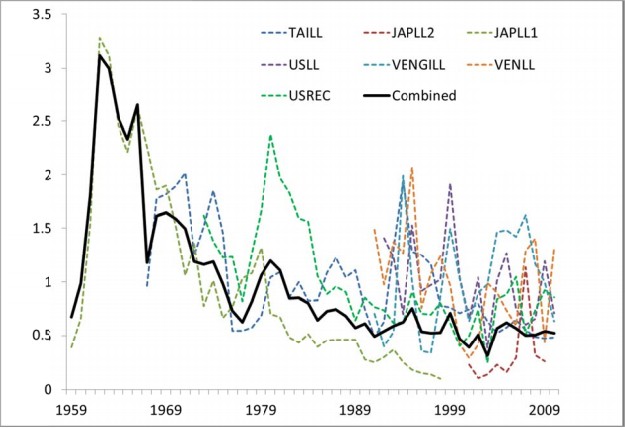


Figure 9: White marlin indices of abundance by fishery. For graphing purposes the indices are scaled to their respective mean value for the period 2009-201015

The west Atlantic sailfish stock is considered possibly overfished and possibly experiencing overfishing, in the face of fragmented data15. Data reporting for this species is also considered incomplete through discard reporting concerns. Figure 10 illustrates high variability in reported abundance indices, and the linked undistinguishable overall stock abundance trend through CPUE data.

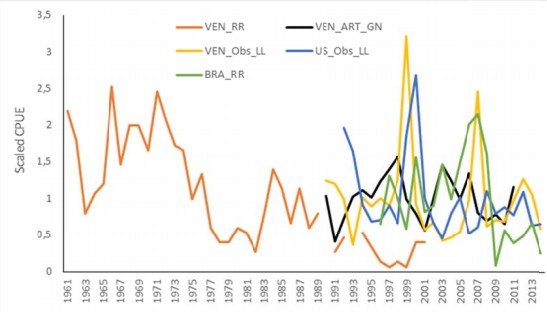


Figure 10: New relative abundance indices for Atlantic sailfish obtained by standardizing CPUE data for various fleets. All indices were scaled th the mean of each series prior to graphing[[19]](#footnote-20)

Spearfish stocks remain unassessed due to lacking specific data and it is unknown if their populations are currently sustainable as a result[[20]](#footnote-21).

# Problem Identification

Three main billfish species are important to recreational fisheries in the WECAFC region: blue marlin, white marlin and sailfish. Two other species are less available: longbill and roundscale spearfish; largely because longbill spearfish are relatively small and typically rare billfish, while roundscale spearfish are probably more important than many anglers realise, but this species is frequently mistaken for the very similar white marlin (see Figure 11). It’s pertinent to realise that the easy, and therefore presumed frequent, misidentification between roundscale spearfish as white marlin amplifies concerns related to both species stock status uncertainty and overall trends of abundance decline.



Figure 11: A white marlin (top) and roundscale spearfish (bottom), illustrating the similarity between these species (Photo credit - John Foster)

Billfish are caught as bycatch in large Atlantic longline, gillnet and purse seine tuna fisheries; however, they represent a mere 0.76% of the reported landings for tunas. This characteristic represents a major hurdle to objectively collect statistical data for the billfish stock assessments required to better define fishery regulations and billfish conservation policy developments. Economically and socially important recreational fisheries targeting billfish do exist throughout the WECAFC region, but these operate alongside commercial fisheries. Recreational and commercial fisheries simultaneously rely on utilising billfish resources, but they naturally have differing intentions and perspectives regarding the resources socio-economic value and linked best use. Resultant disputes between these fishery sectors, particularly between the artisanal and recreational fisheries which spatially overlap their activities most often, continue to increase in frequency, scale and intensity.

Atlantic billfish resources have been subjected to intense commercial exploitation for more than six decades and billfish stocks are depleted as a consequence. Many studies indicate that billfish stocks have already been overfished and/or are currently experiencing overfishing[[21]](#footnote-22). The area of the WECAFC is critically important habitat for billfish in the Atlantic Ocean, and is suggested to contain important feeding, spawning and nursery sites for multiple billfish species. Since the WECAFC region doesn’t geographically encompass all units of Atlantic billfish stocks, this regional plan won’t fully protect billfish in the Atlantic as a whole. Nonetheless, evidence suggests that appropriate focused efforts linked to highly migratory species’ important life-history requirements can provide broad geographic benefits. On-going commercial fishery developments do target billfish and other highly migratory species mostly in the eastern Caribbean Sea, thus compounding and exacerbating the already critical stock condition for these species. Moored fish aggregating devices (mFAD) were introduced into the region in the 1980’s and 1990’s, which further promoted and amplified billfish landings. This simultaneously enhanced competition, and an undesirable “race to fish” scenario, both within and between the various fishery sectors that capture billfish. Ongoing issues concerning each sectors rights to catch/harvest billfish, particularly around moored FADs, continue to develop and negatively impact upon the promotion long term stock sustainability considerations within all sectors.

Reduced billfish species abundances, alongside associated decreases in billfish trophy sizes, is negatively impacting recreational fishing industries within the Caribbean, while data simultaneously suggests these species only provide marginal revenues to commercial fisheries. On the other hand, longline fleets targeting tunas are the main foreign revenue earners in some countries, after tourism, and the fishing industry does employ many people. This scenario is particularly true for small islands in the southern Caribbean. Bycatch species, including billfish, are typically used for local consumption as a source of cheap protein, while large live billfish have the maximum value for non-extractive recreational fleets. This situation exemplifies the need to adjust regional management mechanisms in pursuit of more efficient resource use approaches that will capture the maximum value from billfish resources.

Such complex resources utilization matters represent the most important conservation issue related to billfish resource utilization in the WECAFC region. Table 1 shows a summary of topics, issues, their consequences and potential management solutions for Caribbean billfish stocks. The need for attention to the management of shared marine resources in the wider Caribbean region is well documented. From the early 1980s it has been a main subject for discussion by WECAFC and has continued to present challenges through the implementation of the CLME project and its second phase, the CLME+ project.

Table 1. Summary of topics, issues, their consequences and the linked options available to improve the management and conservation of Caribbean billfish stocks

