Kobe II Bycatch Workshop Background Paper

NON-TARGET FINFISH SPECIES AND SMALL TARGET SPECIES

1. OVERVIEW

In commercial tuna fisheries managed by the five tuna RFMOs, small target species[1] and other non-target finfish species are caught and returned to the sea. These individuals could be: a) dead or injured to the point where mortality is likely; or b) alive and unharmed or with light injuries, so that survival is expected. Mortalities of some of these non-target and small target species may be of concern because they are at risk of depletion due to a combination of factors including relatively high catch levels, low rates of survival after discard, and because measures to reduce this source of mortality are lacking. Section 1.1 below lists non-target finfish and small target species commonly caught in tuna fisheries managed by the five tuna RFMOs, as a basis for a discussion of potential species of concern and conservation measures that have been discussed or implemented within the RFMOs to reduce or minimize impacts of tuna fisheries on these species.

Whether non-target finfish or small target species are retained depends on many factors, such as its condition or quality and its related market value, landing restrictions, and the available space in fish holds. Although there is variation by fishery and by species, the level of concern over these issues has increased in recent years. There is also concern about ecosystem impacts produced by sustained large catches of non-target and small target species. At present, regular stock assessments are not completed for many of these species, and they are not the focus of any management measures, as they are non-target stocks. Due to the incomplete knowledge of specific stocks, the number of species involved, and the concern about ecosystem impacts, the FAO and some of the RFMOs have recognized that precaution needs to be used in decision-making, and that an ecosystem-based approach to fisheries management may be more appropriate.

A related issue often discussed within the tuna RFMOs is the allocation of catches. For example, in some of the RFMOs, there have been discussions about which fisheries enjoy the greatest benefit, in terms of market value and utility, from the catch of certain species and the implications of this. Often discussions are centered on commercial versus recreational fisheries, or industrial-scale commercial fisheries versus subsistence or artisanal fisheries. In addition, there are also frequent discussions in the tuna RFMOs regarding the tradeoffs involved between catching small, sexually immature finfish or mature and reproductive finfish.

1.1. Finfish considered species of concern

Based upon recent developments (i.e., discussions, data, and research associated with tuna RFMOs), the following non-target finfish (excluding sharks) and small target species may be species of concern.

Non-target billfishes: This potential suite of species includes blue marlin, striped marlin, white marlin, and sailfish. These species of billfish were included as species of concern because large numbers are caught in longline fisheries and artisanal fisheries (many are retained, some are released alive, and some are discarded dead). Many of these billfish are also caught in gillnets, and small numbers are captured in purse seine fisheries. Depending on the species, they are retained and sold, or discarded. The status of the stocks of many of these species indicates overfishing and/or overfished states.

[1] The term "small target species" is used here to refer to juvenile tunas and swordfish that are small, not sexually reproductive, and are discarded because they are non-marketable or undersized.

Small target species: This potential suite of species includes small bigeye, yellowfin, and bluefin tunas, and small swordfish. These subgroups are included because there are large numbers of small tunas being harvested before recruitment in RFMO purse-seine fisheries, mainly in the FAD fishery and, to a lesser degree, in longline, troll, gillnet, and trawl fisheries. Catches of small swordfish, on the other hand, are largely due to longline fishing, although these catches can occur in other gear types as well. If not adequately managed, these harvests can negatively impact the status of a stock, reduce the long-term sustainable catch level, and increase the effort required to achieve that catch.

Other non-target species commonly caught in tuna fisheries were considered, including: mahi-mahi or dolphinfish, black marlin, shortbill spearfish, small tunas (e.g., black skipjack, frigate tuna, bonito), carangids (i.e., rainbow runner, yellowtail), wahoo, and opah. These species have not been identified as species of concern at this time due to their life history attributes (e.g., high productivity rates), low levels of catch, or in some cases because there is a lack of information available. Overall, however, it should be noted that tuna fisheries are removing large numbers of high level predators, potentially having an impact on ecosystem structure even if the direct impacts to a single stock are not of concern.

