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ROLE OF SCIENCE IN THE GOVERNANCE OF TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN

By

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ABSTRACT

ROLE OF SCIENCE IN THE GOVERNANCE OF TUNA FISHERIES
IN THE EASTERN PACIFIC OCEAN

By

Shauna Jae Jung Oh

Tunas support valuable commercial fisheries (export value >$6.6M) throughout the world oceans and are traded extensively in the global market for canning and sashimi. The demand and catch for tuna have increased steadily over the last fifty years and the current annual world catch is now over 4 million tons. Catches in the Pacific Ocean have been predominant, representing 65% of the world catch, with about 16% of the world catch from the eastern Pacific Ocean (EPO). The trend for the growing worldwide demand and harvest of tuna is expected to continue and will result in diminished catches if the fisheries are not properly managed. In this dissertation, I present a case study on Pacific tuna fisheries, describing the development and evolution of these tuna fisheries in relationship to the impacts of globalization, the institutionalization of the regional fisheries management organizations in the eastern and western and central Pacific Ocean and the challenges that these organizations have encountered in responding to governance requirements (UN Fish Stocks Agreement, FAO Compliance Agreement), especially as it relates to fisheries science. The increasing exploitation of tunas in the Pacific requires that participating nations develop and implement effective governance structures that can be used to sustainably manage these transboundary fisheries. Next, I examine the role of science at the Inter-American Tropical Tuna Commission (IATTC), one of the first regional fisheries management organizations (RFMOs) to govern tuna resources in the EPO. Its principal duties include coordinating fishery research, development activities

and recommending appropriate conservation measures to main the populations of tuna and other fish stocks taken by tuna vessels fishing in the EPO at levels of abundance that can support maximum sustainable yields (MSY). I evaluate how scientific and technical information are viewed and utilized by the Commission and the relative importance of scientific information in relation to other factors that influence decisions. I conclude by highlighting some key roles of science and its limitations in the sustainable management of tuna resources in the EPO.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

Managing the Eastern Pacific Tuna Fishery: Science and Governance at the Inter-American Tropical Tuna Commission (IATTC)

For nearly 60 years, fisheries science has played a central role in the governance of tuna fisheries in the eastern Pacific Ocean (EPO). The Inter-American Tropical Tuna Commission (IATTC) was established in 1949 as one of the first regional fisheries management organizations (RFMOs) to govern tuna resources in the EPO. Its principal duties include coordinating fishery research, development activities and recommending appropriate conservation measures to main the populations of tuna and other fish stocks taken by tuna vessels fishing in the EPO at levels of abundance that can support maximum sustainable yields (MSY) (IATTC 1949). To acquire the information necessary to determine the levels of stock abundance that can support MSY, the IATTC has carried out a broad-based and comprehensive fishery research program to collect detailed data on the tuna fisheries as well as ancillary biological and environmental data (IATTC 2007a). The data collected are used by IATTC staff to formulate models that can provide assessments of the impact of fishing on the stocks. The fishery research conducted by the IATTC staff, including but not limited to the stock assessments of tuna species represent the best available scientific evidence available for basing tuna fishery management decisions in the EPO.

The role of fishery science in the governance of tuna in the EPO has had even more relevance since 2001. The governance context for fishery science has been codified in the Agreement for the implementation of the UN Convention on the Law of the Seas (1982),

relating to the conservation and management of straddling stocks and highly migratory fish stocks, known as the UN Fish Stocks Agreement, which entered into force in 2001. The agreement not only provides the framework for making management decisions based on the best scientific evidence available but establishes that coastal states and distant water fishing nations conserve and manage straddling stocks and highly migratory fish species, such as tuna, through the establishment of RFMOs. At the core of the Fish Stocks Agreement is the RFMO regime and the specifications for use of science for conservation and sustainable fisheries at such arrangements. Consequently, fishery science and research is the cornerstone of regional fisheries management organizations like the IATTC.

DEFINING THE PROBLEM

A principal issue for the Pacific tuna fishery is that the current governance structure may not ensure the long-term sustainability of the tuna resource. The best available scientific evidence indicates threats of overfishing of tuna stocks from excess capacity of the purse-seine fleet and concerns have been raised that bigeye tuna, an important and lucrative tuna species in the Pacific Ocean, is at the state of being overfished. Fishery science has shown that fish stocks, such as tuna are resilient and will rebound, provided that they are given a chance. As a result, the science advice has been recommending decreasing fishing effort and mortality by limiting capacity, closing seasons and areas to maintain the at-risk stocks of tuna within the safe limits of conservation and sustainability. However the member and participating countries would need to heed the scientific advice and allow their fleet and processing industries to be

negatively impacted so that the stocks can recover. The two RFMOs governing tuna resources in the Pacific have not been able to reverse the trend of increases in fishing mortality in recent years. In fact, the Inter-American Tropical Tuna Commission (IATTC), the more established of the two RFMOs, has experienced difficulty even reaching agreement on the implementation of effective conservation and management measures to manage tuna populations. Over a two-year period, the IATTC has failed to adopt resolutions and the bigeye stock in the EPO has been fished without conservation measures in place since 2007.

DISSERTATION FORMAT

In this dissertation, I first assessed the challenges to and need for more effective governance institutions with responsibilities over the management of the tuna stocks in the Pacific Ocean, comparing two existing institutions for regional governance. The increasing exploitation of tunas in the Pacific requires that participating nations develop and implement effective interjurisdictional governance structures that can be used to sustainably manage the tuna resources. I then focused on one key issue for fishery governance- whether the fishery science advice provide by an RFMO secretariat has enough influence to persuade its members to fully adopt and implement conservation measures to ensure the sustainability of tuna stocks. I assessed the role of science in the decision-making at the Inter-American Tropical Tuna Commission (IATTC), the governance institution established to ensure the sustainability of tuna resources. I decided to examine closely the development and role of science at the IATTC for two main reasons: (1) the utilization of an independent and permanent scientific staff to provide

stock assessments and scientific advice, which is unique to tuna and most other RFMOs; 2) local access to the secretariat of the IATTC and consequently the opportunity to attend the plenary meetings of the Commission and interact with the delegations, observers and staff of the IATTC.

This dissertation is composed of three chapters. The first chapter serves as an introduction, defining the problem and providing a more detailed description of study scope and methods. The second chapter provides an overview of the existing institutions for regional governance of tuna fisheries in the Pacific, comparing IATTC, whose convention predates the establishment of the UN Fish Stocks Agreement, with the Western Central Pacific Fisheries Commission, the newest RFMO whose convention entered into force in 2004. The second chapter describes the evolution of the governance structures and highlights the challenges to effective governance in the context of the comparison between the oldest and newest tuna RFMOs. This chapter has been published in International Governance of Fisheries Ecosystems: Learning from the Past, Finding Solutions for the Future (Oh et al. 2008).

The last chapter examines the role and influence of science at the Inter-American Tropical Tuna Commission and its implications to the sustainability of tuna stocks in the EPO. Some key challenges to sustainability are described, which provide the framework for the assessment of the quality and influence of science and other factors in decision-making. Additionally, recommendations are made on what can improve the quality of science advice and make it more influential or central in the decision-making at the IATTC. The chapter concludes by highlighting the important roles of science and its limitations in the sustainable management of tuna resources at the IATTC. This chapter

will be published in Sustainable Fisheries: Multi-Level Approaches to Global Problem, editors W.W. Taylor, A.J. Lynch, A Schroeder, and M. Schechter.

STUDY SYSTEM

The Inter-American Tropical Tuna Commission (IATTC) is one of five regional fisheries management organizations (RFMOs) created to govern tuna fisheries in the world oceans. The oldest of the tuna RFMOs, the IATTC was created in 1949 by a Convention signed by Costa Rica and the United States. The Convention established the Commission to conserve and manage fisheries for tuna and other species taken by tuna-fishing vessels in the eastern Pacific Ocean (EPO). The boundaries of the EPO were not defined in the Convention but has been since defined in recent resolutions as the area between 40°N and 40°S latitude and between the coastline of North, Central, and South America and 150°W longitude. Since its establishment, the Commission has grown to 16 members (Table 1) and six nations have cooperating non-party or cooperating fishing entity status with the Commission (Belize, Canada, China, Cook Islands, the European Union and Chinese Taipei). The Convention is open to all states whose nationals participate in the fishery for tunas in the EPO.

Table 1: Member countries of IATTC

Member Countries	Year of Adherence
Costa Rica	1949
United States	1949
Panama	1953
Ecuador	1961
Mexico	1964
Japan	1970
France	1973
Nicaragua	1973
Vanuatu	1990
Venezuela	1992
El Salvador	1997
Guatemala	2000
Peru	2002
Spain	2003
Republic of Korea	2005
Columbia	2007

The Commission consists of a national section for each high contracting party or member state and each national section is entitled to have up to four Commissioners, appointed by its government. Each national section has one vote, which may be cast by any Commissioner of that section (IATTC No date). Each national section can appoint an advisory committee to assist with matters related to the work of the Commission. Due to the predominance of Latin American nations, the official languages of the IATTC are

both English and Spanish. The Commission meets at least once a year at its principal or annual meetings and as needed at special meetings convened to address matters that for various reasons cannot be handled at the annual meetings. At the annual meetings, the Director of the IATTC and other members of the IATTC staff present the results of recent research on tuna stocks and make recommendations on conversation measures, if appropriate, for regulation of the tuna fishery. If the recommendation is to be adopted in the form of a conservation resolution it must be approved by consensus of all members. The 1949 Convention established that official actions of the Commission, such as agreements, resolutions, and recommendations, must be approved by unanimous vote but in practice has been consensus (IATTC 2007b).

The main objectives of the IATTC are to cooperate in the gathering and interpretation of scientific information to facilitate maintaining the populations of tunas and tuna-like species in the eastern Pacific Ocean (EPO) at levels which permits maximum sustainable catches. To fulfill these objectives, the IATTC carries out an extensive scientific research program staffed by independent and internationally recruited scientists. The information collected and analyzed by the IATTC scientific staff on catch statistics, biology, and oceanography are incorporated using mathematical and statistical techniques, or the assessment models, to arrive at estimates regarding the status of the tuna stocks in question and to provide assessments of the impact of fishing on the stocks.

The stock assessments for yellowfin and bigeye tunas are prepared annually and presented at the Stock Assessment Review Meetings (previously known as Meetings of the Working Group on Stock Assessment) in the form of scientific working papers and after modifications resulting from the review meeting, are published in Stock Assessment

Reports. The Director convenes the Stock Assessment Review Meetings to provide a kind of peer review by scientific representatives of member nations and interested organizations of the staff's research. The Meetings having been convened since 2000 and the attendees have steadily grown to include not only scientific representatives of member nations, NGOs and other international organizations but also increasing numbers of policy and decision-making representatives, including commissioners and their advisers.

To gain a better understanding of the role and influence the IATTC community attributes to science and the scientific advice generated by the secretariat, individuals from the secretariat staff, commissioners, member country advisors and various organizations that participate at the IATTC meetings were interviewed face-to-face or over the phone. Over the period of two years spanning six plenary meetings of the IATTC and two Stock Assessment Review Meetings, 35 participants in the IATTC process representing 16 countries and 29 different organization, were asked open ended questions about their perception and thoughts on the role of science in the decision making at the Commission (Appendix A). Attendees lists from IATTC minutes annual, ad-hoc, and stock assessment working group meetings were initially used to identify participants, followed further by colleague recommendations, and internal inquiry within different organizations. Prior to the interview, personal contact was made with several members from various delegations and organization in attendance at the meetings and permission requested for an interview (Appendix B). Only two individuals declined to participate in the interview but several individuals recommended others in their organization or delegation for the interview because of their limited comprehension of the

English language. Three participants replied in Spanish. In many instances, the willing participant's availability before, during or after breaks of the plenary or assessment review meetings dictated the number of interviews that were possible at a given meeting and the potential participants' command of the English language determined who among their delegation or organization participated in the interview. All interviews were recorded on an Aiwa digital voice recorder with the participants' consent and subsequently transcribed.

The graph represents the participants in the interviews grouped by their role in the commission process and level of science training (Figure 1). The participants were put into one of five groups: commissioners, government advisors, industry advisors, scientific staff or representative from a non governmental organization (NGO) and also differentiated by whether they stated having received formal education in fisheries science or related field and or whether they were scientists in their current occupation. The experience of the participant involvement with the Commission process ranged from less than five years to several participants having been involved with the Commission for over 30 years (Figure 2). More than a third of those interviewed had been involved with the Commission process less than five years with only one having stated involvement for less than a year.

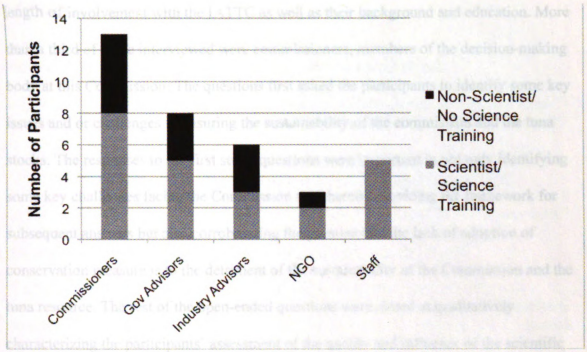

Figure 1: Role of interview participants and fisheries science training (N=35)

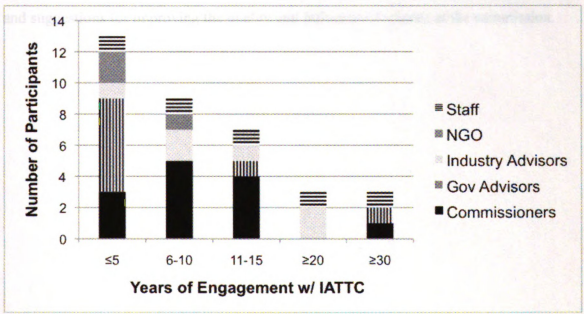

Figure 2: Participants' experience of engagement with the IATTC process (N=35)

The questions asked of participants included information about his or her role and

length of involvement with the IATTC as well as their background and education. More than a third of those interviewed were commissioners, members of the decision-making body at this Commission. The questions first asked the participants to identify some key issues and or challenges to ensuring the sustainability of the commission and the tuna stocks. The responses to the first set of questions were important in not only identifying some key challenges facing the Commission and thereby providing the framework for subsequent answers but also corroborating the premise that the lack of adoption of conservation measure is to the detriment of the sustainability of the Commission and the tuna resource. The rest of the open-ended questions were aimed at qualitatively characterizing the participants' assessment of the quality and influence of the scientific information in the adoption of conservation measures. Their assessment also included identification of other factors that influence the sustainability of tuna stocks in the EPO and suggestions for improving the quality and influence of science at the commission.

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CHAPTER TWO

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CHAPTER TWO

Regional Governance of Pacific Tuna Fisheries

INTRODUCTION

The Pacific Ocean supports valuable commercial fisheries for tuna. The tuna fishery in the Pacific mainly targets populations five tuna species: albacore (*Thunnus alalunga*), bigeye (*T. obesus*), Pacific bluefin (*T. orientalis*), yellowfin (*T. albacares*) and skipjack (*Katsuwonus pelamis*) tuna. The world demand and catch for these five species, commonly referred to as principal market species, have increased steadily over the last fifty years and as of 2004, the annual world catch was over 4 million tonnes (WCPFC 2005). The principal market species of tunas are among the most important fish commodities in the world and are traded extensively in the global market for canning and sashimi. In terms of world catch, the Pacific Ocean has been predominant and with the exception of bluefin tuna, the Pacific Ocean also produces the greatest quantities of each of the principal market species. There are three species of bluefin tuna species in the world oceans with two in the Pacific, but for this paper only Pacific bluefin tuna will be discussed.

The trend for the growing worldwide demand and harvest of tuna is expected to continue and will result in diminished catches if the fisheries are not properly managed. In the Pacific Ocean, there are two regional fisheries management organizations (RFMOs) that directly establish management measures for tuna resources: The Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC). To govern the valuable fisheries of the Pacific Ocean,

these two tuna RFMOs have been created and operate with the objective to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in their respective regions of the Pacific Ocean in accordance with the provisions of the UN Convention on the Law of the Sea Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, commonly known as the UN Fish Stocks Agreement.

This paper reviews the development and examines the current status of regional governance of tuna fisheries in the Pacific Ocean. First, we describe the development and trends in the tuna fisheries in the eastern Pacific Ocean (EPO) and the western and central Pacific Ocean (WCPO). Succeeding sections review the evolution of governance structures pertaining to tuna and the institutionalization of the regional fisheries management organizations (RFMOs) operating in the Pacific. Finally, we present efforts toward effective governance and challenges faced by the regional tuna management organizations and explore their implications for tuna resources. In the process, an attempt is made to make recommendations about the future direction of the regional governance for Pacific tuna fisheries.