| **Topic** | **Issue** | **Consequences** | **Resolution options** |
| --- | --- | --- | --- |
| **Biology of the species** | * Estimations of fish age underpin all biological rate parameters that are vital components of stock assessment modelling techniques. However, it’s very difficult and/or prohibitively expensive to achieve statistically acceptable biological sampling for billfishes. * Combining billfish species latitudinal ranges with their large annual migrations (that maintain these species within preferred thermal ranges) also brings typical seasonal influences used to thermally describe/justify the growth zones under interpretation during the ageing process into question for billfish. What actually causes growth zones in billfish hard structures, and is there a reliably consistent periodicity of zone depositions to genuinely support age estimations with hard parts? * Otoliths used to determine fish growth are small in billfish, fragile and difficult to extract from the cranium. Other “hard parts” including scales, vertebrae and fin spines often used to age fishes (and billfish through convenience of collection), are largely considered less suitable through providing reduced accuracy and precision for age estimations. * Difficulty in extracting (sample size) and interpreting billfish hard structures minimizes confidence in back calculation ageing techniques, and/or marginal zone analyses to validate age estimations. The reality that such techniques require validation of hard part zone deposition periodicity to be effective also precludes the confident achievement of billfish age estimations. * Validating age estimations through typical/robust means (such as bio-mark and recapture or captive individual comparisons) is not currently viable for billfish species either. * As apex predators billfish are likely to accumulate mercury in their bodies through trophic bioaccumulation mechanisms. * Billfish migration patterns and motivations remain undefined. There is an urgent requirement to identify important spawning, feeding and nursery sites to guide efficient sustainability promoting management mechanisms in the WECAFC region. | * Lacking biological data and questionable age estimation accuracy imposes much uncertainty upon parameters and assumptions used for billfish stock analyses. Concerning catch rate declines therefore provide the most direct/robust evidence of stock declines; but even these CPUE based analyses are considered to provide artificially inflated stock condition estimates because of the catch efficiency promotion achieved through FAD use. * Concerns about age estimates and other fragmented data accuracy amplifies uncertainty and likely buffers the genuine stock decline situation. * The conventional tag recapture rate is too low (typical for such highly migratory species) to allow effective analyses of billfish mortality rates and migration routes. Size estimations for tagged billfish are also too subjective/unreliable to effectively infer growth rates through tag recapture methods * Billfish meat could pose a risk to human health according to regional mercury contamination levels and consumption rates. * Billfish unit stocks and their migration routes are not well defined, but they are generally considered to extend beyond the WECAFC region. Focussed management and conservation mechanisms are pending the unambiguous identification of sites of life history importance (spawning, nursery, feeding) for each billfish species. | * Ensure a precautionary and ecosystem approach to fisheries management is employed to account for high levels of stock status uncertainty. * Seek to maintain a precautionary threshold abundance for each billfish species that is required to support small scale and recreational fisheries, likely above MSY levels. * Improve biological data collection through trained observers aboard commercial fleets; ensuring adequate sampling across sufficient geographic and temporal scales to support effective stock modelling for billfish. * Promote electronic tagging techniques to better understand how billfish utilise their lateral and vertical habitat in relation to other pelagic species, environmental conditions and mortality threats. * Effectively investigate seasonal billfish congregations for signs of spawning activity, nursery or feeding importance, with the genuine intention to objectively protect such sites as equitably as possible to maximise regional stock benefits. |
| **Catch and bycatch** | * Although labelled as “bycatch”, billfish have been suggested to provide important financial support to commercial fleets when targeted tunas are not abundant in their fished area. * Transhipments may take place with data not being reported, or being repeated * Data collection from small-scale/ artisanal and recreational fisheries is limited or does not exist at all * Roundscale spearfish identification is inadequate * Most reported Atlantic-wide billfish landings come from commercial industrial longline fisheries that target tuna and swordfish, bycatch species are not a reporting priority. * Limited data from fisheries on moored FADs * High mortality rates are reported for billfish by longline fishers, considered a consequence of their ram ventilation, but some research papers suggest otherwise, and relatively high post release survival, particularly with circle hooks. | * By still having a market value, billfish naturally attract targeted fishing when convenient * Difficult to accurately document total harvest of current fisheries as well as historical billfish landings * Difficult to determine sustainable harvestable biomass. * Catch quotas difficult to implement in bycatch species * Bycatch species are of limited interest, resulting in low research priorities * Alternative gears or method adaptations that could allow live releases of billfish available, but longlines remain the typical gear of convenience, despite high bycatch impacts. | * Limit the harvest of billfish. Options for this include fishery capacity caps, market or landing control mechanisms, various gear type and/or fishing method adaptations/restrictions, spatial and/or temporal fishing closures. * Seek to set quotas according to latest catch records. Modern billfish stocks cannot support historical harvest rates anyway and non-reporting fleets will be encouraged to improve their reporting to gain quota allocations. * Improve data coverage for small scale, artisanal and recreational fisheries through all means available. * Take a precautionary, and ecosystem based approach, to managing billfish stocks. This is suggested as standard practice when facing such uncertainty regarding sustainable harvestable biomass. This action should be further encouraged by recognising the additional uncertainty associated with white marlin and round-scale spearfish very likely to have been historically combined/merged in databases. * Catch quota difficulties should ideally be addressed through implementing mechanisms that reduce the primary capture of billfish, and thus avoid concerns of mortality once already captured by gears. Taking advantage of the natural vertical stratification between billfish and tunas in the water column, and using baits and other technologies that minimize billfish capture should be encouraged. * Ensure effective management of FADs and proactively seek to limit their deployments within manageable limits. * Seek to reduce gear soak times and maximize the value of tuna/swordfish harvests, while minimizing wastage and scavenging influences |
| **Fishing effort** | * Knowledge on spatial distribution of fishing effort is incomplete * Spatial Fleet interactions (commercial and recreational) are not well understood * Use of FADs adds an additional factor for determining spatial fishing effort distribution, and influences comparisons to pre-FAD fishery stock status statistics. * Fishing effort information from recreational and/or small-scale fleets not available in many countries * Different fisheries, and their employed gears have differing billfish catch efficiencies and overall influences upon billfish stocks. | * Difficult to standardize effort/catchability across fishing methods and over time. * Number of vessels active in all fisheries are largely unknown, making fisheries difficult to assess or manage | * Improve data collection and overall MCS. * Institute or update an enforced registry of all fishing vessels, by sector, limit fishing licence numbers and seek economic efficiencies rather capacity increases. Make fishers right to fish more valuable to remove the currently deleterious “race-to-fish” scenario and naturally engender longer term considerations within and between sectors. * Pursue all means necessary to address IUU fishing, so that fishing licences maintain their promoted value. |
| **FAD fisheries** | * FAD fisheries catch rates (CPUE) conceal actual biomass and abundance trends. This occurs through primary habitat effects in the pelagic zone artificially inflating catches around FADs to skew reliant relationship assumptions between catch and abundance towards a higher level. * Potential FAD effects on migration patterns and stock abundance remain unclear * Unknown number of FADs operating in the region * FADs also congregate fishers and resultant fishing effort within smaller relative sections of the pelagic zone. | * Estimates of catch per unit of effort (CPUE) cannot be considered as an unbiased index of relative abundance since the introduction of FADs. * Stock biomass can reduce without the true status of stock abundance being visible through CPUE data (hyper stability). * Not knowing how many FADs are in use, nor having formal controls of their deployments could rapidly lead to an unmanageable situation with negative effects upon many pelagic stocks * Fishers congregating efforts around FADs promotes the race-to-fish scenario, highlights competition within and between pelagic fishery sectors and naturally encourages conflicts between fishers. | * Conduct FAD independent fisheries surveys with historical gears to develop accurate abundance reference points and conversion factors that address FAD data comparability concerns in future stock modelling efforts. * Formalize the management of FADs, require their registration and seek to limit FAD deployments within manageable thresholds. |
| **Habitat degradation and effects from climate change** | * Increases in seawater temperatures and pH can affect billfish prey distributions and have unknown consequences on life stages of the billfish species * Billfish distributions and resultant availabilities to national fisheries will be altered by ocean warming and current variations induced by climate change | * Potential reductions of billfish abundances, seasonal availabilities, changes in habitat use, distributions and/or migration patterns * Potential shifts of locations for important life history events (e.g. the locality of environmental conditions required for spawning) * Billfish migrations and distributions will likely shift towards greater latitudes. | * Maintain precautionary billfish stock abundances to minimize potential negative influences |
| **Socio-economic impacts** | * Socio-economic and demographic data about commercial and recreational fishing sectors generally deficient or non-existent * In several countries, small-scale/artisanal fishers depend upon billfish to support family income and/or provide cheap protein * Different perceptions of the values and best use of billfish among commercial and recreational fisheries impose complex considerations for developing effective management strategies * Right based mechanisms are generally not well understood * Limited practical on the ground application of co-management has been achieved in the region to date * Lacking socio-economic data fisheries capturing billfish, their market structures and value addition options | * Limited knowledge about socio-economics, demographics and dynamic of commercial and recreational fishing sectors * Conflicts between commercial and recreational sectors through extraction uncertainties and ongoing competition for the shared fishing grounds/resources. * Management authorities require additional information to plan and coordinate implementation of measures * General reluctance to accept and implement right-based approaches. Rejection by stakeholders seem to result from a focus upon the ITQ perspective of only “benefiting the wealthy” * Incomplete knowledge of commercial and recreational fishery values | * Improve regional knowledge of socio-economic and demographic conditions for fisheries capturing billfish * Improve post-harvest handling techniques to maximize profits while minimizing wastage. Advisory to link this to effective vessel registration and cap on fleet size to ensure improved profits increase licence value, rather than promoting typical further investment into capacities of fleets already targeting compromised stocks * Further inform stakeholders about rights-based approaches opportunities and risks. Field test mechanisms so lessons learnt promote successful case studies * Further investigate/define commercial and recreational fishery values |
| **Illegal, Unreported, Unregulated (IUU) fishing** | * Collection and systematization of data about IUU fishing deficient or non-existent * Illegal fishing from local and foreign fleets in EEZ waters * Migratory nature of billfish makes it difficult to control IUU fishing * No billfish specific regulations for commercial and recreational fisheries in many countries * Limited regional coordination for exchange of information and use of vessel registers or no register in place at the national level | * Poor knowledge about magnitude of regional IUU fishing makes it difficult/impossible to address * Magnitude of illegal fishing or resultant trade remains largely undefined * Regional collaboration required among stakeholders for IUU fishing to be adequately addressed * Unknown negative economic impacts likely result from IUU fishing * Unreported fishing creates a myriad of challenges for fishery management while undermining the value of fishing licences/rights; thus encouraging a race-to-fish | * Institute comprehensive vessel registration and implement progressive management plans * Develop national legislations to support effective convictions of confirmed IUU fishing * Improve MCS technologies to guide effective enforcement mechanisms * Promote international fishery communications with collaborative enforcement mechanisms |
| **Surveillance and enforcement** | * Expanding distance of fishing areas creates challenges for logistics and funding for surveillance * Establishment of observer programs is difficult and expensive * Satellite based VMS in some countries, however real-time data not always available as required for coordination * No regionally agreed surveillance and enforcement coordination mechanisms in place | * Enforcement becomes inefficient/ineffective. * Enforcement costs increasing, while cost recovery outdated with poor fisheries legislation * Partnerships needed among different stakeholders in the ABNJ * Benefits of available technology aren’t maximized through technological, administrative or political issues | * Review/update legislations to support enforcement * Use FADs effect of congregating fishers to streamline surveillance and enforcement * Outline regionally agreed surveillance measures using synergistic opportunities through Regional Fisheries Management Organisations (RFMOs) * Ensure enforcement authorities have effective access to the VMS systems * Implement novel technologies |
| **Participation in the decision making process** | * Typically low participation of fishers in planning and decision making processes. * Limited organization of commercial and recreational fishery groups, cooperatives/associations complicates stakeholder engagements * Limited participation and influence in ICCAT decision making | * Co-management remains at the pre-implementation phase. * Poor organisation creates non-representation of fishers in important management and decision making processes * ICCAT often not sufficiently informed to effectively recognise Caribbean fisheries. | * Promote regular stakeholder communications to avoid conflict, generate trust and engender a sense of resource ownership among fishery stakeholders * Develop regional representations at ICCAT meetings to promote collaborative SID recognition |
| **Management** | * No governance arrangements for billfish fisheries management at WECAFC level * No national/regional/sub regional billfish management plans in place * Not all WECAFC countries are members of ICCAT * There are no regional bycatch management plans * Lacking long range continuity of government support for fishery management | * No regional cooperation and management in place, except for ICCAT regulations on quota systems and other management measures * Billfish fisheries in the Caribbean is not high on the agenda of ICCAT * Flag state responsibilities under international agreements are not being enforced effectively * Many populations are exploited by multinational fisheries whose regulation, from a political perspective, is exceedingly difficult. * Local or national management and conservation actions are ineffective due to lacking regional coordination and collaboration | * Endorse and implement management plans * Promote ICCAT membership among Caribbean nations * Use value divergences between sectors to emphasize the importance of addressing billfish concerns * Formally recognize and objectively resolve political implications that prohibit effective multinational fisheries management * Merge improved database inputs under WECAFC for holistic stock status representations |
| **Recreational Fisheries** | * Recreational fisheries represent high, but largely untapped economic value * Recreational fisheries infrequently fall under fishery authorities’ competence and formal responsibilities * Increasingly aggressive conflicts occurring through competition for declining shared resources * FADs artificially promote recreational fishery catch rates too, but are flash points for conflicts | * Recreational requirements aren’t formally considered in fishery management decisions * Conflicts continue to escalate without appropriate sector recognitions, right allocations and management protocols | * Determine fisheries overall values and objectively compare results to commercial fisheries * Ensure RFMOs promote informed relative sector recognitions * Include recreational fisheries within legislative frameworks and outline effective management protocols * Proactively address inter-sector conflicts by defining and enforcing resource allocations |