2. INFORMATION AND RESOURCES FOR ADDRESSING BYCATCH

2.1. Type and characteristics of fishery interactions

Data pertaining to non-target finfish and small target tuna catches are available from various sources. These sources may include: vessel logbooks, at-sea observer data, unloading records provided by canners and other processors, export and import records, reports from governments and other entities sent to the five tuna RFMOs, and shore-side sampling programs. In general, large purse seine and longline vessels that carry observers provide the most comprehensive data. Other purse seine, pole-and-line, and troll vessels also provide information on retained catches in some cases, but there is little to no information available on their discards. In addition, there is limited information on the catches of other fishing fleets, particularly artisanal and small-scale coastal fleets. These fleets are known to catch a large variety of pelagic finfish species, most of which are retained for sustenance or sold/bartered on the market given the coastal nature of these fisheries and their proximity to markets and local distribution channels.

Comprehensive reporting of bycatch is not a universal requirement among the tuna RFMOs. Where such reporting requirements exist, some RFMO members have not fully met the data reporting requirements currently in place. Thus, accurate estimates of non-target and small tuna biomass removals are not widely available. The variance in reporting and compliance rates is partly due to the lack of adequate infrastructure and resources to collect the required data. In other cases, members may have confidentiality concerns, a lack of understanding of what needs to be reported, how data should be reported, or a lack of motivation to collect and report the data. These issues are further exacerbated by the dynamic nature of the fishery itself which is constantly changing patterns of retention and utilization. In cases where information is reported from the fishery, it can be difficult for RFMO scientists and managers to access the data due to confidentiality concerns and rules, or a lack of agreement on how to handle such data. This limits the ability of scientists to accurately estimate catch rates and status of non-target populations and can limit the ability of managers to develop and adopt effective management measures to mitigate impacts to bycatch species.

2.2. Species population status

2.2.1. Billfish (marlins and sailfish)

Current evidence available for striped marlin supports a multiple-stock hypothesis in the Pacific Ocean. However, there is not clear consensus on how to characterize the stocks or stock status. For example, an IATTC stock assessment that assumed there was a single stock in the EPO indicated that the stock is in good condition, above levels capable of producing MSY. However, an ISC stock assessment that assumed there was a single stock spanning the North Pacific indicated that the stock biomass and recruitment levels have declined in some areas and, although there are no agreed upon biological reference points, it was recognized that the levels of fishing mortality are likely too high to support MSY.

With respect to blue marlin, the Atlantic stock is considered overfished (i.e., the stock biomass is below the level needed to support MSY). Despite uncertainties in quantifying the fishing effort levels that would produce MSY, it was determined that this stock is close to being fully exploited (i.e., fishing mortality is near or above the level needed to support MSY). Regarding white marlin, there is a single Atlantic-wide stock that is considered overfished.

There remains considerable uncertainty regarding the stock status of the two Atlantic sailfish stocks; however, many assessment model results present evidence of overfishing and evidence that the stocks are overfished. The eastern Atlantic stock is likely subject to higher overfishing rates than the western Atlantic stock, and its biomass has likely been reduced below the level that can support MSY. Currently, insufficient biological information is available to determine stock status of Indo-Pacific sailfish.

Data on billfishes in the Indian Ocean are currently limited with insufficient biological information to determine stock status. Aspects of the biology, productivity, and fisheries that catch these species are still needed for an initial formal assessment.

2.2.2. Small target species

Most of the tunas and swordfish discarded in fisheries managed by the tuna RFMOs are discarded due to their size, low quality product, market conditions, or management measures in place (e.g., minimum size requirements, landings limits). Often, processing plants will not accept small tunas, or they do so at lower prices, so fishermen often prefer to dispense of them at sea. There is conservation concern for most of the target tuna stocks and for at least one stock of swordfish (the Mediterranean stock) based on recent stock assessments. Clear reference points to determine stock status have not been established for all of the target tuna stocks. High rates of fishing mortality and declines in biomass indicate that the stocks are likely fully exploited. Four of the tuna RFMOs (IATTC, ICCAT, WCPFC, and IOTC) have discussed reducing the fishing mortality of young tunas and/or swordfish in order to increase the long term sustainable yield of stocks.