TRENDS IN THE FISHERY

The catch from the Pacific Ocean represents 65 percent, or about 2.5 million tones, of total world catch (Miyake et al. 2004). The main species targeted by tuna fisheries operating in the pacific are skipjack tuna (*Katsuwonus pelamis),* yellowfin tuna *(Thunnus albacares),* bigeye tuna *(T. obesus),* albacore tuna *(T. alalunga), and* Pacific bluefin tuna *(T. orientalis),* in order of importance by catch. A range of other species is

taken incidentally by tuna fishing vessels but those species, including billfish, are not considered in this paper. The tuna fishery in the Pacific Ocean is diverse, ranging from small-scale, artisanal operations in the coastal waters of Pacific island states, to large-scale, industrial purse-seine, pole-and-line, and longline operations both in the exclusive economic zones of coastal and Pacific island states and on the high seas (Langley et al. 2004). Other gears used by the Pacific tuna fishery include baitboats, traps, trolling, handline, gillnets and other unclassified fishing methods used in artisanal fisheries.

The principal market species of tunas are among the most important fish commodities in the world. After shrimp and groundfish, tuna is the third major commodity traded internationally with about 9% of total trade in terms of value. Total tuna trade (export values) reached US$ 6.1 billion in 2004, up from US$ 1.9 billion in 1987 (Josupeit 2006).

The main internationally traded tuna forms are 1) raw materials for canning that are frozen or chilled; 2) pre-cooked loins for canning which are frozen; 3) tuna for direct consumption, in the form of sashimi or steaks that are fresh, chilled or frozen; 4) canned which are in solid pack, chunks, flakes (also in pouch packs) and grated; 5) smoked and dried (mainly skipjack tuna); and 6) fish oil and meal for use in pet or animal feed.

In the following sections, we provide an overview of the tuna fisheries including historical trends in tuna catch and status of the stocks. In reference to certain tuna stocks and governance structures a distinction will be made between eastern Pacific Ocean (EPO, east of 150°W) and the western and central Pacific Ocean (WCPO, west of 150°W) (Figure 3).

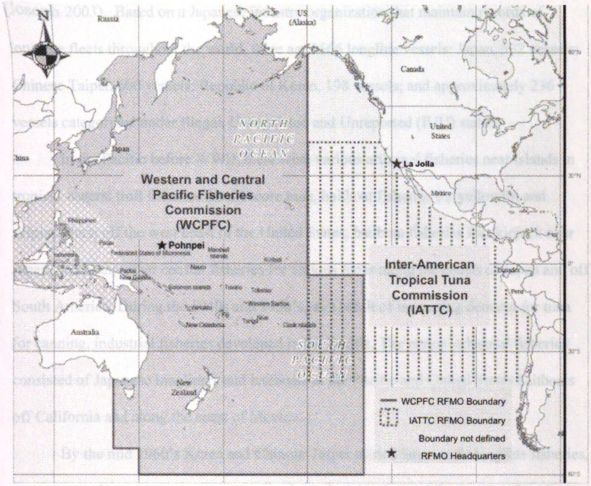


Figure 3. Map of the boundaries of the two RFMOs that establish management measures for tuna resources in the Pacific Ocean: IATTC in the eastern Pacific Ocean and WCPFC in the western and central Pacific Ocean (map modified from Metzer 2005: Global Overview of Straddling and Highly Migratory Fish Stock).

Evolution of Tuna Fisheries in the Pacific

The Pacific Ocean has a long and rich history of fishing for tunas since ancient times. However, it wasn't until after World War II when the demand for protein rich foods propelled the tuna catches in the Pacific. Over time, the growth of the tuna industry led to the expansion of the tuna fleet, both in numbers of vessels and in the sizes of the individual vessels. As of 2000, it is estimated that there are nearly 250 high-seas purse-vessels operating in the EPO and WCPO with a total capacity of over 400,000 tonnes

(Joseph 2003). Based on a Japanese industry organization that maintain records of longline fleets throughout the world, there are 1566 longline vessels: Japan, 532 vessels; Chinese Taipei, 600 vessels; Republic of Korea, 198 vessels; and approximately 236 vessels categorized under Illegal, Unregulated and Unreported (IUU) status.

In the Pacific before WWII, there were various artisanal fisheries near islands in tropical waters: troll fisheries for albacore tuna, baitboat fisheries for yellowfin and skipjack tuna off the west coast of the United States, baitboat fisheries for skipjack near Japan, and many other coastal fisheries for various tunas along the coasts of Japan and off South America. During the 1940s and 1950's, as a result of increasing demand for tuna for canning, industrial fisheries developed in the Pacific. The major industrial fisheries consisted of Japanese longliners and baitboats in the Pacific and United States baitboats off California and along the coast of Mexico.

By the mid 1960's Korea and Chinese Taipei started large-scale longline fisheries, exporting to the tuna canning industry. At the end of this decade, the Japanese longline industry developed super cold storage systems, which established new frozen products for the *sashimi* market, and consequently started to change their target species from yellowfin and albacore to bluefin and bigeye tunas (Miyake et al 2004). In the EPO, the US baitboat fishery off Central and South America was almost completely replaced by purse seiners, which developed a new fishing method known as dolphin fishing or setting on dolphins. In the EPO, where certain dolphin species swim above schools of large yellowfin tuna, a purse-seine is deployed to encircle the entire school of dolphins to capture the tuna (Joseph 1994; Gosliner 1999). The dolphins are then released and tunas are loaded on the vessel. Often the dolphins died as a result of becoming trapped or

entangled in the net, and in the early years of using this fishing technique theses incidental mortalities were very high with estimates between 1959-1972 as high as 350,000 to 650,000 (NRC 1992).

During the 1970's the longline fishery with its super cold storage system gradually shifted its target from yellowfin and albacore for canning to bigeye for the sashimi market. The shift to bigeye was seen among not only Japanese longliners but gradually also expanded to Korean and Chinese Taipei fleets (Miyake et al. 2004). In order to catch adult bigeye found in deeper depths than yellowfin and albacore tunas, the hooks were set deeper, known as "deep longlines". The change in target species by the longline fleets affected the fishing areas, seasons, as well the species compositions of the catches, including bycatch species. Through the 1970's the purse-seine fishery in the EPO continued to develop but due in part to strict regulations aimed at reducing the incidental mortality of dolphins in the fishery in this area, US vessels changed flags to Central and South American countries and shifted their fishing effort to the WCPO.

In the 1980's, the Japanese and Korean longline fleets started to decrease in number while the Chinese Taipei and "flag of convenience" fleets increased rapidly. Small-scale longline fishing operations also started to develop in coastal countries in the Mediterranean and in the Southeast Asia (Indonesia and Philippines). The purse-seine fishery expanded its fishing area, particularly in the WCPO with the development of technological developments such as use of bird radars and helicopters, which increased the efficiency of the purse-seine fleet. According to Miyake et al. (2004), the 1980's also brought many new countries such as Brazil, Mexico, and Venezuela into the large-scale industrial purse-seine fisheries.

Since the 1990's small-scale longline fishing increased extensively while the legal longline fishing industry started to have its capacity limited. At the same time, the number of IUU vessels has increased and have become a major problem for managing tuna fishing capacity (Miyake et al. 2004). It is estimated that there are 1566 longline vessels as of 2000, of which 236 are categorized under illegal, unregulated and unreported (IUU) status. The use of fish aggregating devices (FADs) by the purse seine fleet expanded to the Pacific Ocean. The FAD fishery is less selective than other fishing methods with regard to the species and size of the fish caught and hence, affecting fishing efficiency, fish size, catch species composition, and bycatch species.

Recently a new industry, tuna farming, has developed to supply the Japanese sashimi market (Catarci 2001). Pacific bluefin tuna are one of three bluefin tuna species that are being commercially farmed or "ranched" for fattening purposes. Juvenile or post-spawning adult bluefin tuna are caught by purse seining or in traps and transferred to holding pens, where they are held and fed to increase their weight and fat content. Farming of Pacific bluefin tuna is carried out in northern Mexico, with annual production at about 1000 to 2000 tonnes back in 2001(Catarci 2001). Although bluefin tuna are the main species for tuna farming, bigeye and yellowfin tuna have been farmed in Mexico and Central America and are increasingly being considered as alternate species for farming tuna in warmer water regions. The small to medium tunas caught by purse-seines that once sold to the canning market can now be converted to products for the more profitable sashimi market. Given the difficulty in tracing the output of farming back to the catch, the growth of this industry may have implications for accountability and implementing management regulations.

Biological Stock Status

Tuna fishery management bodies use various biological reference points that provide information on the status of stock in relation to defined limits or targets for exploitation. The reference points commonly include F_{MSY} (fishing mortality at maximum sustainable yield), F_{AMSY} (fishing mortality at average maximum sustainable yield), F_{max} (fishing mortality at maximum yield per recruit), $F_{30\%}$ (fishing mortality at 30% spawning biomass ratio), SSB_{MSY} (spawning stock biomass at MSY), B_{MSY} (biomass at MSY), SBR (spawning biomass ratio), and slight modifications of SBR. These biological reference points might not be appropriate for all tuna species because of significant difference in life history characteristics but nonetheless, they are being widely used.

Skipjack tuna (SKJ), Katsuwonus pelamis

It is assumed that there are at least two stocks of skipjack tuna in the Pacific Ocean, a western and central stock occurring west of 150°W and an eastern Pacific stock occurring east of 150°W (Joseph 2003, Miyake et al. 2004, de Leiva Moreno and Majkowski 2004). Skipjack are among the most widely distributed of all tuna species, inhabiting the upper mixed layer of the tropical and subtropical regions of the oceans, and is found in commercial quantities between 45°N and 40°S (Joseph 2003). It forms large schools often associated with objects such as floating logs and large animals. Skipjack tuna is a short-lived species, with high rates of natural mortality and population turnover. Spawning in the Pacific takes places where the surface temperature is 24°C or higher (Miyake et al. 2004).

Fish aggregating devices (FADs), a method which normally catches a very high

proportion of small fish, were introduced in 1998 (Miyake et al. 2004), and purse-seine vessels fishing on FADs have taken much of the increased catch in recent years. There is concern that increasing fishing effort on FADs in the EPO in order to increase the skipjack catch, could result in increased incidental catches of small yellowfin and bigeye, which might affect the abundance and future catches of those species (Joseph 2003). Currently there is no monitoring of FADs so exact locations, numbers placed, and impacts of FADs are unknown. The regional fisheries management organization in the EPO is working to 1) summarize available information on the impacts of the use of FADS; 2) describe areas where FADs should not be placed because of the probability of catching juvenile tunas; 3) determine the increase in vulnerability of tunas; and 4) determine the number of FADs placed (IATTC, 2007).

For skipjack tuna, reference points have not been estimated for the stocks; however, general information indicates that the stock is exploited well within its safe limits (de Leiva and Majkowski N/A). Further increases in the catches of SKJ could be sustainable; however, because SKJ are being fished together with yellowfin and bigeye tuna, management measure limiting increases in the catches of bigeye and yellowfin tuna would affect SKJ catches.

Yellowfin tuna (YFT), Thunnus albacares

Yellowfin tuna are widely distributed throughout the tropical Pacific with juveniles forming schools in association with other tunas or objects such as floating logs and large animals. Adults are also found in schools, either free-swimming or on the surface in concentration in the mixed layer. In the EPO, large schools of yellowfin are

frequently found associated with schools of dolphins. Spawning takes place in the Pacific where the sea surface temperature is 24°C or higher (Miyake et al. 2004). The yellowfin tuna population in the Pacific is currently managed with a two stocks hypotheses, one in the east and the other in the west separated at 150°W longitude and with limited mixing between them (de Leiva Moreno and Majkowski 2004; Miyake et al. 2004).

In terms of total catch, yellowfin tuna is the second most important principal market species, accounting for about 30% of world and Pacific catch. Most of the commercial catch is for canning and caught at the surface by purse-seine vessels. The purse-seine fleets operate in the equatorial waters of both the western and eastern Pacific and largely in the same areas fished for skipjack. In the EPO, the catch peaked at more than 200,000 tonnes in the late 1970's, mostly from sets made on dolphin-associated schools. The catch started declining after the late 1970's due to overfishing and additionally by severe El Niño conditions. With the decline in catch, many seiners moved to the central western Pacific. The WCPO catch subsequently increased sharply in the mid-1980's and remained at a level averaging 700,000 tonnes (Miyake et al. 2004). Purse-seine sets have traditionally been made on schools associated with naturally-occurring floating objects, and free-swimming schools. Since the introduction of FADs in the late 1990's, FADs have become a commonly used fishing device by purse-seiners.

The stock size of the YFT-EPO and its fishing mortality are both near their reference points. The AMSY is 250,000 tonnes for EPO and F has been stable in recently years at slightly below F_{AMSY}. In the eastern Pacific, catches of yellowfin have averaged about 250,000 tonnes over the last decade. Analyses by scientists of the Inter-American Tropical Tuna Commission (IATTC) indicate that the yellowfin resource in this area is

fully exploited and is producing near the maximum it can sustain, so increasing fishing effort will not result in a sustained increase in catches (IATTC, 2001). The stock size of the YFT-WCPO is above its reference point, and the fishing mortality is near its reference point. The MSY is between 381,000 and 554,000 tonnes and yield projections indicated that increases in fishing mortality would not result in long-term increases in the catch and might result in overexploitation (de Leiva Moreno and Majkowski 2004). FADs could be affecting the sustainability of the stock, as catches of small yellowfin appear to be increasing.

Bigeye tuna (BET), Thunnus obesus

The stock structure of bigeye is not very well understood and it is assumed that there are two separate stocks in the east and west Pacific, however, scientists at IATTC and the Secretariat of the Pacific Community (SPC) have performed population assessments based on the assumption that there is a single bigeye stock in the Pacific Ocean (de Leiva Moreno and Majkowski 2004). Juvenile bigeye form schools with other tunas (skipjack and/or yellowfin) in association with objects such as floating logs and large animals. As they mature, bigeye tend to inhabit deeper waters, below the thermocline. Spawning takes place in warm waters at temperatures 24°C or higher (Miyake et al. 2004).

For adaptation to life at greater depths as adults, bigeye have a layer of subcutaneous fat to insulate them from the cold. The subcutaneous fat in bigeye make this species very valuable in the sashimi market and the target of subsurface longline gear. Medium to large bigeye are fished by longline. With the introduction of deep

longlines in the mid 1970's, catches of bigeye in the Pacific and the world began to increase. In the Pacific Ocean annual catches of bigeye have fluctuated between about 100,000 to 165,000 tonnes prior to 1999, and to over 200,000 tonnes in recent years (Miyake et al. 2004). About 50% of the catch is taken in the EPO, east of 150°W.

Bigeye tuna are also caught using purse seine and baitboat gear. However, bigeye is a bycatch species for the purse-seine and baitboat fisheries targeting skipjack. Until recently longline gear was the principal method of capturing bigeye, but during the late 1980's a new fishing method involving deeper purse-seine nets and FADs was developed (Joseph 2003, Miyake et al. 2004). The bigeye tuna are attracted to the FADs, identified at depth by sonar, encircled with the nets, and captured. The bigeye tuna caught with this method are generally small, averaging about 8kg, whereas the average for the longline fishery targeting medium to large bigeye is about 55-60kg. When purse-seiners set mostly on dolphin-associated tuna schools, the annual purse-seine catch of bigeye in the east Pacific had been small, less than 16,000 tonnes. With the increase use of the new fishing method on FADs, the purse seine catch of bigeye increased to more than 70,000 tonnes. It is believed that the increasing surface catches of bigeye together with the heavy exploitation by long line gear, will contribute to the further decline in the longline catches (IATTC 2001).

The stock size of the BET-EPO and its fishing mortality are above their reference points. However, it was forecast that its stock size would soon decrease to below its reference point. Since 1993, on average, F for BET younger than about 5 years old has increased substantially due to the expansion of the purse-seine fisheries that catch BET in association with FADs. The stock size of the BET-WCPO is possibly near its reference

point and the fishing mortality is possibly above its reference point (de Leiva Moreno and Majkowski 2004). The present fishing mortality rates for both juveniles and adults may not be sustainable in the long-term.