Based on the information presented, the need for a regional billfish management plan is summarized in the following points:

1. Ongoing overexploitation of billfish stocks.
2. Poor governance of commercial and recreational billfish fisheries in the WECAFC region.
3. Limited statistical and biological information objectively collected for stock assessment and reporting purposes (precautionary approach to management advised in such instances).
4. Lack of unbiased CPUE data for conducting accurate and robust stock assessments.
5. Exponential and unregulated expansion of FAD fisheries in the WECAFC area and beyond.
6. In most cases, there are only limited national regulatory and institutional frameworks regarding the management of sport/recreational fisheries.
7. There are options available to address each of the concerns

# 5. Plan principles, the overall goal and specific objectives

## 5.1 Principles

**Participation.** All stakeholders that contribute to fishing mortality, including those involved in recreational fisheries and conservation-related activities, should participate in management processes. All sectoral planning decisions and actions affecting communities should take into account the participation of interested and affected parties. The Consortium on Billfish Management and Conservation should play an important pivotal role to organize stakeholders for participation and ensure they have a voice in the decision making process.

**Adoption of the Precautionary Approach.** Because of the ongoing downward trend in landings, reduced relative abundance indicating a compromised stock and high levels of data uncertainty, successful management of billfish-related fisheries should employ a precautionary approach. A threshold billfish abundance required to maintain small scale and recreational fleet values should be sought.

**Adoption of the Ecosystem Approach to Fisheries (EAF).** Commercial and recreational fisheries exhibit numerous regional distinctions and differences such as: target and incidental species, catch and release, by-catch and by-catch mortality, geographic location, gear, season, vessel and fishing gear characteristics. Consequently, each fishery poses different levels of risk to billfish populations, either directly or through trophic effects. Therefore, as it is defined by FAO, EAF strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

**Gradual application.** The Plan will be gradually implemented following an adaptive process on the basis of evaluating progress and results for the activities, and the priorities set by Governments and/or Regional/Sub-regional Organizations and stakeholders.

**Adaptive management.** Social, economic and biological/ecological variables need to be continuously monitored because they are dynamic and have some level of uncertainty, and adjusting actions and strategies based on new knowledge are to be taken. Therefore, the management process of modifying policies and actions in light of evaluation of the success/failure of past actions related to previously defined operational objectives should be followed.

**Responsibility.**The national fisheries authorities responsible for fisheries management in the WECAFC region are basically responsible for implementing the regional management and conservation plan within their national jurisdictions, and for monitoring and evaluating the status of implementation against the objectives and indicators agreed upon.

## 5.2 Goal

The goal of this Caribbean Regional Billfish Management and Conservation Plan is to create the enabling conditions required to ensure the responsible and sustainable development of commercial and recreational billfish fisheries in the Western Central Atlantic Ocean. This will be achieved through promoting adoption of the FAO Code of Conduct for responsible fisheries and its’ supplements, as well as the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.

## 5.3 Specific objectives

Table 2 shows the logical framework for the plan implementation and Annex 1 shows the proposed regional specific objectives and management activities/measures timeline.

The Regional Management and Conservation Plan has the following specific objectives:

1. Improve fishery catch and effort data collection and reporting programs for billfish in recreational and commercial fisheries.
2. Recover billfish stocks and maximize the sustainable economic value of commercial and recreational billfish fisheries by reducing, to the extent practicable, bycatch and discard mortality of Caribbean billfish in longline and other commercial fisheries.
3. Define target and limit reference points appropriate for billfish species while establishing adequate harvest control rules (HCRs) to enforce them.
4. Increase the coordination, collaboration and participation in current regional governance arrangements to address Caribbean billfish management and conservation.
5. Combat IUU fishing by improving monitoring, control and surveillance systems of both commercial and recreational large pelagic fisheries with harmonized management measures coordinated at regional level.
6. Enhance the governance and economic performance of recreational and commercial billfish fisheries in the WECAFC region by promoting co-management and tenure rights based management approaches in combination with the improvement of billfish fisheries value chains and fishers’ organizations’ social capital in terms of organization, social cohesion, leadership and entrepreneurial capacity.