2.3. Species distribution

The distribution of most of these non-target finfish and small target species overlaps with fishing activities in all five tuna RFMO areas. Information regarding the spatial and temporal distribution and movements of these finfish species and identification of primary spawning grounds can assist in the development of conservation measures based upon areas of high risk of non-target catch. In the case of finfish species, spatial distribution and movement patterns are most often collected through the use of tagging data, catch, effort, size, and observer data. In general, yellowfin and bigeye tuna stocks are primarily found in the eastern and western Pacific, Atlantic, and Indian Ocean basins where their primary spawning areas are located. More research is necessary to precisely identify some of these spawning grounds and the movement and behavioral patterns of non-target species and small tunas and swordfish.

2.4. Fishery impacts

Billfish are primarily caught with commercial longline gear in small coastal artisanal fisheries (e.g., longline, driftnet and hook-and-line gear), and with recreational hook-and-line gear. While billfish are sometimes retained and landed in longline fisheries, depending on market conditions, existing management measures, and landings restrictions, a large number are also discarded (dead or alive). Artisanal catches can be considerable depending on the species/stock in question. Available information on the recreational catches of billfishes is limited to some areas, but their catches are believed to be substantially less than the commercial catches for all species and some recreational fisheries are catch-and-release fisheries. To a lesser degree, billfish are also caught in the purse seine fishery (some species are retained but most are discarded) and targeted in some harpoon fisheries.

In tuna RFMO purse-seine fisheries, the catch rates and composition of species vary considerably by the type of set. There has been concern expressed in tuna RFMOs about the high catch rates of small tunas in purse-seine sets on FADs and in the increase in the use of this fishing method. Looking across all species, the bycatch rates, with few exceptions, are greatest in sets on floating objects, followed by unassociated

sets and, at a much lower level, dolphin sets. Bycatch rates of small bigeye and yellowfin tunas are greatest in floating-object sets. In addition, the bycatch of blue marlin and some other billfishes is generally higher in the floating-object fishery, compared to unassociated and dolphin-associated sets. However, the bycatch rates of sailfish and manta rays tend to be greater in unassociated sets than in floating-object sets. Because of differences like these, most RFMOs have taken distinct measures to address the need to record and monitor the changes in frequency of the different types of purse seine sets to interpret the changes in bycatch figures. However, to date, RFMOs have not attempted to balance effort between different sectors of the fishery to specifically meet a management objective.

Small tunas and/or swordfish are also caught in some harpoon, troll, trawl, gillnet, and pole-and-line operations. However, in general, small tuna harvests are far less in these fisheries than in the purse seine fishery on FADs. Comprehensive catch data are not available for many of these fisheries. In general, the longline fishery tends to catch larger, and mostly mature tunas compared to the purse seine fishery. In particular, this is true with respect to the FAD fishery. The longline fishery does not catch large numbers of small tunas. Catch of small swordfish has been a concern in some longline and gillnet fisheries. It is also important to note that in some ocean basins, a few nations have extensive domestic surface fisheries (e.g., purse seine, ring nets, handline, pole-and-line) that catch a substantial portion of the total small tuna catch due to their primary fishing locations (i.e., areas with high densities of juvenile tunas), the gear type used, and the scale of the fleets.

2.5. Bycatch mitigation measures

The following section focuses on the primary non-target finfish and small target species bycatch mitigation measures being used in the five tuna RFMOs. There are numerous other management measures that can indirectly mitigate the impacts on non-target finfish and small target species or increase the compliance with existing management measures, including prohibiting the use of large-scale driftnets, establishing catch limits for target species, and establishing capacity or effort limits in fisheries. Research undertaken on capacity monitoring and management under the auspices of the IPOA-Capacity, using data envelopment analysis and assessments, shows that there is overcapacity in almost all world purse-seine and longline fisheries. Overcapacity can contribute to poor stock productivity and unsatisfactory economic performance, and can complicate already difficult management discussions. Whatever the level of overall capacity, levels of bycatch naturally follow. Therefore, any reductions in capacity would most likely lead to reduced bycatch levels as well.