Albacore tuna (ALB), Thunnus alalunga

In the Pacific Ocean there are two stocks of albacore, a northern stock that occurs between the equator and about 40°N, from Japan to North America (ALB-NPO) and a southern stock (ALB-SPO) that is found between 15 and 40°S from Chile to New Zealand (Joseph 2003, de Leiva Moreno and Majkowski 2004, Miyake et al. 2004). Albacore tuna are a temperate species, concentrated mainly in cooler temperate and subtropical waters, that undertake extensive migrations. The distribution of this species changes with age with small and medium younger fish inhabiting high latitudes and large adults found in spawning grounds in tropical and subtropical waters. Spawning occurs where the sea surface temperature is 24°C or higher (Miyake et al. 2004).

Small to medium albacore are caught by baitboat, troll and gill net fisheries operating in mostly temperate waters while the medium to large sized adult fish are caught by longline. Purse-seining accounts for only a small portion of the total albacore catch which fluctuates a great deal from year to year, ranging between 80,000 and 160,000 tonnes during the last 50 years. Most of the albacore harvested commercially in the Pacific are captured by surface trolling and by longline and the catch is typically higher from the northern stock.

Based on available information, the stock size of ALB-SPO is above its reference

point, and its fishing mortality is below its reference point (de Leiva Moreno and Majkowski 2004). It is probable that the southern stock is not overexploited. However scientific studies suggest that the northern stock is fully or possibly overexploited. The southern stock is currently above the level of abundance necessary to sustain the AMSY and appears to be sustainable. The catches are likely to continue to increase for the southern stock with further increase in fishing effort, but the extent to which the effort and catches could be increased is unknown (de Leiva Moreno and Majkowski 2004).

It is said that Albacore tuna led to the development of the present day world market for canned tuna (Joseph 2003). The United States was the first to can albacore tuna, marketing the chicken-like white flesh, "Chicken of the Sea". Demand for the white flesh product grew rapidly, which led to the development of the canned light-meat market for yellowfin and skipjack. Canned albacore has always fetched a premium price, due to the high demand for its white flesh, and the limited supplies of raw fish, never exceeding 300,000 tonnes total world catch.

Pacific bluefin tuna (PBF), Thunnus orientalis

According to tagging studies there is considerable exchange of Pacific bluefin tuna between the EPO and WCPO. The spawning grounds are in the western Pacific between the Philippines and southern Japan. Juveniles move northward from the spawning and nursery grounds and become available for the coastal troll fishery in the southern Japan at a size of about 20 cm. They make north-south migrations in the western Pacific as they grow. Some fish undertake trans-Pacific migrations to the eastern Pacific beginning when they are about one or two years of age. These fish may reside for a year

or two in the EPO before retuning to the western Pacific for a stay before venturing back to the EPO. Adults appear to be distributed mainly in the north-western Pacific. It is assumed that there is a single stock of Pacific bluefin in the Pacific Ocean (de Leiva Moreno and Majkowski 2004). The Pacific bluefin are slow-growing and long-lived species.

The major fishing grounds for Pacific bluefin tuna are located at the middle latitudes of the north Pacific between 20°N and 45°N in the west and between 23°N and 33°N in the east. In the northwestern Pacific, around Japan, Pacific bluefin tuna are taken throughout much of the year by a variety of gears, including purse seines, trolling gear, longlines, fixed traps, and pole-and-line gear. In the eastern Pacific, bluefin are caught off Baja California and southern California, by purse-seine and sport fisheries. In the eastern and western Pacific, the largest catch has been made by the purse-seine fishery, followed by longline, baitboat, troll and trap fisheries.

The total catch for the whole Pacific Ocean has shown large fluctuations in the last fifty years, ranging between 10,000 and 35,000 tonnes with lower catches during early 1950s, late 1960s to mid 1970s, and after the mid 1980's. The declines of catch seen before the 1980s were due to the decreased catches in the western Pacific but the decline after the mid-1980s was attributed to the very low catch in the eastern Pacific. The catch in the western Pacific generally exceeded that in the eastern Pacific (Miyake et al. 2004).

In terms of tonnage landed, Pacific bluefin are the least important of the principal market species of tuna. However, because of their large size, color, texture, and high fat content of their flesh, they are the most sought after species for sashimi, commanding a

higher price than other principal market species of tuna.

The stock size of PBF-PO is possibly near its reference point, but its fishing mortality is above its reference point. The Spawning Stock Biomass (SSB) has been declining since 1995 (de Leiva Moreno and Majkowski 2004). If the estimated recent fishing mortality rates continue, the SSB is likely to continue to decline. The results of different population analyses indicate that greater catches could be obtained if age 0 and age 1 fish were not caught, or their catches significantly reduced (Joseph 2003, de Leiva Moreno and Majkowski 2004).

In sum, from a conservation perspective, ALB-SPO and SKJ-WCPO are considered within safe limits for conservation; YFT stocks in both the EPO and WCPO should be closely monitored; and for BET-EPO, BET-WCPO, and PBF-PO, fishing mortality should be reduced, their stock size should be increased, or both (de Leiva Moreno and Majkowski 2004).

EVOLUTION OF GOVERNANCE STRUCTURES

As the preceding sections outlined, the tuna resources in the Pacific are characterized by its highly-migratory nature; occurrence in EEZ and on the high seas; large capacity and mobility of vessels that take most of the catch; several types of gear, taking several species of tuna; stocks that are fully exploited or over exploited; importance to international trade; and expected growth in demand and harvest. Consequently if fishing nations are to continue to harvest tuna, governance structures need to be in place that can accommodate and ensure the effective long-term conservation and management. The following sections provide an overview of the

governance structures pertaining to tuna and the institutionalization of the regional fisheries management organizations (RFMOs) operating in the Pacific.

International Instruments Governing Pacific Tuna Fisheries

Several international conventions and agreements have bearing on the Pacific tuna fisheries. The developments in the international law of the sea, and particularly the emergence of the United Nations Convention on the Law of the Sea in 1982 (UNCLOS) and other associated agreements, have provided an essential framework for establishing a more adequate system of ocean and fisheries governance, including that for the multiple tuna fisheries operating in the Pacific. In addition to the establishment of the exclusive economic zones (EEZ), which extended the jurisdiction of coastal states to 200 miles, UNCLOS established a legal right for coastal states to manage fisheries off their coasts and established a framework within which coastal states can effectively limit access to their fisheries (FAO, 2003a). A consensus among states to strengthen their cooperation in the management of high seas fisheries resources led to the 1995 Agreement for the implementation of the provisions of the UNCLOS relating to the conservation and management of straddling fish stocks and highly migratory fish stocks, known as the UN Fish Stocks Agreement. Highly migratory fish stocks refer to fish species or stocks that carry out extensive migrations and can occur in both EEZs and high seas. This term is usually used to denote tuna and tuna-like species, such as marlins and swordfish.

The main elements of the 1995 UN Fish Stocks Agreement include 1) requiring coastal States and distant-water fishing States/nations (DWFN) to ensure that the conservation and management measures, which are created within the EEZ, and on the

high seas, are compatible; 2) general principles for the conservation and management of straddling fish stocks and highly migratory fish stocks which include tuna resources, including the precautionary approach, which Parties to the Agreement are to apply on the high seas as well as within the EEZ; 3) duties of the flag States with respect to their vessels fishing on the high seas; provisions on enforcement for non-flag states, as well as providing for port-state jurisdiction in respect of fishing vessels; 4) provisions on enforcement for non-flag states and on peaceful dispute settlement; and 5) detailed rules on the establishment and operation of sub-regional or regional fisheries management organizations or arrangements (RFMOs, hereafter), which are to establish conservation and management measures on the high seas (Munro et al. 2004). Parties to the Agreement are obliged to join RFMOs, or agree to comply with the measures they create. If they do not do so, they will not be allowed to fish in the areas where these management measures apply. It specifies the functions of science in the RFMOs and the need for such arrangements to collect, analyze and disseminate information on target species. It also recognizes the need for reassessment of non-target, or bycatch species. The agreement sets out comprehensive areas in which such RFMOs will have competence covering scientific research, stock assessment, monitoring, surveillance, control and enforcement, decision making procedures which facilitate timely adoption of conservation and management measures, and dispute settlement (Art. 10). It has been argued that the RFMO regime constitutes the heart of the Fish Stocks Agreement, bringing the role of RFMOs into sharper focus (Örebech, et al., 1998; Munro et al. 2004; Swan 2004).

The Agreement to Promote Compliance with International Conservation and Management Measure by Fishing Vessels on the High Seas, known also as the

Compliance Agreement, sets forth minimum requirements for registration and authorization of fishing vessels which would be fishing on the high seas, detailed rules on the responsibility of the flag state, duties to cooperate in exchange of information on the registry of fishing vessels, and activities of vessels which undermine international conservation and management measures (FAO 2003b). The Compliance Agreement was adopted in 1993 and was the first stage to be completed of the FAO's Code of Conduct for Responsible Fisheries.

Additionally in 1995, the FAO Code of Conduct for Responsible Fisheries was adopted which seeks to lay down a comprehensive set of guidelines and principles, in accordance with the relevant rules of international law, which among other things, promote responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects. It is directed toward all states, fishing entities, international organizations, non-governmental organizations and all persons concerned with the conservation of fishery resources and management and development of fisheries. Other instruments under the umbrella of the FAO Code of Conduct for Responsible Fisheries, including four International Plans of Actions (IPOAs) on management of fishing capacity, on conservation and management of sharks, on reducing incidental catch of seabirds, and on illegal, unreported, and unregulated (IUU) fishing, and strategy for improving information on status and trends in capture fisheries are complemented by a number of multilateral declarations.

Regional Governance of Pacific Tuna Fisheries

The Food and Agriculture Organization of the United Nations (FAO) defines

governance of fisheries as the sum of legal, social, economic, and political arrangements used to manage fisheries, which has national and local dimensions. It prescribes legally binding rules, such as national legislation or international treaties, and it relies on customary social arrangements as well as on the respective national framework provided for all economic activities (FAO 2003c). It is commonly recognized that effective conservation requires international cooperation and is demonstrated by multiple international treaties and regional cooperation to manage shared natural resources and especially highly migratory species. To govern tuna fisheries in the world oceans, the following five RFMOs have been created to provide scientific and management advice regarding tuna resources: Commission for the Conservation of Southern Bluefin Tuna (CCSBT), Indian Ocean Tuna Commission (IOTC), Inter-American Tropical Tuna Commission (IATTC), International Commission for the Conservation of Atlantic Tunas (ICCAT), and Western and Central Pacific Fisheries Commission (WCPFC). Additionally, the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) and the Secretariat of the Pacific Community (SPC) in the South Pacific carry out or facilitate the assessment of Pacific Ocean tuna stocks, in cooperation with relevant RFMOs. Most of the RFMOs deal both with the scientific study and management of tuna and are comprised of a two-tiered structure, with a science arrangement providing advice to a fishery management body (Ward 1998). The science arrangement relies upon scientists and technical experts to analyze information and to suggest or recommend management options. The adoption of such recommendations is left to the management body, which is comprised of member nations. In the Pacific Ocean, there are two regional fisheries bodies that directly establish management

measures for tuna resources: The Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC) (Figure 3).

IATTC

The Inter-American Tropical Tuna Commission (IATTC) is a regional fishery body with the objectives to conserve and manage the fisheries for tuna and related species in the Eastern Pacific Ocean. The treaty establishing the IATTC was initially concluded in 1949 as a bilateral agreement between the United States and Costa Rica. Since then, the organization has grown to include 15 members, as well as seven other States and entities that enjoy the status of "cooperating non parties" or "coopering fishing entities" (Members: Costa Rica, Ecuador, El Salvador, France, Guatemala, Japan, Mexico, Nicaragua, Panama, Peru, Republic of Korea, Spain, United States, Vanuatu and Venezuela; Cooperating Non Parties: Belize, Canada, China, Cook Islands, the European Union, Honduras and Chinese Taipei) (IATTC website).

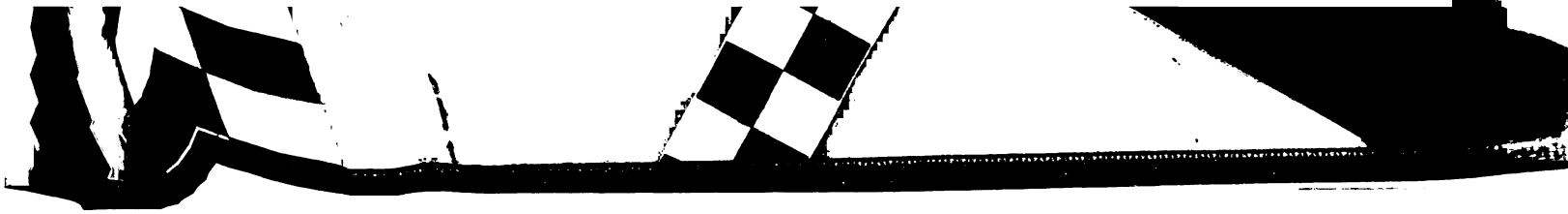
In 2003, the States and entities participating in the IATTC agreed to re-negotiate the original treaty, primarily to incorporate modern principles of fisheries management as outlined by recent international fisheries agreements, particularly the 1995 UN Fish Stocks Agreement. Negotiations toward this end resulted in the Convention for the Strengthening of the Inter-American Tropical Tuna Commission (IATTC), also known as the Antigua Convention, adopted on June 27, 2003, in Antigua, Guatemala. The Antigua Convention, when ratified, will strengthen the mandate of the IATTC to reflect changes in international measures governing living marine resources since the adoption of the original Convention more than 50 years ago.

The Antigua Convention will enter into force fifteen months after the deposit of the seventh instrument of ratification, acceptance, approval, or accession by States that were Parties to the 1949 Convention. To date, 12 States and the European Union have signed the Convention and four countries have so far deposited instruments of ratification (IATTC website). In addition, Chinese Taipei has signed an instrument declaring its firm commitment to abide by the terms of the Antigua Convention, subject to confirmation.

In addition to the over-arching international agreements pertaining to management of highly migratory species, including tuna, the La Jolla Agreement (1992) and the Declaration of Panama (1995) are two voluntary instruments adopted by states in the eastern Pacific Ocean to deal with the problem of dolphin bycatch in the purse-seine tuna fisheries. They have now largely been superseded by the 1998 Agreement on the International Dolphin Conservation Program (AIDCP), which is a binding international agreement based on the two earlier instruments. The AIDCP which was implemented in 1999 seeks to ensure the long-term sustainability of tuna stocks in the eastern Pacific Ocean, as well as living marine resources related to the tuna fisheries; to seek ecologically sound means of capturing large yellowfin tunas not in association with dolphin, progressively reduce the incidental dolphin mortalities in the tuna fishery of the eastern Pacific Ocean to levels approaching zero; and to avoid, reduce and minimize the incidental catch and the discard of juvenile tuna and the incidental catch of non-target species, taking into consideration the interrelationship among species in the ecosystem (IATTC 2003).

The AIDCP was the multilateral solution to an on-going trade and marine conservation dispute surrounding the tuna-dolphin issue. Unilateral efforts by which the

United States attempted to conserve dolphin resources through trade sanctions against other governments failed before the WTO/GATT. Widely recognized as one of the primary facilitators of globalization, the World Trade Organization (WTO) was established in 1995 as a global commercial agency, which transformed the General Agreement on Tariffs and Trade (GATT) into an enforceable global commerce code. The US Marine Mammal Protection Act (MMPA) prohibited the importation of commercial fish or products from fish which have been caught with commercial fishing technology which results in the incidental kill or serious injury of marine mammals in excess of US standards (WTO n.d.). Mexico challenged the MMPA in 1991, under the old GATT agreement arguing that its right to sell tuna in the US had been violated. The WTO/GATT Dispute Resolution Panel found the US import prohibition inconsistent with GATT and rejected as impermissible unilateral efforts by the US to promote conservation of endangered marine mammals through trade sanctions (Joyner and Tyler 2000). In response to the threat of continued trade sanctions and moratorium on dolphin fishing proposed in the amendments to the MMPA, contracting parties of the IATTC worked since 1992 to negotiate a multilateral conservation measures for dolphin and tuna in the EPO which led to the implementation of the AIDCP. The AIDCP established for the first time, a system of allocating the allowable mortality among individual vessels in the fishery, 100% observer coverage on large vessels, and an International Review Panel that would review violations and recommend penalties or sanctions for countries to impose on their vessels. As a result AIDCP is recognized as one of most successful international marine conservation agreements and one that has been commended by the FAO for its diligent application of the Code of Conduct for Responsible Fisheries (IATTC 2005).