Table 2 Logical framework for plan implementation

| ***Specific Objectives*** | ***Outputs*** | ***Activities*** | ***Indicators*** | ***Means of Verification*** | ***Assumptions*** |
| --- | --- | --- | --- | --- | --- |
| 1. Improve fisheries catch, landings and effort data collection and reporting programs for billfish recreational and commercial fisheries | National and regional database with recreational and commercial fisheries data collected based on agreed protocols  Commercial billfish fisheries data and statistics improved in support of management decision making processes, including negotiations for quota at ICCAT | * Design, test, validate and adopt a data collection scheme for recreational fisheries * Establishment of a Fisheries Information System at the WECAFC secretariat in coordination with FAO-FIRMS * Countries start reporting recreational fisheries data to FAO and ICCAT * Capacity building in fisheries statistics | * Recreational fisheries data collection system and protocols validated and adopted in at least 15 countries by year 3 * Regional Fisheries Information System in place at WECAFC secretariat by end of year 1 * Recreational fisheries national databases ready for regional integration in at least 15 WECAF countries by year 3 * Integration with FAO-FIRMS and ICCAT databases by year 5 | * Fisheries data collection system in place in the WECAFC region * Agreements and protocols developed and implemented at the regional level * National Reports of recreational fisheries data available * FAO and ICCAT reports available | * Availability of staff to collect and collate data while maintaining the up-to-date database to allow required analyses. * Financial resources available to support system in the short and long term * Industrial and artisanal commercial fisheries catch and effort data collection for large pelagic species is in place to complement billfish recreational fisheries data and allow accurate comparisons |
| 2. Recover billfish stocks and maximize the sustainable economic value of commercial and recreational billfish fisheries by reducing, to the extent practicable, bycatch and discard mortality of Caribbean billfish in longline and other fisheries | Billfish by-catch and by-catch mortality is effectively addressed and reduced as much as practicable  Novel fishing gears, technologies and fishing methods are field tested and accordingly supported for implementation on national and regional scales | * Awareness raising and creation of incentives for billfish bycatch reduction * Shift from traditional J hooks to non-offset circular hooks in selected fisheries operating in the WECAFC region where billfish are common bycatch and potentially available for release * Carry out training workshops on use of circle hooks and billfish releasing techniques * Promotion, or formal institution of catch and release techniques for billfish in recreational fisheries to eliminate competitive sphere with other sectors * Promotion and regional adoption of IGFA international angling rules for recreational fisheries * Adoption of regulations established by the CRFM sub regional management plan for FAD fisheries * Tests of innovative fishing gears, technologies and/or fishing methods minimize billfish bycatch effects | * Type of incentives in place to address bycatch issues by year 3 in at least 10 WECAF countries * Number of training workshops on circle hooks, billfish handling/release techniques and reporting by year 3 in at least 10 countries * Number of fisheries with circle hooks implemented in longline gears and recreational fisheries by year 5 in at least 10 WECAFC countries * IGFA international angling rules adopted and implemented in at least 15 WECAFC countries recreational fisheries by year 3 * Regulations of the CRFM Management Plan for FAD fisheries adopted and implemented where needed * Number of field tests for novel gears/technologies/fishing methods | * Incentives created and implemented * Official documents adopting circle hooks in fisheries and international angling rules * Fisheries using circle hooks * Training Workshop reports * Official document adopting the management plan for FAD fisheries * Catch statistics reports from commercial and recreational fisheries * Number of commercial vessels/fleets committed to actively avoiding billfish capture and/or releasing billfish as much as practicable * Number of reports published with guiding results from field tests with billfish bycatch reducing gears/technologies/fishing methods | * Fishers are aware of the importance of protecting bycatch species, and alternative values billfish species provide * Moored FADs fisheries do implement the FAD management plan of the CRFM * Appropriate incentive mechanisms allow a value adding shift towards billfish avoidance and/or release among commercial fisheries, without the need for alternative blanket controls * Novel gear tests will be conducted objectively and billfish harvest reductions will result, with ample supporting financial data and analyses for holistic test results. |
| 3. Define target and limit reference points appropriate for billfish species, establishing adequate harvest control rules (HCRs). | Improved stock monitoring capacity accurately defines precautionary harvest limits  A threshold billfish abundance above currently elusive and surpassed MSY levels is defined and effectively maintained  Precautionary harvest limits effectively enforced through adequate harvest control rules | * Adoption of improved data collection mechanisms across fishery sectors that capture billfish * Insights from improved biological, catch and effort data guides the development of appropriately precautionary harvest limits * Improved data comparisons inform development of effective conversion factors to allow improved CPUE modelling and comparisons across FAD introduction * IUU fishing concerns are adequately addressed | * Improved biological, catch and effort data effectively implemented by year 3 * Precautionary harvest limits defined, instituted and achieved in at least 10 WECAFC nations by year 5 * Improvements in data capture and analyses allow more accurate statistical comparisons of CPUE data across the period of FAD implementations | * Data improvements are implemented and reported on national, regional and ICCAT scales * Number of countries for which precautionary harvest limits are implemented for billfish species * Research fishing allows improved comparison accuracy for CPUE data | * Sufficient resources available to support improved data collection and resultant analyses * Sufficient political will to effectively enforce IUU fishing regulations on a regional scale |
| 4. Increase the coordination, collaboration and participation in current regional governance arrangements to address Caribbean billfish management and conservation | Harmonized and adaptive regional billfish management mechanisms, with enhanced partnership between organizations and stakeholders  Improved collective voice, recognition and resultant influence of Caribbean states at ICCAT meetings | * Implementation of the Interim Management Mechanism established under the CLME+ project (WECAFC, CRFM and OSPESCA) * Sign a Memorandum of Understanding between ICCAT and WECAFC for improving participation on management and conservation measures for billfish * Consortium on Billfish Management and Conservation (CBMC) actively participating with recommendations and advice during implementation of the Plan * Evaluate need to continue or not with the WECAFC recreational fisheries working group, and finance its’ ongoing role accordingly * Support development of regionally harmonized regulations and management measures on billfish | * Memorandum WECAFC-ICCAT signed by year 5 * Biannual meetings of the Consortium * Agreements of the Interim Management Mechanism * Ongoing recommendations provided by the Consortium * Increased membership and participation of Caribbean states in ICCAT * Regional regulation developments, updates and adjustments | * Meetings´ proceedings * Signed Memorandum * Signed agreements * Number of WECAFC members also member of ICCAT | * Legal clearance to sign a memorandum of understanding * Consortium and Interim Mechanism in place and operating * Stakeholders interested in actively contributing to collaborative processes |
| 5. Combat IUU fishing by improving monitoring, control and surveillance systems of commercial and recreational large pelagic fisheries with harmonized management measures coordinated at regional level. | Harmonized collaborative regional management measures to monitor and control fishing effort in place | * Implementation of VMS systems in billfish-related industrial/artisanal and recreational fisheries * Find alternatives or complementary options to the use of VMS when appropriate (e.g. AIS) * Implementation/update of a billfish-related vessel register for commercial and recreational vessels * Training on billfish identification for customs and other government officials | * VMS system or alternate option established in billfish-related industrial and recreational fisheries in at least 15 WECAFC countries by year 3 * Alternate VMS for artisanal fisheries options tested and validated by year 3 where needed and implemented by year 5 * Billfish-related commercial and recreational vessels registered in at least 15 WECAFC countries by year 4 * Training on billfish identification carried out in at least 10 WECAFC countries by year 3. | * VMS or alternate systems in place and operating * IUU reports, arrests and resultant convictions * Vessel register in place and implemented * Training reports * Export reports | * Human and financial resources available * Willingness to adopt and implement regional management measures * Legislative processes for issuance of national regulations will be available in due time |
| 6. Enhance the governance and economic performance of recreational and commercial billfish fisheries in the WECAFC region by promoting co-management and tenure rights based management approaches in combination with the improvement of billfish fisheries value chains and fishers organizations social capital in terms of organization, social cohesion, leadership and entrepreneurial capacity. | Opportunities and alternatives identified and implemented for minimizing adverse social and economic effects, in particular for small scale fisheries and consumers  Opportunities to improve the cost effectiveness and overall efficiency of billfish friendly fishing gears, methods and related technologies are fully pursued | * Find and implement incentives and opportunities (business cases) for fishers working towards the conservation of billfish * Incentivise and encourage movement of commercial fishery employment towards the tourism sector, or develop acceptable alternatives * Promote and implement co-management and tenure rights where applicable * Investigate mercury levels in billfish species flesh and potential consequences for the health of consumers according to noted consumption rates * Formally institute catch and release only for billfish in recreational fisheries. | * Number of opportunities and incentives granted to commercial/artisanal fishers by year 5 in at least 10 WECAF countries * Number of business cases prepared and /or implemented by year 3 * Number of compensation mechanisms in place by year 3 * Reduction in billfish catch and/or numbers of verified billfish releases achieved. * Reduction of billfish landings in recreational fleet | * Examples of business cases implemented * Amount of money invested in business cases * Amount and type of incentive mechanisms developed and implemented * Number of fishers/ communities benefited * Number of co-management or tenure rights initiatives implemented * Comparative value adjustments achieved between fishery sectors * Fees paid by recreational fishers if/when they land billfish. | * Political willingness, support and enforcement capacity * Continuous active participation by stakeholders in decision making processes. * Funding available to support innovative management mechanisms |

# 6. Proposed regional billfish management measures

* ***Use of circle hooks in longline and other hook and line fisheries in the region***

**Justification:** The International Commission for the Conservation of Atlantic Tunas (ICCAT) has indicated that it may consider the mandatory adoption of non-offset circle hooks as terminal gear. Research on billfish caught on longline gear fitted with circle hooks reported that, depending on the species, 65-70% of billfish caught on circle hooks are alive on haul back. Released fish fitted with satellite tags indicated that post release survival ranged between 88-93%. Because billfish are caught primarily as bycatch while targeting other species, these results indicate that circle hooks may be a viable conservation tool in longline fisheries. In addition to reduced billfish mortality, the catch rates of several of the targeted species remained unchanged or were greater than the catch rates observed with conventional J hooks.

The ICCAT Standing Committee on Research and Statistics (SCRS) reports that recent research demonstrated that in some longline fisheries the use of non-offset circle hooks resulted in a reduction of marlin mortality, while the catch rates of several of the target species remained the same or were greater than the catch rates observed with the use of conventional J hooks or offset circle hooks. The Committee considers that this approach may be more efficient and enforceable than time-area closures and has recommended that the Commission take this approach. This measure is linked to specific objective 2.