2.5.1. Purse-seine fishery

Three of the tuna RFMOs (WCPFC, IATTC, and ICCAT) have established time/area closures in the purse seine fishery. In most cases, such closures were designed in part to reduce the catch of small juvenile tunas. The WCPFC has established time closures that only apply to purse-seine sets on FADs, which have the highest level of bycatch of small juvenile bigeye tuna. Time/area closures have also been used in longline fisheries to reduce the catch of small juvenile swordfish. Tuna RFMO scientists are currently studying whether spatial, temporal, and environmental factors can be used to predict bycatch in FAD sets and to what extent time/area closures would be effective in reducing bycatch. One issue that has been raised in this regard is the need for finer-scale reporting requirements so that time/area closures can be designed more precisely and can lead to more effective results. For example, rather than reporting in 5° x 5° blocks for each quarter, it may be more useful to report in 1° x 1° blocks for each month, or set by set.

Catch retention requirements have also been established in three of the tuna RFMOs (WCPFC, IATTC, and IOTC). The measures are geared towards reducing the amount of discards of small tunas, reducing capacity, and providing a disincentive to setting on schools with high levels of small tunas. Unfortunately, concerns have been raised about compliance with these measures and whether the measures themselves are effective.

Some of the tuna RFMOs have considered the use of FAD management measures to assess and limit impacts on non-target finfish and small target species caught in the purse seine fishery that sets on FADs. The management measures discussed have included the marking, identification, monitoring (including

satellite/electronic monitoring), design, spatial distribution, limitation to the numbers and types of FADs deployed, and removal of FADs during time/area closure periods. The WCPFC has a requirement that all members must develop a FAD management plan to include management options and are encouraged to require FADs to be marked, monitored, and deployed in limited numbers. In addition, the IATTC established a pilot program to research and gather information on FADs with the adoption of its 2009 tuna conservation measures. Evaluations of various modifications to FAD design have also been initiated with the aim of reducing bycatch.

2.5.2. Longline fishery

Recent work by the tuna RFMOs has shown that a relatively high proportion of billfish can survive interactions with pelagic longline gear. Management measures promoting the safe handling and release of live individuals in this fishery may, therefore, reduce mortality without reducing the catches of target species. The use of circle hooks has also been researched as a means to increase the survival rates of billfish released from longline gear (discussed further in Section 3.1). ICCAT has adopted a conservation measure that requires reductions in the numbers of blue and white marlins that can be landed by longline and purse seine vessels. In implementing the required reductions, marlins that are alive when brought onto the vessel must be released in a manner that maximizes their survival. The IATTC also requires all non-target species, including marlins, to be released if caught in the purse seine fishery. Unfortunately, post-release survival rates are largely unknown, but are suspected to be low. The WCPFC has a non-binding measure put in place to avoid waste within small-scale fisheries that encourages fishermen to release unharmed non-target fish that are not to be retained, to the maximum extent practicable.

ICCAT is the only tuna RFMO that at present, has established minimum size requirements for swordfish and bluefin tuna in order to minimize the bycatch of small fish and discourage fishing in areas with high levels of small fish. Previously, ICCAT had established minimum size requirements for yellowfin and bigeye tunas. These measures were later rescinded as they were not well implemented and, therefore, not considered effective as a conservation and management tool.

3. RESEARCH AND MANAGEMENT TOOLS

3.1. Research and management objectives

The following are some of the research and management objectives aimed at assessing and mitigating the bycatch of non-target finfish and small target species that have been discussed and/or pursued in some of the tuna RFMOs.

The use of acoustic technologies to identify the types of fish which congregate under FADs has been considered by some of the tuna RFMOs, including the IATTC and WCPFC. For example, IATTC scientists have investigated the feasibility of using boat-based echo-sounders, which can be used when fishing on FADs to determine if fish are small or large, how densely packed the school is, and position relative to the FAD. They found that it may also be possible to discriminate bigeye, yellowfin, and skipjack tunas with commercial echo-sounders and via behavioral observations because the acoustic target strength is species-specific based on differences in the swimbladder. This may be a useful tool for managers seeking to avoid the capture of small tuna associated with FADs. Still, more research is needed to determine if this method is effective and efficient.