WCPFC

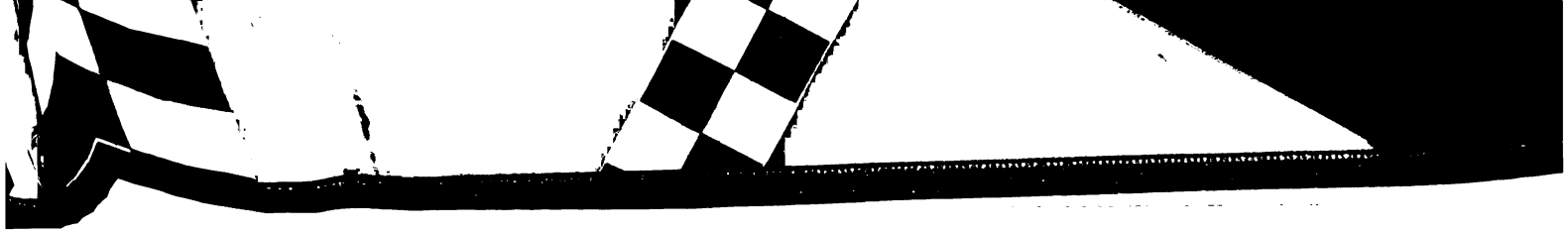
The Convention on the Conservation and Management of the Highly Migratory Fish Stocks of the Western and Central Pacific Ocean, with Annexes, ("the WCPF Convention"), established a brand new regional fisheries management organization, the Western and Central Pacific Fisheries Commission (WCPFC), to conserve and manage tunas and related species in that portion of the Pacific Ocean not covered by the IATTC. The two organizations will have complementary mandates intended to provide for effective and sustainable management of these fisheries throughout the entire Pacific Ocean.

The WCPF Convention was adopted on September 5, 2000, in Honolulu after five years of negotiations. The Convention entered into force on June 19, 2004, and currently has 21 parties (Australia, China, Cook Islands, European Community, Fiji, Federated States of Micronesia, Indonesia, Kiribati, Republic of Korea, Marshall Islands, Nauru, New Zealand, Niue, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tokelau, Tonga and Tuvalu) (WCPFC website). In addition, Chinese Taipei has signed an instrument declaring its firm commitment to abide by the terms of the WCPF Convention, subject to confirmation. As a result, for the first time in any regional fisheries organization, vessels from Chinese Taipei will be bound as a member by the terms of the Convention, including the conservation and management measures adopted pursuant thereto. Similar arrangements were subsequently included in the Antigua Convention, discussed above, which was adopted after the adoption of the WCPF Convention. The United States, although one of the few original signatories, has ratified

the Convention but has not yet deposited its instrument of ratification.

The WCPF Convention was built upon the 1982 United Nations Convention on the Law of the Sea (the LOS Convention) and the 1995 United Nations Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the UN Fish Stocks Agreement). The WCPF Convention gives effect to the provisions of the LOS Convention and UN Fish Stocks Agreement that recognize as essential, and require, cooperation to conserve highly migratory fish stocks through regional fishery management organizations, by coastal States with authority to manage fishing in waters under their jurisdiction and those nations whose vessels fish for these stocks. After four years of preparatory conferences ("PrepCon") under the chairmanship of New Zealand diplomat Michael Powles, the inaugural session of the WCPFC met in Pohnpei, Federated States of Micronesia in December 2004.

The long and often difficult negotiations for during the preparatory conferences were due in part because of the division between coastal states- the Pacific Island countries (PICs) and, to a degree, New Zealand and Australia and the United States and the distant water fishing nations (DWFN), and again the United States, Australia and New Zealand (Fields 2005). The WCPFC, which will bring together some of the largest developed and smallest developing countries, will face political and sustainability challenges as it tries to balance fishing access, interests, and aspirations between the Pacific Island countries and DWFN. The PICs' tendency to vote as Forum Fisheries Agency (FFA) block to focus their efforts on dependence aid will most likely encourage DWFN to form a bloc for fishing access, paving the way for conflict. Another potential obstacle for the Commission's effectiveness is the very remote and inconvenient location

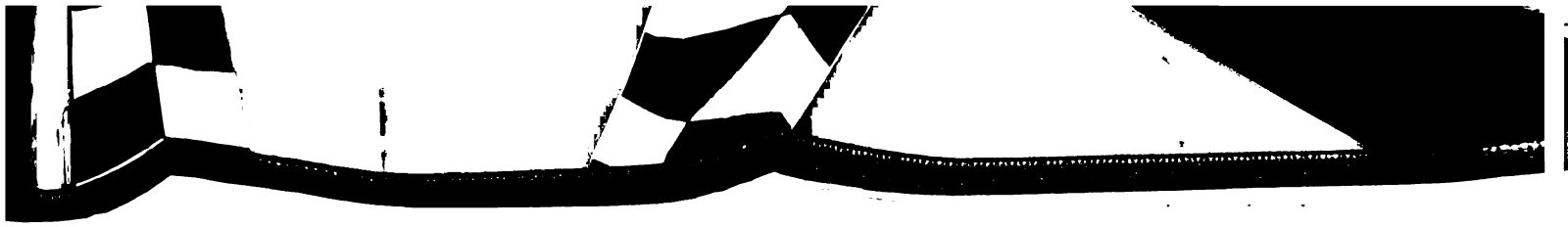


of its headquarters. The Commission's office in Pohnpei, Micronesia may experience similar challenges of limited participation and attracting and retaining quality staff as the United Nation's Environmental Program (UNEP) in Nairobi.

Efforts toward Effective Governance

IATTC

The species covered by the IATTC convention include yellowfin, bigeye, albacore, skipjack, bonito, Pacific bluefin tuna, sailfish, billfishes including marlin and swordfish in the eastern Pacific Ocean (EPO) and through the AIDCP convention, dolphins associated with tunas. The principal duties of the IATTC are 1) to study the biology of the tunas tuna baitfishes, and other kinds of fish taken by tuna vessels in the EPO and the effects of fishing and natural factors upon them and 2) to recommend appropriate conservation measures, when necessary, so that these stocks of fish can be maintained at levels which will afford the maximum sustained catches (Bayliff 2001). With the implementation of the Antigua Convention, the objective of the Commission will change to ensuring the long-term conservation and sustainable use of tunas and other species taken by tuna fishing vessels in the EPO, in accordance with relevant rule of international law. The key objectives of the AIDCP are to progressively reduce and eliminate incidental dolphin mortalities in tuna purse-seine fishery in Area; seek ecologically sound means of capturing large yellowfin tunas not in association with dolphins; ensure long-term sustainability in the Treaty Area; avoid, reduce and minimize bycatch and discards of juvenile tunas and non-target species (Meltzer 2005). To help meet these objectives, the IATTC has established working groups to consider various



issues such as compliance, bycatch, fishing by non-parties, stock assessment, and dolphin safe certification system and to make recommendation to the IATTC appropriate measures for addressing those issues.

As a general rule, decisions, resolutions, recommendations and publications must be approved by consensus. All decisions and resolutions require unanimous approval through votes of all members. Each national section has the right to one vote. There is no objection or opting out procedure. And there is no formal mechanism for settlement of disputes. All Resolutions are binding whereas recommendations are non-binding. Decisions on the types of conservation measures that the Commission may make are not specified in the Convention. However, the Commission has previously set catch quotas within the CYRA (Commission Yellowfin Regulatory Area), although these have not been implemented since 1979. Most decisions of the Commission are notified as Resolutions, which in recent years have included resolutions on: dolphin conservation studies; fish aggregating devices; compliance; regional vessel register; fleet capacity; at-sea reporting; bigeye tuna, yellowfin tuna; bycatch; finance; fishing by non-party vessels; dolphin safe tuna certification procedures; revised tuna tracking and verification system; transshipping on the high seas; and north Pacific albacore.

Contracting parties or members enforce management measures within their EEZs. For the purposes of aiding enforcement, IATTC established a register of tuna fishing vessels active in the Convention Area and a register for large purse-seine vessels authorized to fish in the Convention Area; "positive" list of longline vessels greater than 24 meters in length authorized to fish in Convention Area; and a list of illegal, unreported, and unregulated (IUU) vessels. There is also a sighting and reporting system

for vessels operating in the Convention Area, where the Director of the Commission notifies flag States of non-compliant vessels and flag States then order vessels to withdraw from the Convention Area. There is no at-sea inspection scheme for non-flag States. On board observers report possible infractions, which are investigated by the flag States and reviewed by a Compliance Working Group.

In efforts to strengthen the IATTC, the Commission adopted the Antigua Convention in 2003, which when ratified, would address most UN Fish Stock Agreement provision. An analysis of RFMOs pertaining to straddling and highly migratory stocks (Meltzer 2005) reported several IATTC accomplishments which include but are not limited to ratifying and implementing the AIDCP; improving transparency, compliance and enforcement framework; enhancing inter-RFMO cooperation; establishing IUU vessel list, sighting and reporting procedure; and including ecosystem effects of fishery in science mandate and developing appropriate biological reference points (BRPs). However, the challenges reported for IATTC were just as numerous, including having to obtain necessary ratifications to bring Antigua Convention into force; manage and limit IUU fishing for bigeye tuna and other species; address seabird bycatch in longline fishery; implement an observer program on longline and small purse-seine vessels; operationalize and implement the precautionary approach and the ecosystem approach; and coming to grips with overcapacity and overfishing. The Commission will have to face these challenges in light of geopolitical sensitivities and budgetary constraints which have resulted from the difficulty faced by some contracting parties in paying dues.

WCPFC

The WCPF convention applies to all species of highly migratory fish stocks within the Convention Area (western and central Pacific Ocean), except sauries, with emphasis on skipjack, yellowfin, albacore, and bigeye tuna. Conservation and management measures under the Convention are to be applied throughout the range of the stocks, or to specific areas within the Convention Area, as determined by the Commission. The objectives of this new tuna RFMO are to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean in accordance with the 1982 UNCLOS and the UN Fish Stock Agreement. Despite having been organized in 2004, the WCPFC has established several working committees to address science, technical and compliance issues, and an ad hoc task group dealing with data.

According to the WCPFC Rules of Procedure (WCPFC 2004), decision-making in the Commission shall be by consensus whenever possible, with the absence of any formal objection made at the time the decision was taken. If all efforts to reach a decision by consensus have been exhausted, decisions by voting in the Commission on questions of procedure shall be taken by a majority of those present and voting. Each member of the Commission shall have one vote. Decisions on questions of substance shall be taken by a three-fourths majority of those present and voting provided that such majority includes a three-fourths majority of the members of the South Pacific Forum Fisheries Agency present and voting and a three-fourths majority of non-members of the South Pacific Forum Fisheries Agency present and voting. Such decisions are binding and there

is no objection procedure. Decisions of the Commission are notified as Resolutions or Conservation and Management Measures. Resolutions describe non-binding statements and recommendations addressed to members of the Commission and cooperating non-members where as Conservation and Management Measures describe binding decisions relating to conservation and measures (WCFPC 2005). Since its inaugural meeting in December 2004, the WCPFC has adopted and has had entered into force Resolutions on incidental catch of seabirds; reduction of overcapacity; non-target fish species; and mitigating the impact of fishing for highly migratory fish species on sea turtles. As of June 2006, WCPFC has adopted and has had entered into force Conservation and Management Measures dealing with record of fishing vessels and authorization to fish; cooperating non-members; specification for marking and identification of fishing vessels; bigeye and yellowfin tuna in WCPO; and south Pacific albacore and north Pacific albacore.

The enforcement procedures for the WCPFC are established by articles in the UN Fish Stock Agreement pertaining to procedures for inspection and enforcement. The negotiated Convention that established the WCPFC as a RFMO largely consistent with the UN Fish Stock Assessment is a very strong foundation for effective fisheries governance for this important region. Consequently, the precautionary and ecosystem approaches are included in the Convention. The WCPFC has established a Pacific Island Countries group and is working on tuna management plans for coastal/island States. As can be said for other RFMOs, implementing the Convention will be a challenge for a Commission at its infant stage. Some of the specific hurdles were reported in the Meltzer (2005) overview of straddling and highly migratory fish stock, and include addressing

conservation concerns for bigeye and yellowtail; reducing bycatch and revising reporting obligations for bycatch of seabirds, sharks and turtles; and ensuring participants in negotiation process, who have yet to ratify or accede, become members as soon as possible as well as ensuring effective participating while strengthening capacity of developing coastal/island countries.

Recognizing the importance of working together to effectively manage tunas in the Pacific Ocean, the two tuna commissions have formalized their intention to collaborate. At its 73rd meeting of the IATTC in June 2005, the Commission recognized the importance of close cooperation with WCPFC as well as the need to move carefully forward to establish the basis for such cooperation. The staffs of the two Commissions have collaborated to prepare a draft Memorandum of Understanding for the consideration of the member governments of both organizations (IATTC 2006). The draft draws heavily on the Antigua Convention and the WCPFC Convention, and is intended to provide a simple and general framework under which cooperative efforts can proceed.

Challenges to Effective Governance

Decision-making process

For effective fisheries governance, the RFMO decision-making process needs to allow for meaningful conservation and management measures that science and the state of fish stocks require, at the same time respects State sovereignty while minimizing the scope of States to hinder the adoption and implementation of the measures. Provisions in the UNFSA regarding RFMO decisions-making procedures direct the states to "strengthen existing decision-making procedures as necessary" and agree on "efficient

and expeditious decision making procedures". In the case of IATTC, the current decision making procedure requires consensus to approve decisions, resolutions and recommendations without an objection or opting out procedure. Given that IATTC requires unanimous agreement among all members for its decisions, this should prevent the occurrence of disputes and objectives. However, consensus may not be effective at a time with increasing number of States participating in the EPO tuna fishery with conflicting interests and aspirations. On the positive side, consensus agreement outcomes enlist as many States as possible as supporter and more importantly, engage the support of the states with the most interest in the outcomes (McDorman 2005). However, often times, consensus agreement may often consists of no more than a policy not to disagree, rather than the States' positive affirmation of mutually agreed substantive rules and often times results in agreements with little utility or unenforceable because they are undesirable compromises (Jenkins 1996). Additionally, the "lowest common denominator" outcomes are, in some cases, achieved only after prolonged debate leading to non-timeliness adoption of management measures (McDorman 2005). If parties or States are free to avoid the international obligations undertaken by others, without suffering adverse consequences, one can expect that the goals of the agreements will be undermined. Despite the IATTC's reliance on consensus, members of the Commission often have disregarded its decisions.

Despite the trend in RFMO decision making procedure to use consensus or unanimous voting, the newly formed WCFPC uses a complex voting system. For the WCFPC, the "general rule" is that of consensus, but if consensus cannot be reached then decisions are to be taken by a three-fourths majority provided that this majority includes

three-fourths of members of the South Pacific Forum Agency and three-fourths of the non-members of the South Pacific Forum Agency and hence, a weighted-voting model (WCPFC 2005). The WCPFC convention further provides that a proposal cannot be defeated by two or fewer votes. The complex voting systems would use State consent for more important or sensitive decisions for instance, quota allocation and use majority voting for less important/sensitive types of decision. It's too early to tell, but perhaps WCPFC's use of hierarchy attached decisions making process that utilizes differing decision making procedures with different types of management measures will not only increase States' buy-in but also meet the timeliness criteria for effective decision making.

Compliance and Enforcement

Effective mechanisms are needed within the RFMO's in the Pacific Ocean not only to monitor compliance but also to enforce compliance by both contracting and non-contracting parties with the conservation and management measure adopted by the two tuna commissions. Within the IATTC there is a permanent working group on compliance, whose role is to review and monitor compliance with conservation and management measures adopted by IATTC; to recommend means of promoting compatibility among the national fisheries management measures of members; and to recommend to the IATTC appropriate measures for addressing matters related to compliance with fisheries management measures (IATTC compliance working group ruses and procedures). At the meetings of the permanent working group on compliance, possible violations of resolutions adopted by the Commission including resolutions on bycatch including turtles, seabirds, and sharks, purse-seine closure, fleet capacity, at-sea reporting and data

provision are reported and reviewed. In particular, IATTC has been working actively to address the issues of IUU fishing in the area regulated by the IATTC. In 2002, the IATTC adopted a resolution on purse seine fleet capacity. Among other things, the resolution specified that any purse seine vessel not included on the IATTC vessel register be not authorized to fish in the IATTC area. The Inter-American Tropical Tuna Commission (IATTC) has agreed in principle on the optimum overall vessel capacity limit for the EPO but has been unable to agree on its allocation which will, in any event, require a reduction of existing capacity. IATTC adopted measures both for a catch certification scheme for bigeye tuna and for the development of a "positive list" of large-scale longline fishing vessels authorized to fish in the area regulated by the IATTC. The Commission also adopted a set of criteria for identifying "cooperating non-parties." Key to such designation is that vessels from such non-parties provide all relevant data about their operations and that they respect all rules, regulations and resolutions governing fishing for highly migratory species in the IATTC area.