**Implementation advice:** Incorporation of fisher’s knowledge and perspectives into the decision making process will ensure maximal likelihood of adoption, identify barriers to the implementation of circle hooks and streamline the process of overcoming challenges. Capacity building and support may be required for effective implementation, as may information about the best rigging techniques for circle hooks. National and/or regional standards for non-offset circle hooks to be used must be determined and effectively communicated.

* ***Ban on exports of billfish with a linked regional ban on billfish landings from Distant Water Fishing Nations’ (DWFN) fleets***

**Justification:**  An effective way for protecting species is preventing market development, particularly if the species are not a target in a fishery. Trade through international markets promotes overcapacity in national fisheries. Preliminary results from studies carried out under the Caribbean Billfish Project indicate that the value of commercial landings of billfish in the WECAFC region is less than 1% of total fisheries production. As such, commercial harvest of billfish is not considered a significant revenue source for countries in the WECAFC region. Considering the relatively low market value of commercial billfish, and these species broader economic contributions to the region, a conservation approach may be to ban the exports of billfish species. Doing so would reduce incentives for commercial fishers retaining and landing billfish beyond that of the demand of local markets. Species with market value, particularly those with export value, are naturally retained by commercial fisheries regardless of formal classifications as target or bycatch. National market trends will naturally influence billfish harvest rates if sales are no longer available into broader international market spheres. Billfish captures can be avoided by commercial fleets if that is a genuine, market encouraged intention.

Controlling regional markets export capacities should be combined with a ban of billfish landings in the region by DWFN fleets. Billfish landings from large DWFN commercial fleets directly compete with national fleet sales in seafood markets. Export restrictions should thus be aligned with the protection and capture of the value still obtained from billfish species within national fleets and seafood markets.

In addition, it is noted that most people are unaware that marlins have been reported to accumulate harmful levels of mercury. The United States Environmental Protection Agency (EPA) health guidelines for fish consumption indicate that any fish with a mercury level greater than 1.5 parts per million (ppm) should not be consumed in any amount.  Marlins, especially large specimens, have been found to have mercury levels as high as 15 ppm. Some of the highest levels of mercury contaminations recorded in bony fishes were noted in billfish, which lead to national billfish sale bans in other regions. Local consumption rates are considered relatively high in Caribbean nations due to the traditional seafood consumption reliance which is typical of island states, and the relatively cheap price of billfish in regional markets. Further studies on socioeconomic and health aspects related to billfish consumption rates and quantities would be required before considering linked controls on local trade and consumption. This measure is linked to specific objectives 5 and 6 and the concurrent regulation of billfish landings in recreational fleets.

**Implementation advice:** Regional regulation developed, adopted and implemented at national level. Carry out training on species identification for customs officials and any other government officials as required. Ensure sufficient support for regulation authorities with legislation that supports enforcement and actual convictions when required.

* ***Fishing vessels for highly migratory species are required to use Vessel Monitoring Systems or similar alternate options***

**Justification**: Vessel Monitoring Systems (VMS) and Automatic Identification Systems (AIS) are extensively used to monitor and assess the position and activity of commercial fishing vessels, and they can also be used in recreational fisheries. Potential benefits resulting from the use of VMS and/or AIS include: important information to manage fisheries resources is provided (potentially in real time when required), improved compliance with fisheries regulations through positional information and insights about vessel activity, provides information about the stock status and fish movements by contributing to increased accuracy and timeliness of catch and effort information acquisition, and facilitates efficient rescue responses to emergencies at sea. This measure is linked to specific objective 4.

**Implementation advice:** Establishment of national VMS for fishing vessels (both commercial and recreational). In addition, the region explores ways to integrate the national systems through protocols and agreements among countries. Development and implementation of VMS linked to monitoring, control and surveillance schemes. Of special importance is to test and validate alternate systems, including AIS systems, to be implemented in artisanal or small-scale fisheries where usual VMS shipboard equipment cannot be installed. The legal framework at national level should be developed or adapted if needed.

* ***Novel gears, technologies and fishing methods that minimize the capture of billfish, and other bycatch species are regionally encouraged and formally phased into commercial fisheries wherever practical***

**Justification**: In many fisheries there are subsidies and incentives aimed at maintaining the profitability of ecologically inefficient fishing gears and practices in the face of consistently declining stocks. A counterproductive, yet common, modality that targets symptoms of underlying fisheries issues, but not their underlying cause. Such systems have obvious deleterious ramifications and are not considered sustainable in the long term, but it is difficult to reverse these cycles once instituted. Incentive and subsidy mechanisms should be geared towards promoting fishing gears, technologies and activities that seek to maintain the sustainability of, and maximize the profits from, limited target fishery resources with an ecosystem approach perspective. Incentives should therefore seek to minimize the risks associated with fishery stakeholders’ efforts to promote the long term sustainability of the ecosystems upon which their industries existence ultimately depends. This measure is linked to specific objective 2

**Implementation advice**: Practical alternative gears, technologies and fishing methods should be field tested and then actively promoted within various fisheries. Objective comparisons investigating the success of case studies should be used to adjust incentive mechanisms towards supporting fisheries conversions towards successful applications.

* ***Commercial and recreational fishing fleet for highly migratory species should be officially registered to combat IUU fishing***

**Justification:** Licensing and registration are necessary conditions for monitoring, control and surveillance of fisheries, and for implementing tenure rights approaches. They are also an important contribution to combat IUU fishing. There are already examples of national industrial fishing vessel registers linked to a sub-regional fishing fleet register in OSPESCA countries belonging to the SICA. Data could include the identification of the vessel and ship-owner, and a record of performance and compliance. In a regional/sub regional context, information can be shared, under agreed procedures, among participating States in the region and decisions can be made regarding allowing a vessel access to fish in the area. Vessel registration is an area that merits considerable attention for both monitoring, control and surveillance purposes, but also for vessel safety requirements. The potential exists for this to be a credible international management tool for both flag State and port State control. This measure is linked to specific objective 4.

**Implementation advice:** Inclusion of all large pelagics commercial and recreational fishing vessels in the register. National vessel registers linked to a regional/sub regional register under procedures and provisions agreed by the WECAFC or sub regional fisheries bodies member States. Linked to the VMS system (as above).

* ***Improve and harmonize billfish fishery monitoring systems (catch/ landings and effort data) at regional level.***

**Justification**: Billfish catch and effort data for commercial and recreational fisheries are often incomplete, but greatly needed for billfish stock assessments, and provide vital information for decision making. In addition to national needs, the highly migratory nature of billfish stocks requires regional research and management that can only be effectively informed through the analysis of complementary catch and effort data sets that ensure complete and holistic stock coverage.  In some cases, data only exist on paper or electronic data are not organized and analyzed with sufficient statistical rigor and/or data only represent short time periods.

Fishing effort is another key variable, particularly because most stock assessment models use catch per unit effort as an index of abundance. One particular concern regarding fishing effort is the use of FADs, many of which are not reported and recorded as part of the fishing effort as it should be. Fishery independent data could provide a direct measure of the effectiveness of management and regulations, and are of particular importance if a country is an ICCAT member. In recreational billfish fisheries there are fewer landings and they are rarely reported. In general, catch/ landings and effort data collection for many fish species continues to be one of the main challenges of several fisheries departments in the Caribbean. This measure is linked to specific objective 1.

**Implementation advice:** Countries should invest to improve data collection from commercial and recreational fisheries as the issue of catch and fishing effort data collection has been recurrent for many other fisheries and in Caribbean regional/subregional management plans (e.g. queen conch, flyingfish, spiny lobster). Improved coordination and cooperation among stakeholders in designing and participating in a meaningful way to data gathering can improve the quality of the data and reporting.

Due to the variety and particularities of Caribbean countries there is no one-size-fits-all solution for implementing a statistical data collection scheme. In most of the cases, statistical sampling approaches could be probably used to estimate total effort, catches, and discards. The Caribbean Billfish project will test and validate a data collection scheme for recreational fisheries which can be used. Those countries with important recreational and/or FADs fisheries will need to put in place a system for data collection which could include mandatory reporting of logbooks and fishery licenses. Electronic Monitoring Systems (EMS) are considered the most cost and time effective means of data collection, with the potential to provide streamlined analysis pathways on a regional scale. WECAFC could maintain a regional hub database and utilize its global personnel assets to aid data analyses as required.