The use of sorting grids in purse-seine nets to allow the release of juvenile tunas has also been tested and discussed in some tuna RFMOs; most notably, in the IATTC. This technology has shown mixed results as a method for reducing small tuna bycatch. One concern is that skipjack tuna, generally smaller than bigeye and yellowfin tunas, might escape the purse-seine net along with the small bigeye and yellowfin tunas, and that fishermen would not be able to retain an important target species. In addition, escape mortality may be an issue for juvenile tunas that are pursed, stressed, and injured as a result of passing through the sorting grids. However, selectivity of sorting grids has progressed in recent years, and further refinements are being made to increase their effectiveness.

Most tuna RFMOs are also conducting research on the characteristics of FADs, such as depth,

construction, and operational details. In addition, some studies are utilizing underwater cameras and other tools to characterize species, size composition, spatial distribution, and the behavior of tunas aggregating around floating objects.

Tagging initiatives provide information on various biological and fishery processes such as exploitation rates, natural mortality, migration, growth rates, stock composition, and spatial and temporal variability in habitat use. Some of the most extensive tagging programs have been conducted in the Pacific Ocean; for example, the joint SPC/Papua New Guinea National Fisheries Pacific Tuna Tagging Programme has released over 250,000 tagged tuna in the equatorial WCPO. Most of the tuna RFMOs have conducted tagging studies of tunas and/or billfish to varying degrees of size, scope, and success. ICCAT also encourages the tag and release of marlin caught in various fisheries and offers incentives to fishermen for participating in the program.

Some studies investigating the effects of hook size and type on catchability and post-release survival have found that the use of circle hooks in longline fisheries has resulted in an increase in the survival of some billfish species (e.g., white marlin, sailfish), while not appreciably affecting catch rates of target species compared to using standard "J" hooks. Most of the tuna RFMOs are also conducting or encouraging their members to conduct research on the use of circle hooks in longline fisheries.

There have also been several projects in the longline fisheries in the WCPO testing different gear configurations aimed at setting hooks deeper so they are not in the preferred habitat of billfish (by fishing with hooks set at depths greater than 100 meters). Methods under investigation include removing the shallowest hooks, using weights to pull the shallowest hooks deeper, and using longer float lines. Preliminary results have demonstrated that fewer blue marlin, striped marlin, spearfish, dolphinfish, and wahoo were captured in the experimental sets.

The number of individuals that are removed from the ecosystem as bycatch is often used as a proxy for the ecosystem impact of fisheries. For some highly depleted species or those with low reproductive potential, even low take rates may be of concern. In many cases, bycatch comprises a small percentage of total removals. Studies using ecosystem models have begun to assess the impacts of bycatch and total fisheries removals in ecologically meaningful terms (e.g., time to replacement, trophic level) rather than only in terms of numbers of individuals or biomass removed. Further development of this approach could offer an opportunity to advance management discussions from a single species focus into an ecosystem context.

3.2. Risk assessment

ERA is a scientific tool used to assist managers in setting priorities for conservation action based upon areas of greatest need. Greatest need can be identified for species, geographic region, and economic value, among other factors. ERA has been used in some of the tuna RFMOs to improve decision-making and to take into account uncertainty when developing conservation measures, although the precise methodologies and scope of such assessments have varied considerably. For example, ICCAT's Standing Committee on Research and Statistics has conducted a provisional ERA for bycatch species in its fisheries and it identified some non-target fish species most at risk given their particular life history and exploitation rates which may warrant prioritization for conservation action. The WCPFC is currently collaborating with the SPC to conduct an ERA implementation project that covers a range of research and associated activities on bycatch. In addition, the Global Environment Fund project on ERA has proposed collaboration with the IOTC on pelagic species assessments in the future.