Similarly, the WCPFC has a technical and compliance committee whose role is to provide the Commission with information, technical advice and recommendations relating to the implementation of, and compliance with, conservation and management measures; monitor and review compliance and make necessary recommendations to the Commission; and review the implementation of cooperative measures for monitoring, control, surveillance and enforcement adopted by the Commission (WCPFC 2000). To date, the TCC has met twice and is beginning to address the following monitoring, control and surveillance (MCS) issues for adoption and implementation, VMS (vessel monitoring systems) standards, specifications and procedures, the MCS component of the

observer program, agreed upon boarding and inspection procedures, port State measures, port inspections, and transshipment monitoring.

Some of the control measures implemented or considered for implementation by the two tuna RFMO's in the Pacific such as imposition of observers, vessel monitoring systems, and at-sea reporting are used to detect non-compliance. Annual reporting of compliance or violations by compliance committees helps address non-compliance. However, too often, public shaming at the plenary sessions are the only sanction measures applied to deter further violations. However, more recently, RFMO's including the IATTC and WCPFC are considering trade restrictive measures to punish non-compliance and deter further violations. Recently, the contracting parties of the IATTC adopted a resolution on trade measures to promote compliance, which was modeled on International Commission on the Conservation of Atlantic Tunas (ICCAT) recommendations (IATTC 2004).

Trade restrictive measures aim to disrupt market access by requiring contracting party States to refrain from importing specified fish or fish products from non-contracting party (NCP) States whose vessels have fished in violation of the conservation and management measures of a given RFMO. However, the processes designed to implement such measures are cumbersome and lengthy, involving first identification, and then a request to rectify, followed by further assessment at yet another meeting of the RFMO, followed by a threat to impose such measures (Rayfuse 2005). The IATTC and WCPFC typically only meet annually so this process can take up to two or three years, during which time non-compliance can and will most likely continue. In the case for illegal, unregulated, and unreported (IUU) fishing, Rayfuse (2005) in her working paper on

promoting compliance in high seas fisheries reports that when sanctions are imminent, using trade restrictive measures often promotes the practice of flag-hopping to NCP States and port-hopping to offload in objecting or NCP ports which then act as 'launderers' of the IUU catch. To facilitate prompt, appropriate and adequate responses Rayfuse recommends that RFMOs 1) develop measures aimed at ensuring greater transparency by which contract party States verify and investigate alleged violations; 2) develop uniform sanctions or penalties to be applied in cases of violation by which contracting party States must then implement in their domestic legislation; and 3) seek to carefully spell out the implications that go beyond public shaming or trade restrictive measures of various implemental failures. For tuna RFMO's in the Pacific, perhaps revoking voting rights in setting conservation measures or requiring flag states temporarily ground their vessels could be options for consideration in the case of contracting parties' failure to investigate and prosecute violations.

Implementation of UNFSA

As mentioned in the section on International Instruments governing Pacific Tuna Fisheries, advances have been made in attempts to sustainably manage highly migratory fish stocks with the adoption of global instruments such as the UN Fish Stocks Agreement (UNFSA), and the accompanying Compliance Agreement and the International Plan of Action to Deter, Prevent and Eliminate IUU Fishing (IPOA-IUU0). However, problems with tuna fishing overcapacity still exist, IUU fishing in the Pacific Ocean continues, and several tuna stocks are showing signs of trouble. The infrastructure is in place to make the desired advances in conservation of tuna stocks in the Pacific but

similar strides for implementation have not been made. What may be needed now is that the RFMOs "just do it", that is, fully implement and enforce the adopted instruments.

One of the first steps in securing better implementation of the UNFSA and the associated fisheries instruments is to secure broader and more effective adherence to UNFSA by States (Nandan 2005). The Fish Stocks Agreement entered into force on 11 December 2001 with ratification by the thirtieth State, and is the most comprehensive of the international instruments in defining the role of RFBs. To date the UNFSA has been signed by 60 States and entities (UN 2006), and the number of States that will deposit ratifications is expected to grow. Although the vital role of RFMOs in implementing the Fish Stocks Agreement is widely recognized, the reality is that no RFMO (including WCPFC and IATTC) is composed exclusively of Parties to the UNFSA (Swan 2004). Consequently no RFMO is bound by the UNFSA. In addition, several important tuna fishing States are not parties, including China, Chinese Taipei, Indonesia, Korea, Mexico, Philippines, and Venezuela.

Adding to the problem of adherence of the UNFSA is the inadequate implementation at the regional level, including the lack of institutional standards, lack of coordination between regional bodies and inadequate harmonization of measures (Nandan 2005). The absence of a systematic approach has been noted by the UN Secretary General as a significant obstacle to the effective implementation of UNFSA. The UNFSA does not provide a mechanism whereby RFMOs and States who fish in an area but fail to join the relevant RFMO can be held account. Even in the case where systematic approach is adopted, as in the case of IATTC in its adoption of the Antigua Agreement to address most of the provisions of the UNFSA, implementation is not

assured if the Agreement is not ratified and thus not entered into force.

Contemporary organizational challenges

The two tuna commissions face some contemporary organizational challenges that hinder their efforts toward effective governance. The challenge for the IATTC is finding a replacement for the current Director at a time when the major resource, YFT and BET, requires protection from overfishing and an international fleet that is active with excess capacity. The IATTC currently has no Chairperson elected but at the end of their last annual meeting in June 2006, the Director, Robin Allen announced that he would be retiring in September 2007 (personal observation). Without an elected Chairperson, the authority to organize the recruiting and selection process for a replacement cannot proceed in earnest until June 2007 when a Chair may be elected. For WCPFC, the challenge is overcoming the remote location in order to be more successful in securing and retaining experienced staff for the Secretariat and establishing an equitable system for protecting the resource from overfishing.

CONCLUSION

How do we define effective governance of the Pacific tuna fishery? Would the definition require more biologically stable populations of tuna? Would it require that more tuna are available for global trade, more choices in the forms of tuna traded? Would the definition require more information exchange or technology transfer? Would it require that the tuna fishery have positive social or economic effects such as more employment, encouraging business or sectors, increased cooperation among

stakeholders? Has the two tuna RFMOs played an active role in making the tuna fishery in the Pacific Ocean biologically sustainable, economically and socially viable? Does society put enough value to tuna resources to care about effective governance? These are some questions that need to be addressed if we are to think critically about the future of regional fishery governance and continued harvest of tuna.

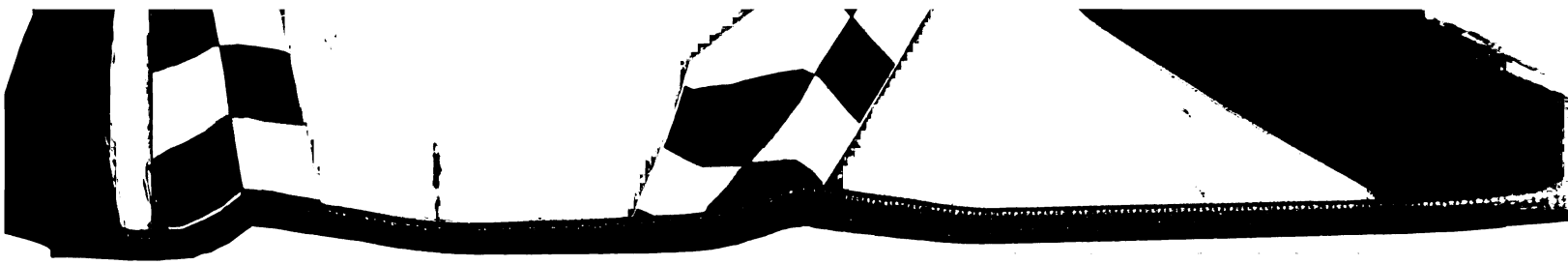
The commodification of tuna species has resulted in many countries and parties that are impacting the tuna resource. There are indeed more tuna and more choices that are available to consumers than ever before. The expansion of the tuna fishery has created multiple effects, creating new sectors and leading to more overall employment since the fishery has modernized. However, based on current knowledge about biological stock status, most species of tuna in the Pacific Ocean require close monitoring and or protection from increasing fishing mortality. The continued rates of exploitation by an active and expanding international tuna fleet leave several tuna stocks in precarious positions. The biological instability of many of the highly sought species such as yellowfin and bigeye will no doubt, if it hasn't already, impact the economic and social viability of this fishery. Fishery science has shown stocks such as tuna are resilient and will rebound, provided that you give them a chance. So in theory, if you decrease fishing effort and mortality by limiting capacity and or closing areas or seasons, many of the at-risk stocks of tuna will remain within the safe limits of conservation and sustainability. Even more uncertain is whether member and participating countries would allow their fleet and processing industries to be negatively impacted so that the stocks can come back. One of the key issues for tuna fishery governance is whether RFMOs have enough influence to persuade its members to fully implement and enforce adopted instruments to

ensure sustainability of tuna stock.

It can be argued that the RFMOs operating in the Pacific have played and continue to play a major role in sharing and exchanging biological, social, and economic information. By working closely with member countries and industry, the older of the two RFMOs, the IATTC has played a very important role in the orderly development of an immature tuna fishery in the EPO. Additionally, IATTC has played a critical role in providing and sharing biological status information to member countries to set quotas and establish compliance controls. But the tuna RFMOs are no longer dealing with an immature fishery and in order to manage a mature fishery such as the Pacific tuna fishery, we believe the organizations have to evolve and mature with the fishery. Some would argue a wholesale regime change for RFMOs, a new conceptual framework for regional governance. The skeptics could legitimately question, with their legacies of successful fisheries expansion and development, whether the RFMOs including IATTC and WCPFC can successfully transition into modes of fishery maintenance and reduction. The two tuna RFMOs in the Pacific have the structure in place to handle development but they need additional capacity, resources, and power to control fishing capacity and enforcement so that they can evolve into their new roles of restraining development and encouraging compliance.

The FAO has identified strengthening of RFMOs at the regional governance level as one the key issues for improvement of fisheries governance (FAO 2003a). RFMOs would be strengthened so that they have the capacity for management decisions and enforcement. Depending on particular circumstances, this may involve a review of their legal and statutory requirements, procedural matters and institutional and capacity

building measures. The IATTC and WCPFC have the opportunity with their strengthened or already strong Conventions to bridge the gap between the international instruments and the more local levels of fisheries management with respect to the shared stock of tuna for Pacific States with authority to manage fishing in waters under their jurisdiction and those nations whose vessels fish for these stocks. The IATTC and WCPFC are among RFMOs that have already made important contributions to governance in the following areas: promoting the development of national research and management capacity; improving and strengthening data collection, handling and dissemination; addressing new issues such as IUU fishing, fleet capacity, the effect of the payment of subsidies and by-catch and discards; adopting management measures and resolutions relating to such issues as effort reduction, gear type, minimum sizes, mesh sizes, etc; taking measures to enable implementation of recent international legal instruments. However as Swan (2004) reports in her description of the evolving role of Regional Fisheries Bodies (RFBs), Arrangements (RFAs), or Management Organizations (RFMOs), the strengthened governance role of RFBs does not always translate into more effective fisheries management. As reflected by the preceding section, RFMOs face a number of constraints: a lack of political will to delegate sufficient decision-making powers and responsibility to the RFMOs; lack of financial resources, in the form of none payment of dues; decision making processes that are often a cumbersome compromise relying on peer pressure as the primary means of enforcement; conflicting interests or inadequate cooperation between member States; lack of performance targets and measures for sustainable catch in light of large stock variability (difficulty implementing precautionary approach); overcapacity; and ignoring or failing to seek economic dimensions of



scientific advice (Swan 2004; World Bank 2004; FAO N/A; personal observation). The IATTC and the WCPFC must find ways to overcome some of these constraints to effective fisheries management and governance, if they are to fulfill their objectives of ensuring the long-term conservation and sustainable use of tuna stocks in a region that has the largest and most valuable tuna fisheries in the world.

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CHAPTER THREE

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CHAPTER THREE

Role of Science at the Inter-American Tropical Tuna Commission: Limitations to Sustainability

INTRODUCTION

The role of regional fisheries management organizations (RFMOs), as the key delivery mechanism for sustainable management of transboundary fish stocks such as tuna, has been recognized in international fisheries management (Lodge 2005). The Inter-American Tropical Tuna Commission (IATTC) is one of five tuna RFMOs, responsible for the conservation and management of the world's tuna resources. As the oldest of the tuna RFMOs, the Convention that created this Commission in 1949 mandates that the populations of tunas, tuna-like fishes, and other kinds of fish taken by tuna fishing vessels in the eastern Pacific Ocean (EPO) be maintained at levels of abundance that can support maximum sustainable yields (IATTC 1949). The Convention also provides for a program of scientific investigation as the basis for management of the tuna fisheries.

That responsible fisheries policy requires a sound scientific basis has been a mantra in international fisheries management and codified in multiple international fisheries instruments. The relevant instruments that apply to the Inter-American Tropical Tuna Commission include The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (also known as the UN Fish Stocks Agreement) which sets out principles for the

conservation and management of those fish stocks and establishes that such management must be based on the best available scientific information (Article 5, 1995 UN Fish Stocks Agreement). It specifies the functions of science of RFMOs and the need for these arrangements in the collection and analysis of scientific data, evaluation of scientific advice, cooperation in scientific research and dissemination of information for target and non-target species (Article 10 d-g, UN Fish Stocks Agreement). Even before the formalization of these scientific functions in the UN Fish Stocks Agreement, the IATTC has required through the mandates of the original convention high quality and independent scientific advice to ensure that the tuna resources of the EPO are managed sustainably. As one of the former Director of the IATTC once pointed out, "foremost of the work for this Commission is the imperative to provide a scientific basis for the management of tuna fisheries" (IATTC 2001).

The IATTC secretariat has been providing science advice and recommendations for over 50 years but the Commission in recent years has frequently chosen not to fully implement or ignored the science advice provided by the secretariat. At a time when the international fisheries governance and conservation communities are calling for more science based decisions and with the continual improvement of scientific understanding of the tuna populations and its environment, it's curious why the conservation actions are not fully reflecting the science recommendations at the IATTC. Why isn't science more central in the adoption of the management measures? Has the role or influence of science in this commission changed? Is it science quality, reliability or transparency that is undermining or delaying decision-making? The answers to these questions have

implications about not only the effectiveness but also the sustainability of the organization and consequently the tuna stocks in the EPO.

The purpose of this chapter is to examine the role of science at the IATTC and its implications to sustainability of tuna stocks in the EPO. The first section briefly reviews the status of the tuna resources and fishery in the EPO followed by the section introducing the functions of the Commission as they relate to science and management responsibilities. The third section presents some key issues or challenges to sustainability, which provide the framework for the assessment of the quality and influence of science and other factors in decision-making. The assessment of science also includes suggestions on improving its quality. The last section highlights the important roles of science and its limitations in the sustainable management of tuna resources at the IATTC. Finally I conclude with suggestions and remarks on what can improve the role of science in facilitating and influencing the decision-making at this Commission, which will hopefully result in sustainable outcomes for tuna stocks in the EPO.

TUNA FISHERY IN THE EASTERN PACIFIC OCEAN

The annual world catch of tuna has been over 4 million tons over the last several years and catches in the Pacific Ocean have been predominant, representing 65% of the world catch. About 16% of the world catch is from the eastern Pacific Ocean (EPO). In the eastern Pacific Ocean, the major species of tunas caught are yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), bigeye (*T. obesus*), and albacore (*T. alalunga*), with lesser catches of Pacific bluefin tuna (*T. orientalis*). Yellowfin, skipjack, and bigeye tunas comprise the most significant portion of the retained catches of the

purse-seine and long-line fleets in the EPO. Over the last ten years, the catches of the above three species has averaged about 650 thousand tons with 47% yellowfin, 35% skipjack and 18% bigeye tuna (Figure 4). At the 2008 IATTC meeting, the Director reported that the catch of yellowfin, bigeye, and skipjack tunas combined in 2007 was more than 100 thousand tons less than in 2006 (IATTC 2008c).