* **Other management measures**

In addition, there are other management measures which could be considered for further discussion in the future:

* + closed areas
  + closed seasons
  + broader bans on billfish landings
  + identification and conservation of critical billfish spawning areas
  + billfish minimum size limits
  + catch and bycatch quotas
  + cap on commercial fleet sizes with an emphasis shift to license value and fishing efficiency for target species

These measures have not been included in this plan because they are not applicable in the WECAFC region under present circumstances. Nevertheless, some of them are already in place under ICCAT, e.g. minimum size limits and catch quotas, but further discussions are needed on how some of the ICCAT regulations can be adopted in the WECAFC region.

# 7. Adaptive management mechanisms for implementing and reviewing the management and conservation plan

This plan is a first step to establish a scheme for adaptive management and conservation of billfish which form part of the oceanic highly migratory species group, and are bycatch species for large-scale tuna fisheries. The Interim Coordination Arrangement for Sustainable Fisheries developed under the CLME+ project among FAO/WECAFC, CRFM and OSPESCA seems to be a useful instrument to further the management and conservation of billfish fisheries in the region. The Interim Coordination can assist with promotion of better fisheries management and ensure greater participation of the region in ICCAT decision making processes, while contributing to its objectives. The importance of large pelagic fisheries, including those capturing billfish, for the region was recognized by countries that participated in the GEF (International Waters) funded Caribbean Large Marine Ecosystem (CLME) project in recent years. The Strategic Action Programme (SAP) of the CLME, which was endorsed by more than 25 governments in 2013, incorporated a strategy (5B) “Enhance the governance arrangements for implementing an ecosystem approach for large pelagics fisheries”. The SAP implementation will therefore contribute to the establishment, and implementation of the Caribbean billfish Management and Conservation Plan.

Figure 12 shows a proposed flowchart for the plans adaptive implementation and revision. At the national level, countries implement, review and evaluate the plan while generating findings and recommendations which are then submitted to their respective subregional organizations (e.g. OSPESCA, CRFM and the CFMC). In turn, each subregional organization will follow the same process which will generate advice and recommendations to be provided to WECAFC at the regional level. In the case of countries that do not belong to any of the aforementioned organizations, then the advice is provided directly to WECAFC.

At the WECAFC secretariat level, advice and recommendations provided from the subregional level are sent for further considerations to the Consortium on Billfish Management and Conservation (CBMC) and the WECAFC/ OSPESCA/ CRFM/ CFMC recreational fisheries working group. The latter has to be evaluated in the near future to determine whether it is desirable to continue in operation, or if it should be replaced by the CBMC.

At the regional level, it is also suggested by Figure 12 that a formal partnership agreement would have to be negotiated between FAO/WECAFC and ICCAT through a Memorandum of Understanding (MoU) or otherwise. It is suggested that WECAFC takes the lead in these negotiations as it has the broadest membership in the Caribbean, and many more of its members are therefore also ICCAT members. Furthermore, WECAFC can also seek assistance regarding the preparation of the legal instrument in consultation and cooperation with FAO headquarters and the Interim Coordination Arrangement.

The regional level decision making regarding any management plan amendments is to be carried out at WECAFC, and then reported back to the countries for their implementation.

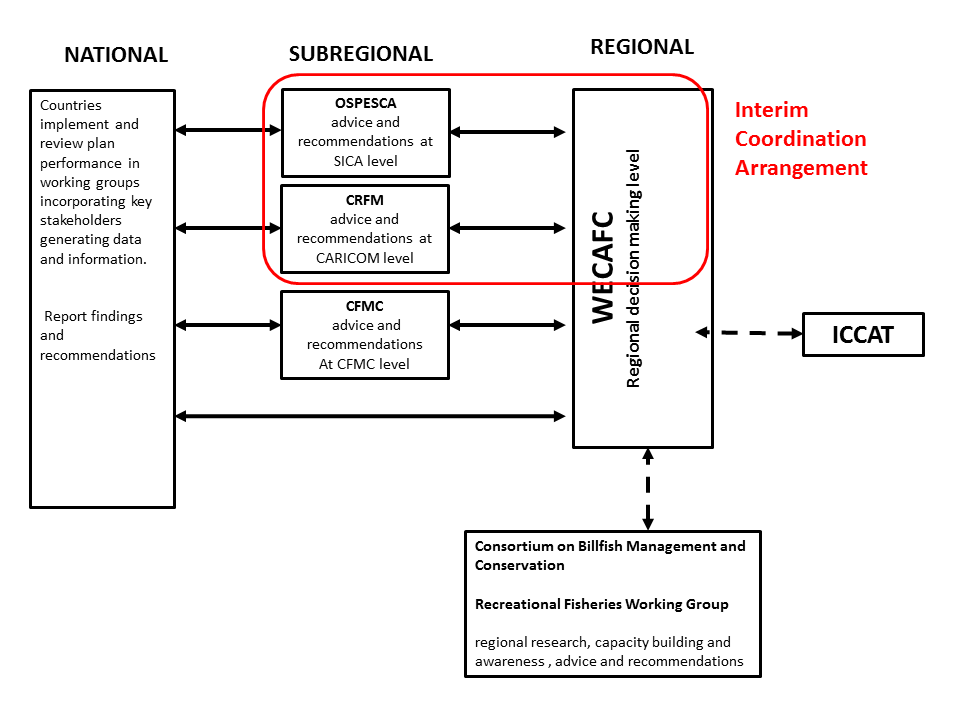


Figure 12: Proposed management plan implementation and revision mechanism

The main responsibility for monitoring and evaluating the implementation of the plan at the national level lies with the national fishery authorities, in coordination with local key stakeholders. At the subregional level, RFB organizations are responsible for monitoring plan implementation, particularly if we consider the existence of the Interim Coordination Arrangement agreed under the CLME+ framework. At the regional level, the overall responsibility for the coordination of all monitoring and evaluation activities lies with FAO/ WECAFC in coordination with ICCAT; in the case that these organizations do sign the Memorandum of Understanding (MOU).

Furthermore, multi and bi-lateral development agencies, funds, financial institutions as well as government and non-government agencies, including stakeholder organizations, which will be funding and investing in the implementation of particular activities, will have to monitor and evaluate the use of their finances and the outcome of interventions and activities following their own established procedures.

Monitoring information and a review of progress with the implementation of each activity should be conducted on an annual basis. A first evaluation of the impact and outcome of each specific objective and the underlying activities should be conducted after three years and a major amendment of the plan carried out after five years, with the plan renewed accordingly.

Resources will need to be mobilized for the Billfish Management and Conservation Plan to succeed. There is also a need for budget allocations and incorporation of the activities in the national plans at the country level, as well as for increased private investment and credit support to develop business plans. For this to happen, the fishery sector needs to continuously demonstrate its beneficial economic and social role grounded on a transparent governance structure with full participation and involvement of all concerned stakeholders and the general public. At a regional/ subregional level, the fishery organizations should cooperate and support the countries through projects implementation. Funding may be provided through a combination of public and private funding avenues provided appropriate approaches, structures and transparency can be achieved and demonstrated.

# Research priorities

From the desk and field studies carried out under the Caribbean Billfish Project in 2015 and 2016, a frame of potential social, legal and biological research studies that could significantly improve billfish conservation efforts in the WECAFC region have been identified. Research initiatives need to be carefully designed and implemented, with ample consideration of the limitations in human and financial resources in the Caribbean region.

The following research is required to support successful implementation of the management and conservation plan:

1. Conduct a major review and re-assessment of billfish growth parameters to fine-tune the billfish stock assessment models of ICCAT.

2. Design and implement a realistic and effective pilot program on recreational fishery statistics in the WECAFC region, to support the management decision making processes.

3. Develop regional indices of billfish relative abundance in relation to corresponding agreed stock targets and limit reference points, with the linked establishment of adequate harvest control rules (HCRs) that are validated and to be incorporated within ICCAT stock assessment models.

4. Develop and conduct integrated and spatially-explicit analyses of the ecological and fishery effects of FADs upon billfish stocks; and their relative implications in the WECAFC region.

5. Identify the lateral and vertical habitat use patterns of billfish resources in the WECAFC region by means of satellite tagging programs. Lateral habitat use findings could facilitate resource allocations, guide the identification of potential protected areas linked to commercial incidence models and billfish congregations that may link to important life-history events, inform potential seasonal fishing regulations and could enhance fishing practice efficiencies between sectors. Environmental data will inform potential spawning area locations and assist forecasting of climate change influences upon billfish movements and abundances. Vertical habitat use research will guide the selection and implementation of gear and fishing method innovations seeking to maximize the efficiency of target species capture, while simultaneously taking advantage of natural inter-species vertical stratification norms to minimize billfish bycatch.

6. Conducting long term and robust socioeconomic studies on commercial and recreational fisheries for highly migratory species. Better economic data about prices, fishing costs and resultant earnings are required to improve assessments of billfish fisheries value chains and value generations ensuring food security and livelihood support in the Caribbean. Application of the Recreational Fisheries Economic Impact Assessment Manual should be promoted in as many WECAFC countries as possible.