3.3. Monitoring and reporting schemes

At-sea observation of interactions between fishing operations and non-target species is recognized as one of the most effective ways to collect information needed to assess and mitigate bycatch, and in some cases to ensure compliance with management measures. Data from regional and national observer programs have been essential to understanding and estimating levels of non-target finfish and small target species catch within all five tuna RFMOs, despite the fact that coverage rates and other national program

standards vary considerably across fleets and fisheries. In addition, observer coverage can motivate member countries and their fishermen to abide by the conservation measures that have been adopted. Some tuna RFMO scientific committees have stressed that consistency and harmonization of standards and protocols between tuna RFMO observer programs is necessary to avoid burdensome training requirements and to reduce multiple formats for countries that are members of multiple tuna RFMOs. To date, the tuna RFMOs have not attempted to coordinate the development of comprehensive observer program minimum standards, including goals, objectives, coverage levels, and data protocols, as a more standardized approach to data collection.

As mentioned previously, logbook records, landings receipts, and other reporting schemes are also useful for understanding and estimating levels of finfish non-target and small target species catch within all five tuna RFMOs. However, there are some limitations to the use of this data due to the uncertainty associated with the accuracy, uniformity, and consistency of the information provided. In addition, while port sampling is useful to estimate tuna landings and verify species identification, it is not useful in assessing catch or mortality of discarded species.

ICCAT has recently hired a Bycatch Coordinator to further advance the development of forms and other approaches to improve data collection and reporting. The results of this work are anticipated in late 2010. Also to be completed in 2010, the SPC is developing the WCPFC Bycatch and Bycatch Mitigation Information System to provide access to current information on bycatch biology and bycatch mitigation methods via the WCPFC website. The IATTC is also testing the use of a form for recording the type and specific characteristics of all gear used in its fisheries. The use of a standardized form across the tuna RFMOs for this purpose might greatly assist tuna RFMOs in achieving a better understanding of how gear is likely to interact with bycatch species and how gear might be modified to reduce bycatch.

3.4. Periodic review and evaluation of effectiveness

Periodic review of conservation action and evaluation of measures is critical to ensuring that the most effective practices are being employed and that decision-making adapts with the availability of new information. Review of adopted measures can also be helpful in assessing potential changes to impacts on bycatch species as the characteristics and/or extent of a fishery changes, new fisheries develop, or new information becomes available. Four tuna RFMOs have adopted conservation measures to address non-target finfish catch (IATTC, ICCAT, IOTC, and WCPFC) that call for some form of review of the adopted measure to determine if it has been proven effective and, in some cases, whether it should be amended based upon new information. Performance measures are also useful as tools for identifying where specific techniques or decisions are having the desired effect, but have not been included in any of the current RFMO conservation measures in place to address non-target finfish and small target species catch.

3.5. Education and training

Education and training of vessel owners, processors, fishermen, scientists, and other stakeholders is useful to facilitate full compliance with any agreed-to tuna RFMO conservation measures and to encourage innovation of bycatch mitigation techniques. Raising fishermen's awareness of the overall benefit to them and to bycatch species has been shown to improve the implementation of measures and can assist managers in identifying any practical difficulties of implementation by opening a constructive dialog with fishermen. Educational materials can also improve the ability of both fishermen and observers to identify species as a way to improve data collection. The implementation of capacity building programs such as providing training in data collection and sampling methods can also assist fishermen, scientists, and personnel that handle data in the implementation of bycatch mitigation measures. Some tuna RFMOs and member nations have allocated funds to build capacity in nations without the resources necessary to collect the required data. For example, ICCAT organizes training workshops every year voluntarily funded by some of its members. In these workshops, scientists from developing countries are trained in various areas, such as data collection and stock assessment techniques. ICCAT has also developed a manual that describes what data reporting is required and when it should be submitted to the Secretariat.

The IATTC conducts regular workshops to train captains in current bycatch mitigation methods and collaborate with them on issues such as increasing gear selectivity or changing fishing methods to reduce non-target catches.

3.6. Independent performance reviews

Three of the five tuna RFMOs (CCSBT, ICCAT, and IOTC) have complete independent performance reviews, as called for by the UN Fish Stocks Review Conference in 2006. In all three cases, the review panels noted the need for the RFMOs to make further progress toward the application of ecosystem-based consideration, such as the adoption of conservation and management measures for non-target species and species dependent on or associated with target stocks, including with respect to data collection requirements for the catch of non-target species. For example, the ICCAT panel recommended that ICCAT develop and adopt more effective measures to deal with the catch of small yellowfin tuna including closer regulation and reduction in the use of FADs on the West African coast. The ICCAT panel also recommended that more effective measures be developed and adopted to deal with the catch of small bigeye tuna including closer regulation of FAD use and that efforts continue to be made to improve the timeliness and accuracy of data submissions.