Majority of the tuna catch in the EPO is taken by purse seine vessels (89%) while the longline vessels take 10% and the remainder taken by other gear types (the pole-and-line fleet and various artisanal and recreational fisheries). Longline vessels, used by Japan, Korea, Chinese Taipei, and China, target large bigeye and yellowfin as well as albacore while the purse seine vessels, used by Mexico, nations in Central and South America, and EU catch yellowfin, bigeye, and skipjack tunas (Maunder and Harley 2006). Purse-seine vessels are typically categorized by one of three fishing methods: sets made on tunas associated with floating objects (e.g. Fish Aggregating Devices (FADS) and floating flotsam), set on free-swimming schools of tunas, and sets on tunas associated with dolphins (Maunder and Harley 2006).

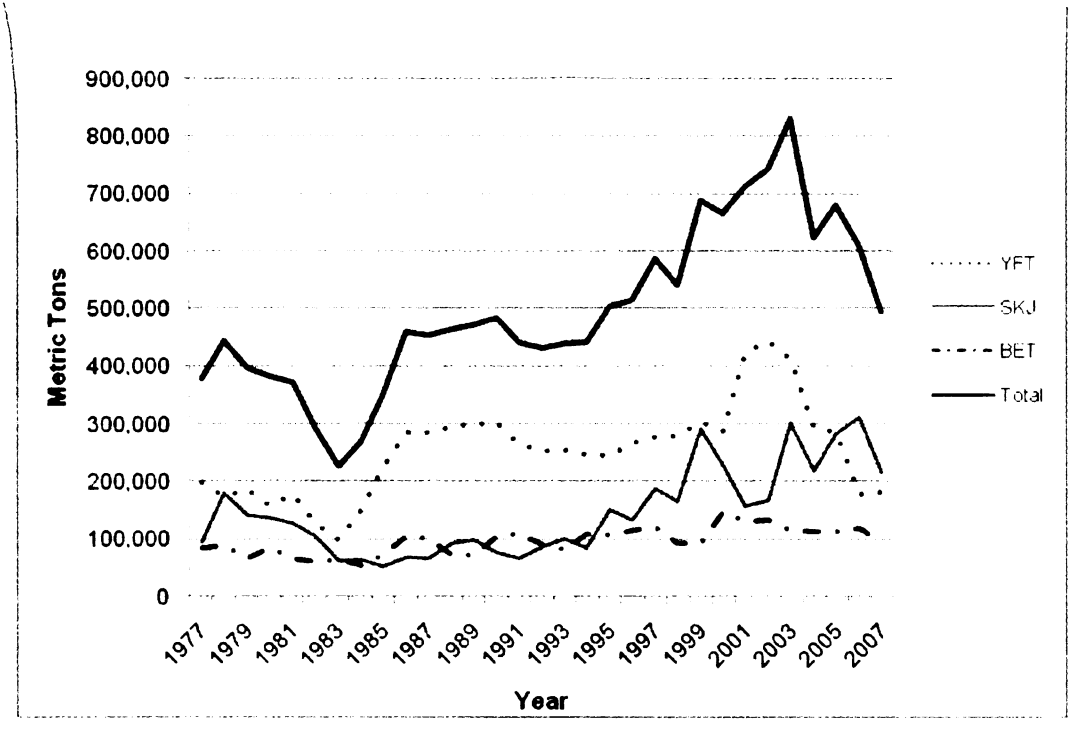

Figure 4. Catches of tuna in the eastern Pacific Ocean, 1977-2007.

Yellowfin Tuna

Most of the yellowfin tuna catch in the EPO are taken by purse-seine vessels deploying sets on schools associated with dolphin. Catches of yellowfin tuna over the last ten years averaged about 305 thousand tons, having peaked in 2002 at 440 thousand tons and at 182 thousand tons in 2007. The catches of yellowfin tuna in 2006 and 2007 were the lowest since 1984 (Figure 4).

The most recent (2008) assessments of stock status in the EPO have indicated that the yellowfin tuna stock is not in an overfished state, nor is overfishing occurring (i.e., that fishing mortality rate is less than the rate corresponding to maximum sustainable yield (MSY)). However, the stock status report (IATTC 2008b) also suggests that if a stock-recruitment relationship is assumed, the outlook for the yellowfin stock is more

pessimistic with current biomass that could be below the level corresponding required to produce MSY. Given the uncertainty, stock assessment scientists at the IATTC suggest that keeping fishing mortality close to a level that would produce MSY is probably the most appropriate approach (Maunder and Harley 2006).

There are concerns of overfishing associated with the growth of the purse-seine fleet. The purse-seine fleet has currently reached its highest level of capacity in the history of the fishery in the EPO, having increased from about 125 vessels to 230, and their total fish-holding-well volume from about 32 thousand to above 227 thousand cubic meters since the early 1960s (Figure 5). The IATTC is concerned that if the fleet continues to grow, it will become increasingly more difficult to implement conservation measures that will maintain the stock at the level that produces the maximum sustainable yield.

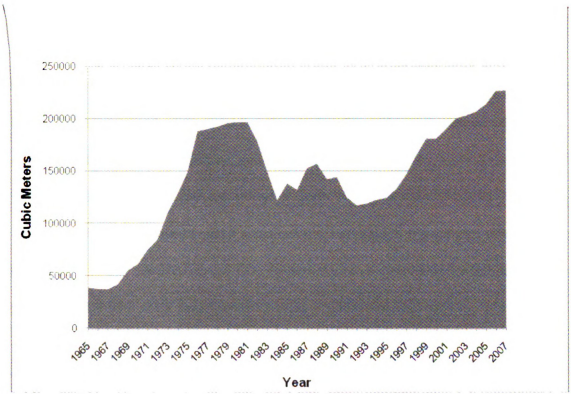

Figure 5. Carrying capacity in cubic meters of well volume of the purse-seine fleets in the eastern Pacific Ocean, 1961-2007.

Conservation measures for yellowfin tuna have been associated with the growth of the purse-seine fleet. The yellowfin tuna stock in the EPO was first placed under conservation or management control in 1966 when catch quotas were set on the harvest of the stock. Between 1983 and 1997 the capacity of the fleet was less than the stock and so no management measures were necessary. But by 1998, the growth in fleet capacity required the first restriction of the fishery since the mid 1960's. In 2002, IATTC decided to restrict the fishery by using temporal closures instead of catch quotas. The closed fishing season for the month of December was implemented primarily to halt overfishing and to rebuild the overfished bigeye tuna stock, but it also served to control fishing effort on yellowfin tuna (the fleet catches both species) and prevent overfishing. The continued

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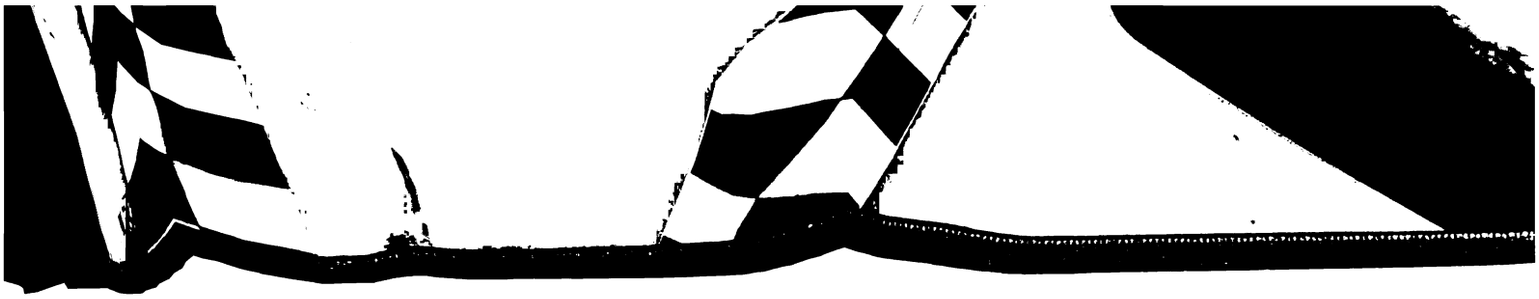
steady growth of the purse-seine fleet led to the annual closure for 42 days from 2004-2007. The staff has recently recommended a closure of 69 days but there has been no conservation measure in effect since 2007. At the November 2008 plenary meeting of the IATTC, some nations had reported that they had unilaterally implemented voluntary closures of the purse-seine fishery, and others confirmed that they were in the process of implementing a voluntary closure; however, some countries stated that their national legislation does not allow any such measures to be applied in the absence of a multilateral measure agreed by the IATTC (IATTC 2008e). Given that most of the fishing had taken place for 2008 with some countries not having implemented any closure, compliance overall would be mixed at best.

Skipjack Tuna

Almost all the skipjack tuna in the EPO are caught by purse-seine vessels (99%) and the purse-seine fishery on tunas associated with FADs is directed primarily at skipjack tuna. The average catch of skipjack tuna over the last ten years has been about 230 thousand tons with peak catches over 300 thousand tons. Most information indicates that the population is healthy and highly variable from year to year because of variation in recruitment (Harley and Maunder 2006). The results of the stock assessment conducted in 2002 indicate that skipjack tuna in the EPO are not fully exploited, and increased fishing effort would on the average most likely result in sustained increases in catch. However, with the temporal closure established for yellowfin and bigeye tunas which prohibits fishing in the EPO, full utilization or exploitation of skipjack tuna may be

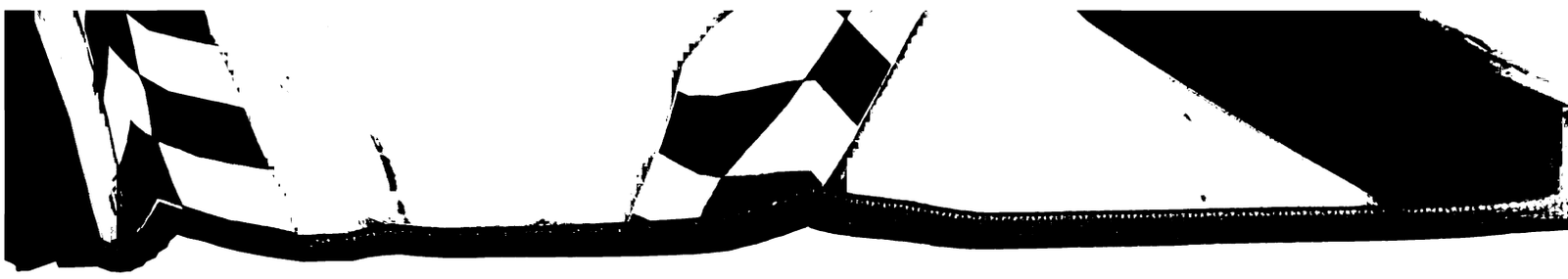


difficult to realize since any reduction in the floating object/FADs fishing effort would decrease the catch of skipjack tuna.

Bigeye Tuna

Over the last ten years the bigeye tuna catch in the EPO has averaged about 116 thousand tons. The catch of bigeye tuna in the EPO has decreased from the peak of about 150 thousand in 2000 to 95 thousand tons in 2007. There have been substantial changes in the bigeye tuna fishery in the EPO. Most bigeye tuna catch in the EPO, prior to 1993, were taken by longline vessels, and the tuna captured were large and near the size at which they could support high yields. With the expansion of the purse-seine fishery on fish-aggregating devices (FADs) targeting on skipjack tuna since 1993, large numbers of very small bigeye tuna mixed with skipjack tuna were captured resulting in the purse-seine fishery taking an increasing portion of the bigeye tuna (IATTC 2007b). Now more than half of the current catch of bigeye tuna is from the floating-object/FAD fishery (IATTC 2008b) as the bycatch. Based on recent stock assessments, bigeye tuna population is overexploited and overfished, with recent fishing mortality rates well above those corresponding to MSY. IATTC scientists have indicated that the high purse seine fishing mortality rate has contributed to the decline of the population (Maunder and Harley 2006).

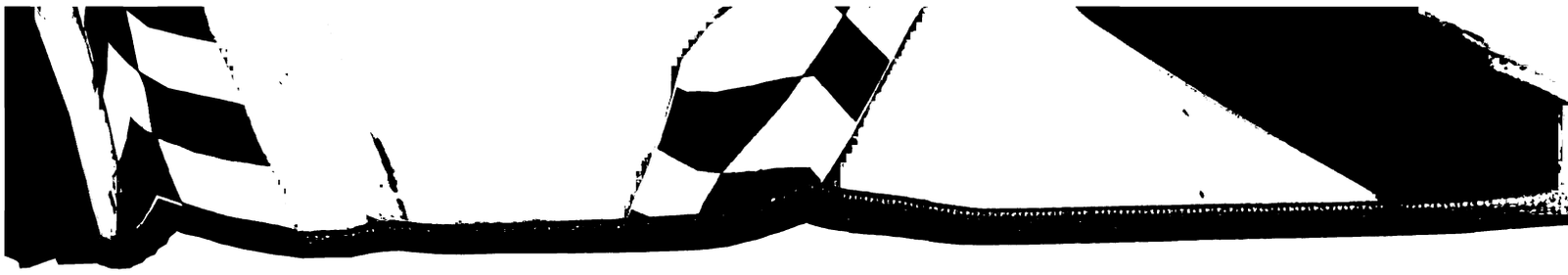
As discussed above in the section on yellowfin tuna, the Commission established a temporal closure for the month of December in 2002 prohibiting all purse-seine fishing in the EPO, in efforts to reduce fishing mortality on bigeye as well as yellowfin tuna. For 2004-2007 the Commission adopted conservation resolutions establishing a 42-day (6-



week) closure of the entire EPO for purse-seine fishing and limits on catches by long-line vessels. A fishing nation could choose to restrict its purse-seine vessels during one of two periods, 1 August to 11 September or 20 November to 31 December. In addition, the resolutions established individual limits on the longline catch of bigeye tuna for the nations to their 2001 catch levels. As was the case for yellowfin tuna, there has been no conservation resolution in place for the closure to fishing for bigeye tuna in the EPO since the end of 2007 and the stock continues to be in an overfished and overfishing state.

INTER-AMERICAN TROPICAL TUNA COMMISSION (IATTC)

The Inter-American Tropical Tuna Commission (IATTC) is one of five regional fisheries management organizations (RFMOs) created to govern tuna fisheries in the world oceans. The oldest of the tuna RFMOs, the IATTC was created in 1949 by a Convention signed by Costa Rica and the United States. The Convention established the Commission to conserve and manage fisheries for tuna and other species taken by tuna-fishing vessels in the eastern Pacific Ocean (EPO), the area between the coastline of North, Central, and South America and 150°W. Since then, the Commission has grown to 16 members (Columbia, Costa Rica, Ecuador, El Salvador, France, Guatemala, Japan, Korea, Mexico, Nicaragua, Panama, Peru, Spain, United States, Vanuatu, and Venezuela) and six nations have cooperating non-party or cooperating fishing entity status with the Commission (Belize, Canada, China, Cook Islands, the European Union and Chinese Taipei). The Convention is open to all states whose nationals participate in the fishery for tunas in the EPO.



The Commission consists of a national section for each high contracting party or member state and each national section is entitled to have up to four Commissioners, appointed by its government. Each national section has one vote, which may be cast by any Commissioner of that section (IATTC No date). Each national section can appoint an advisory committee to assist in with matters related to the work of the Commission. The official languages of the IATTC are both English and Spanish. The Commission meets at least once a year and as needed at special meetings convened to address matters that for various reasons cannot be handled at the annual meeting. At the annual meetings, the Director and other members of the IATTC staff present the results of recent research on tuna stocks and make recommendations on conservation measures, if appropriate, for regulation of the tuna fishery. If the recommendation is to be adopted in the form of a conservation resolution it must be approved by consensus of all members. The 1949 Convention established that official actions of the Commission, such as agreements, resolutions, and recommendations, must be approved by unanimous vote but in practice by consensus (IATTC 2007b).

In 2003, the Commission adopted the Antigua Convention, which updates the original Convention and will strengthen the mandate of the IATTC. The Antigua Convention incorporates the relevant principles of international law related to the conservation and management of living marine resources reflected in the 1982 United Nations Convention on the Law of the Sea (UNCLOS), as well as the provisions of Agenda 21 and the Rio Declaration of 1992, the 1993 FAO Agreement to promote compliance with international conservation and management measures by fishing vessels that fish on the high seas, the 1995 FAO Code of Conduct for Responsible Fishing, and

the 1995 Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of December 10, 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks (IATTC 2003). The Convention will enter into force 15 months after the date of deposit of the seventh instrument of ratification or accession by governments which were Parties to the 1949 Convention at the time the Antigua Convention was opened for signature. The seventh instrument of ratification was deposited in May 2009 so that the new Convention will enter into force in August 2010 (IATTC 2009b).