Results and recommendations produced by the priority research studies described above will be communicated annually during the World Recreational Fishing Conference and the Regional Workshop on Caribbean Billfish Management and Conservation of the WECAFC/ OSPESCA/ CRFM/CFMC working group on recreational fisheries. During these events research priorities will be evaluated and adapted, if required.

# 9. Glossary

**Binding**

**​**In legal terms, it refers to an agreement or resolution that cannot be legally ​avoided or stopped.

**Biomass**

The total weight of a fish species in a given area.

**Bycatch**

Species that are unintentionally captured by fisheries while targeting other primary species. Considered by fisheries managers as the total fishing mortality minus the retained catch of the target species.

**Catch per unit of fishing effort (CPUE)**

Catch per unit of fishing effort (CPUE) is the total catch divided by the total amount of effort used to harvest the catch.

**Co-management**

A management process (of resources) in which the government shares power with users, attributing to each of the parties specific rights and responsibilities regarding information and decision-making.

**Critical habitat**

Fisheries habitat necessary for the production of a given fishery resource. May be critical nursery habitat (e.g. mangroves and seagrasses) or critical spawning habitat (e.g. particular geographic location in the ocean where fish aggregate to spawn).

**Discards**

The components of a fish stock that are thrown back into the habitat after capture. They are generally not retained for value or legal reasons.

**Ecosystem**

An organizational unit consisting of an aggregation of plants, animals (including humans) and microorganisms, along with the non-living components of the environment to constitute a dynamic system of complex interactions of populations between themselves and with their environment.

**Ecosystem Approach**

A form of fisheries management that explicitly recognizes the complexity of ecosystems and the interconnections among their component parts when making management decisions.

**Exclusive economic zone (EEZ)**

A zone under national jurisdiction (up to 200 nautical miles wide) declared in line with the provisions of 1982 United Nations Convention of the Law of the Sea, within which the coastal state has the right to explore and exploit, and has responsibilities to conserve and manage, the living and non-living resources.

**Fish Aggregating Device (FAD)**

Any man made structure used to attract/aggregate fishes around it. FADs usually seek to congregate oceanic species in the pelagic zone, and can take a myriad of forms from permanent, semi-permanent or temporary structures, and can be of a fixed position (moored) or drifting nature.

**Fish stock (also fish/fishery resource)**

The living resources in the community or population from which catches are taken in a fishery. Use of the term “fish stock” usually implies that the particular population is more or less isolated reproductively from other stocks of the same species and is thus self-sustaining. In a particular fishery, the fish stock may be one or several species of fish, but the definition is also intended to include commercial invertebrates and plants.

**Fisheries management organizations or arrangements**

The institutions responsible for fisheries management, including the formulation of the rules that govern fishing activities. The fishery management organization and its subsidiary bodies may also be responsible for all ancillary services, such as collecting information; assessing stocks; conducting monitoring, control and surveillance (MCS) and consultations with stockholders; applying and/or determining the rules access to the fishery, and for resource allocation.

**Fishery**

The term “fishery” can refer to the sum of all fishing activities on a given resource, for example, a shrimp fishery. It may also refer to the activities of a single type or style of fishing on a particular resource, for example a beach seine fishery or trawl fishery.

**Fishing capacity**

The maximum amount of resources that can be extracted by a fishing fleet per unit time, if fully utilized, given the biomass and age structure of the fish stock and the present state of the technology.

**Fishing effort**

The total amount of fishing activity on the fishing grounds over a given period of time, often expressed for a specific gear type, e.g. number of hooks set per day or number of hauls of a beach seine per day. Fishing effort would frequently be measured as the product of (i) the total time spent fishing and (ii) the amount of fishing gear of a specific type used on the fishing grounds over a given unit of time.

**Fishing intensity**

The fishing effort per unit area per unit time. This is essentially equal to the effective area covered by the fishing gear per unit time as a fraction of the area occupied by the stock.

**Fishing mortality**

A technical term which refers to the proportion of the fish available being removed by fishing in a small unit of time; e.g. a fishing mortality rate of 0.2 implies that approximately 20 percent of the average population will be removed in a year due to fishing.

**Fishing power**

Defined as the product of the area of influence of the gear during a unit operation and the efficiency of the gear during that operation.

**Fleet**

The total number of units of any discrete type of fishing activity using a specific resource. Hence, for example, a fleet may be all the boats trawling for shrimps or all the fishers setting nets from the shore in a tropical multispecies fishery.

**Fully exploited/fished**

The theoretical term used to qualify a stock that is neither overexploited nor under-exploited and is producing, on average, close to its maximum sustainable yield (MSY).

**Indicator**

A variable that can be monitored in a system.

**Management**

The art of taking measures affecting a resource and its exploitation with a view to achieving certain objectives, such as the maximization of the production of that resource. Management includes, for example, fishery regulations such as catch quotas or closed seasons. Managers are those who practice management.

**Management measure**

Specific controls applied in a fishery to contribute to the achievement of desired objectives, including some or all of the technical measures (gear regulations, closed areas and time closures), input controls, output controls and user rights.

**Maximum sustainable yield (MSY)**

The highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing (average) environmental conditions without significantly affecting the reproduction and resultant fishery recruitment process.

**Non-offset circle hook**

A circle hook is defined as a non-offset hook with the point turned inwards perpendicular to the shank.

**Otoliths**

Each of three small oval calcareous bodies in the inner ear of vertebrates, involved in sensing gravity and movement. Otoliths are one of various “hard structures” used to age fishes and other creatures, because they often show rings or layers of differing density, termed growth zones, which are considered to result from thermally influenced growth rates in temperate species. If the periodicity of growth zone deposition is known/validated, and consistent, then growth zone counts can accurately reflect the age of the organism under investigation.

**Over-exploited/fished**

Exploited beyond the limit believed to be sustainable in the long term, and beyond which there is an undesirably high risk of stock depletion and collapse. The limit may be expressed, for example, in terms of a minimum stock biomass or a maximum fishing mortality, beyond which the resource would be considered to be over-exploited.

**Pelagic zone**

Also termed “the open ocean”, this is the largest habitat component of the ocean, is vertically divided into multiple subzones and is ultimately neither close to the coast nor the ocean bottom.

**Pelagic fish**

Fish that spend most of their life swimming and feeding in the pelagic zone, as opposed to resting on or feeding off the bottom. Examples are tunas and billfishes.

**Principle**

A fixed or predetermined policy, mode of action or an overarching guiding concept for managing natural resources that is usually developed in the context of global agreements and/or legislation. Examples: ‘the precautionary approach”, “maintaining ecosystem integrity”.

**Precaution**

An action taken in advance to protect against possible danger or failure; a safeguard. Caution practiced in advance. Forethought or circumspection.

**Precautionary Approach**

A set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible while explicitly taking into account the existing uncertainties and the potential consequences of being wrong.

**Property rights**

A legal right or interest in respect to a specific property. A type of resource ownership by an individual (individual right) a group (communal right), or the state (state property).

**Quota**

A share of the total allowable catch allocated to an operating unit such as a country, a community, a vessel, a company or an individual fisherman (individual quota) depending on the system of allocation. Quotas may or may not be transferable, inheritable and tradable. While generally used to allocate total allowable catch, quotas could be used also to allocate fishing effort or biomass.

**Stakeholder**

Any person or group with a legitimate interest in the conservation and management of the resources being managed. Generally speaking, the categories of interested parties will often be the same for many fisheries, and should include contrasting interests: commercial/recreational, conservation/exploitation, artisanal/ industrial, fisher/buyer-processor-trader as well as governments (local/ State/ national). The public and the consumers could also be considered as interested parties in some circumstances.

**Stock**

A group of individuals in a species occupying a well-defined spatial range independent of other stocks of the same species. Random dispersal and directed migrations due to seasonal or reproductive activity can occur. Such a group can be regarded as an entity for management or assessment purposes. Some species form a single stock (e.g. southern bluefin tuna) while others are composed of several stocks (e.g. albacore tuna in the Pacific Ocean comprises separate northern and southern stocks). The impact of fishing on a species cannot be fully determined without knowledge of the stock structure.

**Stock assessment**

The part of Fisheries Science that studies the status of fish stocks as well as the possible outcomes of different management alternatives. It tells us if the abundance of a stock is below or above a given target point and by doing so lets us know whether the stock is overexploited or not; it also tells us if a catch level will maintain or change the abundance of the stock.

S**ustainable use**

The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its’ potential to meet the needs and aspirations of present and future generations.

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**Target species**

Those species that are primarily sought by the fishermen in a particular fishery. The subject of directed fishing effort in a fishery. There may be primary as well as secondary target species.