3.7. Coordination with other relevant RFMOs and IGOs

Most tuna RFMOs are trying to adapt to a more ecosystem-based approach to fisheries management that includes mitigating the impacts on non-target species. Thus, coordination with other RFMOs, international organizations, and others with similar relevant experience may prove essential to efficiently and effectively address these issues. Some tuna RFMOs are collaborating via MOUs to facilitate data exchange and research. Other opportunities to avoid duplication of efforts and minimize costs could include the establishment of an MOU between RFMOs and international organizations to harmonize the data and information collected within a jointly-developed observer program, affording RFMOs the opportunity to take advantage of existing research on effective mitigation measures to reduce bycatch.

In addition, individual tuna RFMO members are conducting research on finfish bycatch mitigation to be discussed at the various RFMOs. Projects like these could be useful resources to all five tuna RFMOs considering such research and with similar data needs. For example, the European Union-funded FADIO project (Fish-Aggregating Devices as Instrumented Observatories of Pelagic Ecosystems) is designed to develop new instruments and methods to observe fish around FADs and to collect data on the behavior of fish around drifting FADs. Project MADE (Mitigating Adverse Ecological Impacts of Open Ocean Fisheries), also funded by the European Union, is aimed at proposing measures to mitigate adverse impacts of fisheries targeting large pelagic fish and is primarily focused on the FAD purse seine fishery and the longline fishery. In addition, the Smart FAD project, funded by the U.S. Pelagic Fisheries Research Program, has developed an instrumented FAD with sonar for observing fish aggregations around anchored FADs. The results of these and other projects could provide the tuna RFMOs with essential information and expertise for developing and refining measures to mitigate non-target and small target finfish catches, if shared widely.

4. INVENTORY OF EXISTING CONSERVATION MEASURES

The following table provides a general overview of the active conservation measures that have been adopted by the five tuna RFMOs to mitigate impacts on non-target finfish and small target species. The aspects of the conservation measures that do not apply to non-target finfish or small target species are not included in the table. In addition, measures that may have an indirect effect on finfish non-target catch and small tunas (e.g., capacity limits, catch limits on target species) are not included in the table.