The Commission also has significant responsibilities for the implementation of the Agreement on the International Dolphin Conservation Program (AIDCP), which addresses bycatch associated with tuna fishing, including but not limited to dolphin, and provides the Secretariat for that Program. Consequently, the Commission responsibilities are met with two programs, the Tuna-Billfish Program and the Tuna-Dolphin Program (Bayliff 2001).

The main objectives of the IATTC with respect to highly migratory species are to cooperate in the gathering and interpretation of scientific information to facilitate maintaining the populations of tunas and tuna-like species in the eastern Pacific Ocean (EPO) at levels which permits maximum sustainable catches. To fulfill these objectives, the IATTC carries out an extensive scientific research program staffed by independent and internationally recruited scientists and adopts management measure that are based on the best scientific evidence available. The principal responsibilities of the IATTC's Tuna-Billfish Program are 1) to study the biology of tunas and related species of the eastern Pacific Ocean with a view to determining the effects that fishing and natural factors have

on their abundance; 2) to recommend appropriate conservation measures so that the stocks of fish can be maintained at levels which afford maximum sustainable catches; and 3) to collect information on compliance with Commission resolutions.

The Commission's total budget, currently at a little above $5.5 million, is funded by contributions from its members who share the joint expenses of the research program. A little over a third of the total budget is directed towards the Tuna-Billfish Program. The contributions are generally in proportion to how much tuna is caught and or utilized by each member, as provided in the Convention. However, many governments are either late with their payment or fail to pay at all.

Technical Role of the Secretariat

The 1949 Convention provides for the appointment of a Director and an independent and permanent scientific staff to carry out the research required by the Commission as a basis for its conservation measures. The utilization of a permanent scientific staff at IATTC is unlike most other tuna RFMOs. Using the categories defined by Ward et al. (1998) in the review of science arrangements at RFMOs, most tuna RFMOs use the multinational approach, where national scientists meet to develop scientific advice for the management body. The multinational approach relies on national scientists conducting fishery science, and its activities are usually supported by an administrative secretariat (Ward et al. 1998).

An example of the science arrangement that uses the multinational approach is the International Commission for the Conservation of Atlantic Tunas (ICCAT). The ICCAT utilizes the Standing Committee on Research and Statistics (SCRS) that reports to the

Commission. The SCRS comprises of national scientists from Contracting Parties, although scientists from non-Contracting Parties may participate. The main task of the SCRS is to assess the status of stocks under the ICCAT mandate and to advise the Commission of areas where management measures need to be taken. The SCRS meets in plenary once a year in order to discuss and approve the findings of its various subsidiary bodies and also undertakes various research programs. Transparency is emphasized through participation and access by representation on the SCRS by any member country, website distribution of data, software results and consensus advice (ICCAT 2007).

The responsibilities of the secretariats of other RFMOs are largely confined to administrative functions, but the IATTC, as a science secretariat, has a large staff to handle the administrative functions, collects and analyzes fisheries data and carries out extensive research on the population and fisheries for which the IATTC is responsible under the mandate of the 1949 Convention. Consequently, the staff salaries account for the largest share of the IATTC budget. With the science secretariat approach, the emphasis is on the independence of science advice and access to quality information for each and every member country, regardless of its national science capacity.

The IATTC secretariat currently has a staff of 63. To collect data from the fishery and to provide local administration of the observer program, the Commission maintains 18 staff members in six field offices in Costa Rica, Ecuador, Mexico, Panama, and Venezuela (IATTC 2009). The remainder of the staff members are located at the Commission's headquarters in La Jolla, CA. The focus of their work of the staff is largely on biological studies and conduct of stock assessment. The results of the IATTC staff's research are published in the IATTC's Bulletin and Stock Assessment Report series, in its

Special Report and Data Report series, and in books, outside scientific journals, and trade journals (IATTC 2007). The IATTC publishes a summary of each year's activities in its Annual Reports and Fishery Status Reports and much of the following is taken from the most recent publications of those reports.

Duties of the Science Secretariat

To meet the Tuna-Billfish Program responsibilities, the IATTC conducts a wide variety of research investigations at sea, in ports where tunas are landed, and in its laboratories (IATTC 2007a). As emphasized in the previous section, the research is carried out by a permanent, internationally recruited research and support staff supervised by the Director, who is directly responsible to the Commission. The scientific staff carries out the technical functions of the secretariat as defined in Article II of the 1949 Convention (IATTC 1949): 1) conducting research on the abundance, biology, biometry and ecology of the tunas of the EPO, and of other types of fishes fished by tuna vessels and the effects of natural factors and human activities on the abundance of the populations; 2) collecting and analyzing information on the conditions, trends and tendencies of the fish stocks; 3) studying and analyzing methods and procedures of maintaining and increasing the fish stocks; 4) recommending, on the basis of scientific research, joint actions for maintaining the fish stocks at the maximum sustainable level; 5) compiling statistics and reports relating to the fisheries; and 6) disseminating research, scientific and statistical data on the fisheries. The research conducted by the scientific staff can be classified into four broad categories: 1) fishery statistics/ data collection, 2) biology of tunas and other species taken by tuna vessels (i.e. tagging studies, ecosystem

studies, early life history studies); 3) oceanography; and 4) stock assessments. The information on statistics, biology, and oceanography are utilized to arrive at conclusions regarding the status of the stocks. This information on the status of the stocks is the basis for making conservation and management recommendations necessary for long-term sustainability of the tuna stocks. Each aspect of the research program and the flow of scientific information through the Commission is briefly discussed below and generalized in the flow diagram (Figure 6).

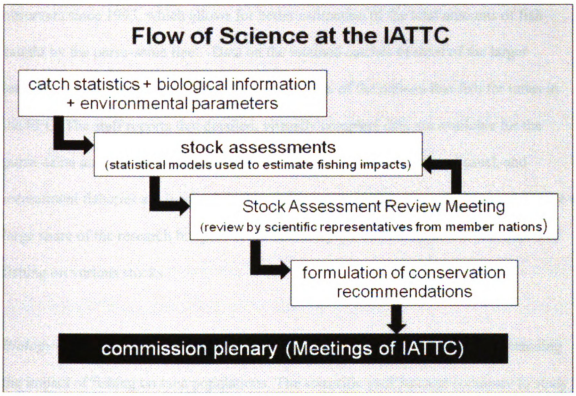


Figure 6. Flow of scientific information through the IATTC.

Catch statistics- Fundamental to the IATTC research program are the basic data on the fishing activities of the vessels, the catches they make and the sizes of fish comprising the

catch. The data collected by the scientific staff and summarized in the Fishery Status Reports are derived from various sources, including vessel logbooks, observer data, unloading records provided by canners and other processors, export and import records, reports from governments and other entities, and estimates derived from the species and size composition sampling program. Data on catches and fishing effort by surface gear (purse-seine and pole-and-line) are obtained from logbook records of purse-seiners and pole-and-line vessels that fish in the EPO. Data for fish discarded at sea by purse-seine vessels with carrying capacities greater than 363 metric tons have been collected by observers since 1993, which allows for better estimation of the total amounts of fish caught by the purse-seine fleet. Data on the retained catches of most of the larger longline vessels are obtained from the governments of the nations that fish for tunas in the EPO. The staff reports that detailed, virtually complete data are available for the purse-seine and pole-and-line fisheries but the data for the longline, artisanal, and recreational fisheries are incomplete. The collection and management of these data take a large share of the research budget but are necessary for the assessment of the effects of fishing on various stocks.

Biology of Tunas- Understanding the biology of tunas is required for the understanding the impact of fishing on tuna populations. The scientific staff has and continues to study the population structure of tunas and billfishes in the EPO with analysis of data on catch distribution, spawning, tagging, morphometric and meristic characters, genetics and biological markers. The biological research program also provides for studies of growth, rates of mortality, behavior and physiology of the fish. In addition the staff directs

substantial effort on understanding the effects of ecological relationships on tuna production through studies on predator-prey dynamics and early life history, including aspects of spawning and rearing. The Commission maintains a field laboratory in Panama specifically for life history studies.

Oceanography- The IATTC staff conducts studies of oceanography to understand how the environment affects tunas. Since tunas are pelagic during all stages of their lives understanding how the ocean environment affects their abundance is important for the efficient management of the stocks. The focus of the staff's investigations is biological oceanography with only limited attention to physical and chemical oceanography. However, because IATTC has reduced its expenditures for oceanography in recent years and because a comprehensive oceanographic program would be prohibitively expensive, the staff's oceanographic investigations are conducted on a limited scale and rely on publicly available data (IATTC 2007c).

Stock Assessments- A stock assessment describes the current status of a fish stock relative to biological reference points and predicts the future status of the stock given a range of management options (Cooper 2006). The stock assessment requires substantial amounts of information, including data on retained catches, discards, fishing effort, and the size compositions of the catches of the various fisheries. Information collected and analyzed by the IATTC scientific staff on catch statistics, biology, and oceanography are incorporated using mathematical and statistical techniques, or the assessment models, to arrive at estimates regarding the status of the tuna stocks in question and to provide

assessments of the impact of fishing on the stocks. Even with the large amount of data collected, assumptions are made about processes such as growth, recruitment, movement, sex and age-specified natural mortality, fishing mortality, and discards by age.

The IATTC staff applies the most modern statistical stock assessment models and the stock assessments for the main tuna species are based on an length (age)-structured statistical assessment model, A-SCALA that was developed by the staff (Maunder and Watters 2003). The IATTC staff is considering switching to a better documented model, the *Stock Synthesis II,* SS2 (Methot 2005), for its stock assessments. Most recent stock assessments for bigeye tuna were conducted using SS2.

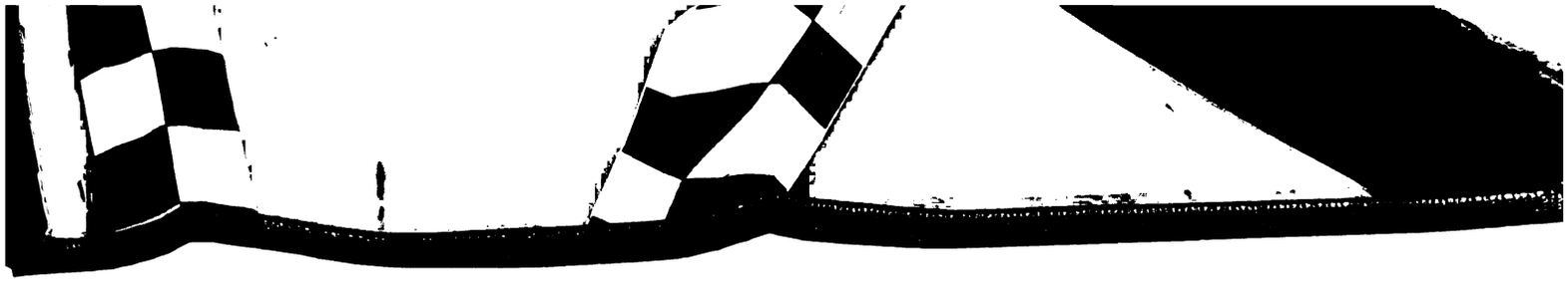
Stock Assessment Review Meetings- Stock assessments results for yellowfin tuna, bigeye tuna and other EPO species are prepared and presented annually at the Stock Assessment Review Meetings (previously known as Meetings of the Working Group on Stock Assessment) for peer review. Comments received at that meeting are considered by the staff in modifying its reports of findings, interpretations, proposals and recommendations that are later published in Stock Assessment Reports. The Director convenes the Stock Assessment Review Meetings to provide a form of peer review by scientific representatives of member nations and interested organizations of the staff's research. The Meetings, having been convened since 2000, have experienced a steady increase in attendance to include not only scientific representatives of member nations, but also NGOs and other international organizations and policy and decision-making representatives, including commissioners and their advisers.

Conservation Recommendations- When stock assessment results indicate that fishing mortality exceeds the reference point and needs to be reduced in order to maintain the tuna populations at levels that can sustain maximum yields, the Director formulates conservation recommendations to present to the Commission at its annual meeting. The staff recommendations are summarized in a Conservation Recommendations document and the management controls typically recommended include limits on fleet capacity and spatial and or temporal restrictions designed to reduce fishing mortality.

Management Role of the Commission

The Commission staff makes recommendations on the basis of the best scientific evidence available, designed to maintain populations of tuna and tuna-like fishes in the EPO at levels which will permit them maximum sustainable catch. In turn, the decision-making body of the Commission, the commissioners from the member states, collaborate with each other in adopting suitable effective conservation measures. Each year the Commissioners at the beginning of an annual meeting select one person, usually a Commissioner, to serve as the Chairman of the meeting and through the following year until the next annual meeting. Since 2005, the Commission agreed to extend the period of office for the Chairman to two years (IATTC 2006), but this was not implemented.

The Chairman is responsible for presiding over the meetings and manages necessary actions and affairs of the Commission. There are no clear rules for handling the recommendations of the staff. The Commission can accept, modify, ignore or reject recommendations. If a recommendation is to be accepted or adopted as a resolution, it must be approved by consensus of the Commission. Cooperating non-parties may not



vote, but can choose to be bound by the decisions of the Commission. The decision is then binding on the members as well as any cooperating non-party that agrees to be bound by it. It is the responsibility of each member government to implement the resolution through legislation and to enforce the legislation to ensure that vessels flying their flag comply with the adopted conservation measures.

Traditionally, the Commission has adopted multi-annual conservation measures addressing directly the conservation of the tuna stocks, such as yellowfin tuna and bigeye tuna. The specific conservation measures adopted by the Commission are discussed briefly in the status of the tuna fishery section above. The Commission has also adopted numerous measure related to the management of fishing operations including fleet capacity, incidental catch (bycatch species) and promoting compliance through monitoring, control and surveillance.

Recognizing the importance to limit fishing capacity in the EPO in order to help ensure that the tuna fisheries in the region are conducted at a sustainable level, the IATTC initiated efforts to limit fleet growth and in 2002 adopted a resolution to limit purse-seine fleet capacity to the target of 158 thousand cubic meters of fish-holding-well volume. The scientific staff had estimated that the target volume for the purse-seine fleet was adequate to take current levels of catch. Additionally, since 2005 the Commission had in place a Plan for the Regional Management of Fishing Capacity which provides additional basis for addressing purse-seine capacity reductions as wells as reductions in longline efforts (IATTC 2005). The intent of the resolution and plan was to fix the number of vessels that are authorized to fish in the EPO, using a Regional Vessel Register system with special provisions for certain coastal states to acquire additional

limited capacity. Despite the good intention of the Commission actions, fleet capacity increased and is currently close to 230 thousand cubic meters and with no concrete plans for reducing the capacity to the recommended level of 158 thousand cubic meters (IATTC 2009a).

This excessive fleet capacity, which continues to increase, results in upward pressure on fishing mortality and increased difficulty to reach agreement on the implementation of effective conservation and management measures for tuna stocks. In fact for the past six plenary meetings over a two-year period since February 2007, IATTC has failed to adopt conservation resolutions to manage tuna populations (Table 2). At the end of each meeting the results were the same, the Commission could not reach agreement on any proposal for tuna conservation and management beyond 2007. The minutes from these meetings (IATTC 2008a) would report that the meetings concluded due to lack of time and without any agreement on conservation measures and that despite extensive discussion and wide agreement on many elements of a conservation program, the Commission could not reach consensus on all points. The following statements submitted by member states at the 78th meeting of the IATTC express the frustration and discontent with the meeting.

> *"As a Commission, we have not fulfilled our obligation of conserving the stocks of tunas in the eastern Pacific, whose condition does not allow us the luxury of postponing a decision any further. ... all of us here have many other obligations to meet, and if we carry on in this way, I don't see any point in wasting more time in the future on apparently useless meetings and debates."* Statement by Venezuela at 78th Meeting of IATTC (IATTC 2008)

"*...that although the fourth meeting to address this matter is about to end, it has been impossible to reach the consensus necessary for its adoption; that, according to the most reliable scientific evidence available, the catches of tunas in the EPO are at their lowest historical levels; that the sustainability of the tuna stocks is essential for the social and economic development of our coastal States.*" Statement by Central American Countries at 78th Meeting of IATTC (IATTC 2008)

Table 2: Meetings of the IATTC from 2007-2008.