**Tenure**

The rules that define how rights to land and other natural resources are assigned within societies as well as rights to use, control and transfer these resources.

**Uncertainty**

The incompleteness of knowledge about a state or process in nature. In statistics, the estimated amount or percentage by which an observed or calculated value may differ from the true value

# 10. Additional background studies and information

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# Annex 1 Proposed regional specific objectives and management activities/measures timeline

| ***Specific Objectives*** | ***Outputs*** | ***Activities*** | ***Years- Expected implementation*** | |
| --- | --- | --- | --- | --- |
|  | | | 1-3 | 3-5 |
| 1. Improve fisheries catch, landings and effort data collection and reporting programs for billfish recreational and commercial fisheries | National and regional database with recreational fisheries data based on agreed protocols  Commercial billfish fisheries data and statistics improved in support of management decision making processes, including negotiations for quota in ICCAT | Design, test and validate a data collection scheme for recreational fisheries |  |  |
| Adoption of a data collection scheme for recreational fisheries |  |  |
| Establishment of a Fisheries Information System at WECAFC secretariat in coordination with FAO-FIRMS |  |  |
| Countries start reporting sport/ recreational fisheries data to FAO and ICCAT |  |  |
| Capacity building in fisheries statistics |  |  |
| 2. Recover billfish stocks and maximize the economic value of commercial and recreational billfish fisheries by reducing, to the extent practicable, bycatch and discard mortality of Caribbean billfish in longline fisheries and other fisheries operating around FADs. | Billfish by-catch and by-catch mortality addressed and reduced  Novel fishing gears, technologies and fishing methods are field tested and accordingly supported for implementation on national and regional scales | Awareness raising and creation of incentives for billfish bycatch reduction |  |  |
| Shift from traditional J hooks to non-offset circular hooks in selected longline fisheries operating in the WECAFC region where billfish are common bycatch |  |  |
| Carry out training workshops on the change and use of circle hooks and billfish releasing techniques |  |  |
| Promotion, or formal institution, of catch and release techniques for billfish in recreational fisheries to eliminate competitive sphere with other sectors |  |  |
| Promotion and adoption in the WECAFC region of IGFA international angling rules within recreational fisheries |  |  |
| Adoption and implementation of the regulations established in the CRFM sub regional management plan for FAD fisheries |  |  |
|  |  | Tests of innovative fishing gears, technologies and/or fishing methods that minimize billfish capture are conducted and guide future incentive and/or management measures |  |  |
| 3. Define target and limit reference points appropriate for billfish species, establishing adequate harvest control rules (HCRs). | Improved stock monitoring capacity is used to accurately define precautionary harvest limits  A threshold billfish abundance is defined and effectively maintained  Precautionary harvest limits effectively enforced through adequate harvest control rules | Adoption of improved data collection mechanisms across fishery sectors that capture billfish |  |  |
| Insights from improved biological, catch and effort data guides the development of appropriately precautionary harvest limits |  |  |
| Improved data comparisons allow the development of an effective conversion factor to allow more genuine CPUE modelling and comparisons across FAD introduction |  |  |
| IUU fishing concerns are adequately addressed |  |  |
| 4. Increase the coordination, collaboration and participation in current regional governance arrangements to address Caribbean billfish management and conservation | Harmonized and adaptive billfish regional management mechanisms with enhanced partnership between organizations and stakeholders  Improved collective voice, recognition and resultant influence of Caribbean states at ICCAT meetings | Support the Implementation of the Interim Management Mechanism established under the CLME+ project (WECAFC, CRFM and OSPESCA) |  |  |
| Sign a Memorandum of Understanding between ICCAT and WECAFC for improving participation on management and conservation measures for billfishes |  |  |
| Consortium on Billfish Management and Conservation (CBMC) actively participating with recommendations and advice during the implementation of the plan |  |  |
| Adoption and Implementation of IGFA recreational fishery regulations at the WECAFC level |  |  |
| Evaluate the need to continue or not with the WECAFC recreational fisheries working group |  |  |
| Support the development of regionally harmonized regulations and management measures on billfish fisheries |  |  |
| 5. Combat IUU fishing by improving monitoring, control and surveillance systems of commercial and recreational large pelagic fisheries with harmonized management measures coordinated at regional level. | Harmonized regional management measures to monitor and control fishing effort in place | Implementation of a VMS systems in billfish-related industrial/ artisanal and recreational fisheries |  |  |
| Find alternatives or complementary options to the use of VMS when appropriate (e.g. AIS) |  |  |
| Implementation/update of a billfish-related vessel register for commercial (industrial and artisanal) and recreational vessels |  |  |
| Training on billfish identification for customs officials and other government officials |  |  |
| 6. Enhance the governance and economic performance of recreational and commercial billfish fisheries in the WECAFC region by promoting effective co-management and tenure based approaches | Opportunities and alternatives identified and implemented for minimizing adverse social and economic effects, particularly for small scale fisheries and consumers  Opportunities to improve the cost effectiveness and overall efficiency of billfish friendly fishing gears, methods and related technologies are fully pursued  Fisheries value chains and fishers organizations social capital in terms of organization, social cohesion, leadership and entrepreneurial capacity are improved. | Identify and implement incentives and opportunities (business cases) for small scale/ artisanal fishers who adopt conservation of billfishes, want to move to the tourist sector or develop an alternate fishing activity |  |  |
| Promote and implement mutually beneficial co-management and tenure based mechanisms |  |  |
| Investigate mercury levels in billfish meat and their consequences for health of consumers |  |  |
| Formally institute catch and release only for billfish in recreational fisheries. Exceptions of national record fish and +1000lb marlins are acceptable/advised. |  |  |

1. In ICCAT it is classified as *Tetrapturus albidus* [↑](#footnote-ref-2)
2. http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/whitemarlin2002.pdf [↑](#footnote-ref-3)
3. https://www.igfa.org/Conserve/New%20publications%20of%20the%20Caribbean%20Billfish%20Project [↑](#footnote-ref-4)
4. http://www.iucnredlist.org/details/170333/0 [↑](#footnote-ref-5)
5. FAO Fisheries Department. The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2. Rome, FAO. 2003. 112 p [↑](#footnote-ref-6)
6. Based on the legal and institutional framework desk study by the consultant Cristina Leria under the Caribbean Billfish Project GCP/001/SLC/WBK (Leria, 2015), and the CRFM reports by Singh-Renton and McIvar (2015), and Berry and Tietze (2013) [↑](#footnote-ref-7)
7. UNCLOS entered into force 16 November, 1994. More details on: http://www.un.org/depts/los/ [↑](#footnote-ref-8)
8. Agreement for the implementation of the Provisions of the Convention relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks in force since 11 November 2001. More details on: http://www.un.org/depts/los/convention\_agreements/convention\_overview\_fish\_stocks.htm [↑](#footnote-ref-9)
9. The FAO 1993 Agreement to promote compliance with international conservation and management measures by fishing vessels on the high seas. More details on: http://www.fao.org/fileadmin/user\_upload/legal/docs/012t-e.pdf [↑](#footnote-ref-10)
10. FAO Agreement on Port States Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (adopted by the FAO Conference in 2009). More details on: http://www.fao.org/fishery/psm/en [↑](#footnote-ref-11)
11. http://www.iccat.int [↑](#footnote-ref-12)
12. The Code can be found on: http://www.fao.org/docrep/005/v9878e/v9878e00.htm [↑](#footnote-ref-13)
13. http://www.fao.org/3/a-i6204e.pdf [↑](#footnote-ref-14)
14. FADs can be moored FADs (mFADs) or drifting FADs (dFADs) [↑](#footnote-ref-15)
15. Clarke DJ, Ditton RB, Chaparro RS. 1994. The Economic Importance of Recreational Billfish Angling in Puerto Rico. Proceedings of the Forty Sixth Annual Gulf and Caribbean Fisheries Institute. 47-59pp. [↑](#footnote-ref-16)
16. Recommendation by ICCAT to Further Strengthen the Plan to Rebuild Blue Marlin and White Marlin Populations [Rec. 12-04] [↑](#footnote-ref-17)
17. https://www.iccat.int/Documents/SCRS/ExecSum/BUM\_ENG.pdf [↑](#footnote-ref-18)
18. https://www.iccat.int/en/Assess.htm [↑](#footnote-ref-19)
19. https://www.iccat.int/Documents/SCRS/ExecSum/SAI\_ENG.pdf [↑](#footnote-ref-20)
20. http://www.takemarlinoffthemenu.org/global\_status\_of\_billfish#\_ftn3 [↑](#footnote-ref-21)
21. https://www.iccat.int/en/Assess.htm [↑](#footnote-ref-22)