	CCSBT	IATTC	ICCAT	IOTC	WCPFC
	Recommendation to mitigate the impact on Ecologically Related Species of fishing for southern bluefin tuna, 2008	Resolutions C-04-05 (Rev 2), C-09-01, and 99-07	Recommendations 03-04, 06-09, 08-04 and 08-05, 04-01 and 08-01, 06-02 and 08-02, and 09-04	Resolution 10/01 and Recommendation 10/12	Resolution 2005-03; Conservation and Management Measures 2008-01, and 2009-02
4.1 Binding	No	Yes	Yes	No (10/12) and Yes (10/01)	No (2005-03) and Yes (2008-01 and 2009-02)
4.2 Management Objective	Mitigate incidental harm to ecologically related species caused by fishing for southern bluefin tuna.	(04-05): Reduce levels of bycatch and release non-target species; (09-01): Reduce mortality on bigeye tuna stock; (99-07): Effectively manage the FAD purse seine fishery.	(06-09): Rebuild blue and white marlin stocks; (08-04 and 08-05): Rebuild bluefin tuna stocks; (04-01 and 08-01): Reduce the catch of undersized bigeye and yellowfin tunas; (03-04, 06-02, 08-02, and 09-04): Rebuild swordfish stocks.	Reduce fishing mortality of bigeye and yellowfin tuna stocks.	(2005-03): Minimize catch and impacts to non-target fish species that are not to be retained; (2008-01 and 2009-02): Reduce fishing mortality on WCPO bigeye tuna stock and ensure no increase in fishing mortality on WCPO yellowfin tuna stock.
4.3 Vessel Applicability and Area of Application	Recommendation adopts IOTC/WCPFC measures	Purse seine vessels	Varies by measure	Varies by measure	Varies by measure
4.4 General Requirements	Recommend Members and Cooperating Non-Members collect and report data on interactions with ecologically related species in southern bluefin tuna fisheries. Recommends compliance with all current measures aimed at protecting, or collecting and reporting data on, ecologically related species, of	(04-05): Require fishermen on purse-seine vessels to promptly release unharmed, to the extent practicable, all billfishes, dorado, and other non-target species. (09-01): Tuna catch retention requirement; two time/area closures in the purse seine fishery; establishment of a pilot program for research and gathering information on FADs. (99-07): Prohibits the transshipment of purse seine caught tuna at sea; prohibits the use of tender vessels operating in support of fishing vessels fishing on FADs; and requires that research be conducted on the relationship between catches tunas and the maximum depth of FADs; the	(06-09): Two phase program that includes blue and white marlin landings limits, requirements to release all live marlin caught in the longline and purse seine fisheries, requirements to keep records of releases, and promotes the use of monofilament leaders, and tag and release of billfishes. (08-04 and 08-05): Minimum size requirements, limitations on percentage of small bluefin in total landings; limitations on percentage of bluefin retained in non-target fisheries; time/area closure in spawning areas; encourage live release of bluefin tuna caught in the sport fishery. (04-01 and 08-01): Time/area	(10/01): Time/area closure for the purse seine and longline fisheries. (10/12): Ban on discards of tuna and non-target species in the purse seine fishery.	(2005-03): Encourage vessels to avoid, to the extent practicable, the capture of all non-target fish species that are not to be retained, and any such species shall be promptly released to the water unharmed, to the extent practicable. (2008-01 and 2009-02): Limits on purse seine fishing effort; tuna catch retention requirement in purse seine fishery; time closures on setting purse seines on FADs; and a requirement for each CCM to develop a FAD management plan.

	CCSBT	IATTC	ICCAT	IOTC	WCPFC
	IOTC and WCPFC when fishing for southern bluefin tuna in the relevant area.	effect of the use of baited FADs on catch rates and size composition of the catch of tuna; estimates of the natural mortality of the various populations of tunas; and the establishment of a maximum number of sets on floating objects which the EPO tuna fishery can support.	closure for the baitboat and purse seine fisheries. (03-04, 06-02, 08-02, and 09-04): Minimum size requirements, limitations on percentage of undersized swordfish in total landings, requirement to reduce the mortality of undersized swordfish, and a time closure.		
4.5 Reporting on Implementation	Yes	Yes	Yes	Yes	Yes
4.6 Research and Refinement of Mitigation Measures	No	(04-05): For the purse seine fishery: develop technology for releasing juvenile tunas, particularly sorting grids; apply technology for the identification of species and size composition in schools prior to setting. For billfish: develop techniques and/or equipment to facilitate release; determine the survival rates of released animals; and define areas and periods associated with high levels of catch.	(06-09): Parties encouraged to conduct research on blue and white marlin, including on post-release survival rates, life history characteristics, models for stock assessments, etc. The SCRS is required to conduct a stock assessment of blue and white marlin in 2010.	No	(2008-01 and 2009-02): Establishes a three year program to explore methods to reduce the catch of juvenile bigeye and yellowfin tuna caught in association with FADs.
4.7 Live Release; Safe Handling Measures	Recommendation adopts IOTC/WCPFC measures	Yes	Yes (06-09; 08-04 and 08-05)	No	(2005-03): Yes
4.8 Review for Effectiveness and Revision	Yes	Yes	Yes	Yes	(2008-01 and 2009-02): Yes
4.9 Collection and Use of Observer Data	Collection specified through CCSBT Observer Program Standards	Yes	Yes	Yes	(2008-01 and 2009-02): Yes
4.10 Mechanism for Consultation with Other RFMOs and IGOs	Yes	Yes	Yes	No	Yes
4.11 Consideration of Artisanal or Small-scale Fisheries	No	No	(06-09): Yes	No	Yes

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