Dates	Meeting	Conservation Measures for YFT and BET
5-6 Feb 2007	Ad Hoc Meeting (to consider mgt options for BET and YFT)	"no consensus among the participants"
27-29 Jun 2007	75th Meeting of IATTC	None adopted
22-24 Oct 2007	76th Meeting of IATTC	None adopted
5-7 Mar 2008	77th Meeting of IATTC	None adopted
23-27 Jun 2008	78th Meeting of IATTC	None adopted
6-7 Nov 2008	79th Meeting of IATTC	None adopted

LIMITATIONS TO SUSTAINABILITY

During this period of indecision and inaction to manage the tuna stocks in the EPO, I set out to examine the role of fishery science in the decision making at this commission, which as described earlier, is unique in that the secretariat carries out an

extensive and expensive research program with its own permanent staff of scientists. The main objective of the study was to gain a better understanding of the role and value of the IATTC community attributes to science and the scientific advice generated by the secretariat. The secondary objective was to make recommendations on what can make science advice more influential or central in the decision-making at the IATTC. In the process, I had hoped to gain insights about what aspects of the scientific advice may be undermining the decision-making process and how it may interact with other factors in the IATTC taking conservation actions to ensure the sustainability of tuna stocks in the EPO.

To evaluate how scientific advice is viewed and assessed by this commission, individuals from the secretariat staff, commissioners, member country advisors and various organizations that participate at the IATTC meetings were interviewed. Over the period of two years spanning the above mentioned six meetings of the IATTC and two meetings of the Stock Assessment Review, 35 members of the IATTC representing 16 countries and 29 different organization, were asked open ended questions about their perception and thoughts on the role of science in the decision making at the Commission. The questions asked each interview participants included information about his or her role and length of involvement with the IATTC as well as their background and education. More than a third of those interviewed were commissioners, members of the decision-making body at this Commission. The first set of questions asked the participants included identifying some key issues and/or challenges to ensuring the sustainability of the commission and the tuna stocks. The responses to this first set of questions were important in not only identifying some key challenges facing the

Commission and thereby providing the framework for evaluating subsequent answers but also for corroborating the premise that the lack of adoption of conservation measure is to the detriment of the sustainability of the Commission and the tuna resource. The rest of the open-ended questions were aimed at qualitatively characterizing the participants' assessment of the quality and influence of the scientific information in the adoption of conservation measures. Their assessment also included identification of other factors that influence the sustainability of tuna stocks in the EPO and suggestions for improving the quality and influence of science at the commission. In the following sections of this chapter, as it relates to the topic of discussion, I have tried to let the interview participants speak for themselves. Given the assurance of anonymity, I do not attribute comments to particular members of the IATTC community.

Key Issues Influencing Sustainability

Although a number of issues were identified as those affecting the long-term sustainability of the Commission, four key issues were most commonly mentioned. First, almost two thirds of the participants identified success at managing the fishery by achieving conservation measures and recovering tuna stocks for the sustainability of the Commission. Second, funding or limited funding from late or non-payment by members was seen as a difficulty for the Commission in its operation. Third, managing excess fishing capacity in the face of declining tuna stocks was identified as another key issue for the Commission. Finally, requiring unanimous consensus for adopting resolutions was seen as a major impediment to conservation (Figure 7). To some extent, excess capacity and decision-making by consensus were put forward as explanations for why the IATTC

was having difficulty achieving conservation measures. When asked to identify some key issues in the long-term sustainability of tuna stocks in the EPO, many of the issues mentioned overlapped with those identified for the Commission. That is, many participants commented that the sustainability of the Commission was dependent, if not closely linked, to the sustainability of the tuna stocks. Top ranking issues were excessive fishing capacity and associated high fishing mortality; juvenile catch; and the lack of significant conservation action taken by the Commission (Figure 8).

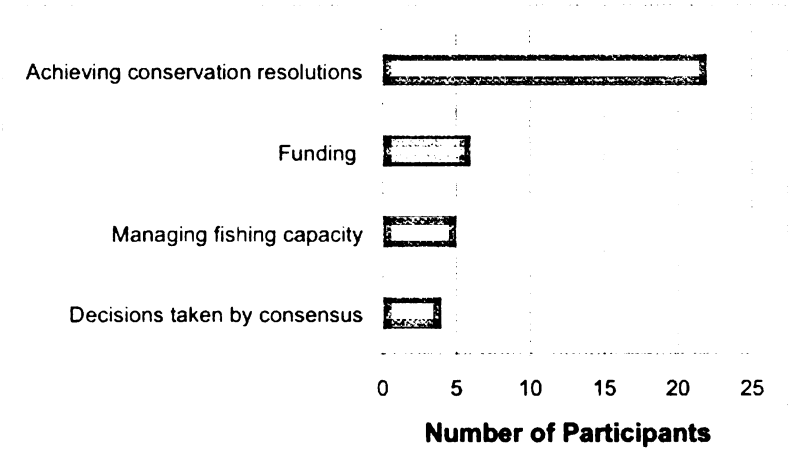


Figure 7. Top four key issues identified by interview participants in ensuring the long-term sustainability of the Commission.

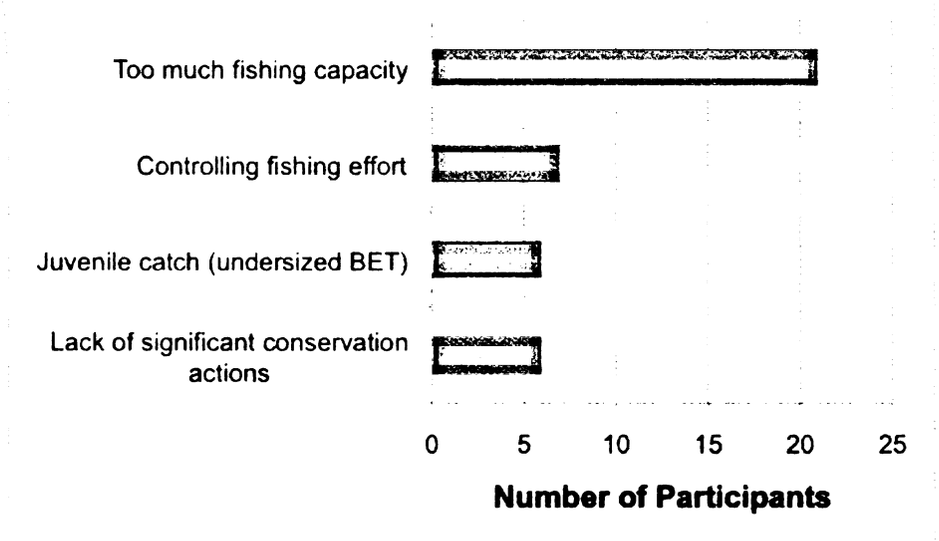


Figure 8. Top four key issues identified by interview participants in ensuring the long-term sustainability of tuna stocks in the EPO.

Achieving Conservation Measures

IATTC was created with the clear objectives of managing the tuna fishery in the EPO by recommending scientifically based conservation measures and executing necessary joint action by the high contracting parties to maintain the populations of tuna at the level of abundance that will permit maximum sustained catches. In recent years, the Commission has experienced extreme difficulty in coming to agreement on executing joint actions necessary for reducing fishing mortality and rebuilding or maintaining maximum productivity from the tuna stocks. During 2007 and 2008, despite the efforts at six different plenary meetings of the Commission, the Parties have not reached an effective consensus on the implementation of conservation measures, generating concerns with the IATTC members' ability and effectiveness towards meeting the IATTC's objectives. In a joint statement submitted by nine NGOs (IATTC 2008a) to the IATTC, the signatories warned that repeated failures in adopting conservation measures put the

Commission's credibility at risk but that more importantly, jeopardized the health and sustainability of the tuna resources.

Many of those interviewed also echoed similar sentiments and felt that the Commission needs to make some hard decisions and agree to regulatory actions necessary to maintain the sustainability of the tuna stocks. Some of the comments are as follows:

> *"The thing that assures the long term sustainability of the commission is the success at managing the fishery, that is the most important thing. It has mostly been successful but right now it is having a very difficult time. I believe its really important that it manages to solve its current problem this year or its future may be under some threat if it doesn't succeed in achieving a conservation resolution this year. Its members will feel less committed to it and the rest of the world will look upon it very critically and think of other ways they may achieve conservation of tunas in the eastern Pacific.*" (Participant #513082)

> *"...we must, as a Commission take significant conservation action if we're going to maintain sustainability and health of all tuna stocks..."* *(Participant #306081)*

> *"...there just does not seem to be the political will for some of the member nations to take the steps necessary, at least those steps that have been revealed by the science as necessary, to reduce harvest levels or reduce effort to assure that there is a safe spawning stock level and that these stocks don't head downward..."* *(Participant #306082)*

Funding

The Commission understands and recognizes the importance of ensuring sufficient funding in a timely manner for the continuation and implementation of the research and management program of the IATTC (IATTC 2008d). However, at the joint meeting of tuna RFMOs in Kobe, Japan the Director of the IATTC identified funding as one of the current challenges facing the Commission (IATTC 2007b). He reported that the Commission has been discussing a new formula for allocating the budget contributions among its members since 1999 but that a lack of an agreed upon formula and late or non payment by some members are leading to financial difficulties. The Commission has since agreed on a formula for calculating the contributions of the Parties to the Commission's budget but is continuing to have problems with late or non-payment by member states. At the time of the 78th meeting in June 2008, there was $2.1 mil in outstanding unpaid contributions (IATTC 2008b).

> *"...they're going to have start bringing enough money from their members to keep going financially because without that they're not going to be able to support their scientific or administrative works..." (Participant #509073)*

> *"[A key issue in ensuring the long-term sustainability of the IATTC is] making sure that the funding gets paid on time and paid at all. The problem with the funding is that there is not a strong penalty for not paying your dues for each country so some of the countries don't pay on time or pay at all." (Participant #513083)*

Fleet Capacity

The issue of excess fishing capacity is a global concern for sustainable fisheries and has been addressed through the FAO Code of Conduct for Responsible Fisheries. The Code of Conduct provides that States shall take measures to prevent or eliminate excess fishing capacity and shall ensure that levels of fishing efforts are commensurate with sustainable use of fishery resources. Recognizing that excess fishing capacity in the tuna fishery of the EPO is a problem that can contribute to overfishing and the degradation of tuna resources, the IATTC has adopted a Plan for the Regional Management of Fishing Capacity in the EPO. The objective of the Regional Plan is to achieve, by 1 January 2006 or as soon as possible thereafter, an efficient, equitable and transparent management of fishing capacity in the EPO, to assist in achieving long-term sustainability of the fishery targeting species covered by the Convention (IATTC 2005). The Regional Plan has a target of 158 thousand cubic meters of well volume for the purse-seine fleet but the current fleet size in 2008 has nearly 230 thousand cubic meters which is 45% greater than the target level (Figure 5). The IATTC Secretariat at the second Joint Meeting of Tuna RFMO's in 2009 (IATTC 2009a) had reported that although the Commission has in place the Regional Plan, discussions to address the purse seine capacity reductions as well as reduction in longline effort have not occurred. This was a report on the progress made in respect to the course of actions taken by the IATTC since identifying managing fleet size in balance with the productive capacity of the tuna stocks as the greatest challenge faced by the Commission at the first Joint Meeting of Tuna RFMO's in 2007. Consistent with the Secretariat reports, the over capacity of the purse seine fleet was the most widely recognized issue for the sustainability of tuna stocks by the interview participants.

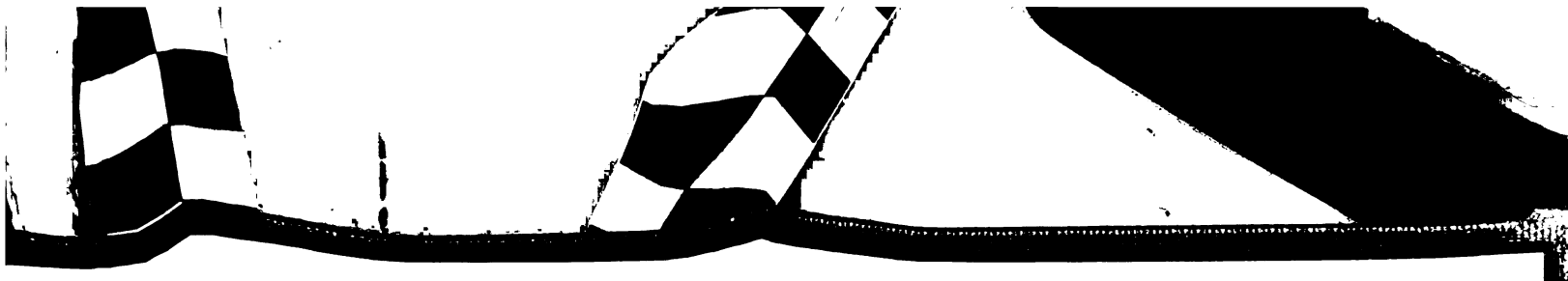
"The key issue facing the tuna stocks in the EPO is too much capacity; the purse seine fleets plus the long line fleets combined are too big. There needs to be a very substantial reduction in the size of the fleet." (Participant #513082)

...fishermen focus on immediate gains so IATTC is here to look at the longer term and the long-term sustainability is linked to the measure we will be able to put into force and will be able to control and one of the big question for the moment is the capacity. We have too much capacity and each country wants to keep its own and that is one of the big issue... (Participant #123072)

"I think the key issue is the excess capacity of the fleet. This is something that block, in many cases agreements because there is a lot of pressure from the industry or the socio-economical factors involved in the fishery" (Participant #509071)

Juvenile Catch

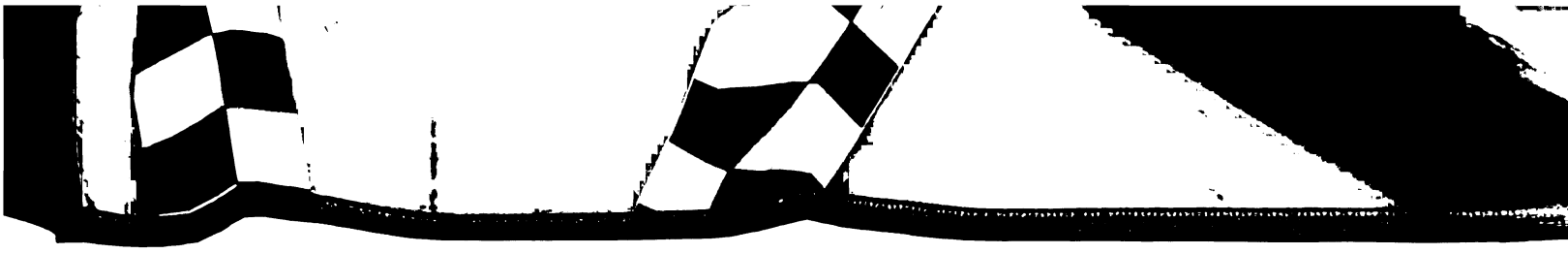
The Commission has been concerned about the high levels of bycatch and discards of small tunas by purse seine vessels that set on tuna schools associated with floating objects, specifically fish aggregating devices (FADs). FADS initially seemed a useful alternative to setting on dolphins associated schools. However, while FADS avoided problems with encirclement of dolphins, this fishing method produces relatively large bycatch of unwanted species along with mixed species of tuna compared to other



methods of purse-seine fishing for tunas. The FADs tended to catch small yellowfin, bigeye and skipjack tunas. This concern is consistent with provisions in the FAO Code of Conduct for Responsible Fisheries and the UN Fish Stocks Agreement which recognize the need for fisheries management to be concerned with fishing across the ecosystem with consideration of non-target, or bycatch species. Prior to 1993, when the pure-seine FAD fishery began, most bigeye tuna in the EPO were taken by longline vessels, and the tuna captured were large and near the size at which they could support high yields. When the purse-seine FAD fishery began, large numbers of very small bigeye were captured and now the purse-seine FAD fishery takes more than half of the current catch of the bigeye tuna (IATTC 2008b).

With recent stock assessments indicating that overfishing of the bigeye stock in the EPO is currently taking place, it is reasonable that many interview participants would cite overharvest of juveniles as a key issue affecting sustainability of tuna stocks. However when bycatch was cited as an issue for the sustainability of the Commission, it had different implications. The participants that discussed bycatch in reference to the Commission were more concerned that consideration and management of bycatch were taking away resources from focusing on maintaining the target species at full utilization. By having to move towards studying all the impacts of the fisheries ecosystem, some felt would diminish the Commission's effectiveness.

> *"...certainly overfishing and the associated increases in capacity [are key issues]...but the real problem is with bycatch and the capture of juvenile tuna."* *(Participant #306082)*



"We see a frightening situation where the more and more juveniles are being caught and there is a reduction, obviously, of the amount of fish available to be caught and that is, obviously, something that we should pay immediate attention to..." (Participant #123073)

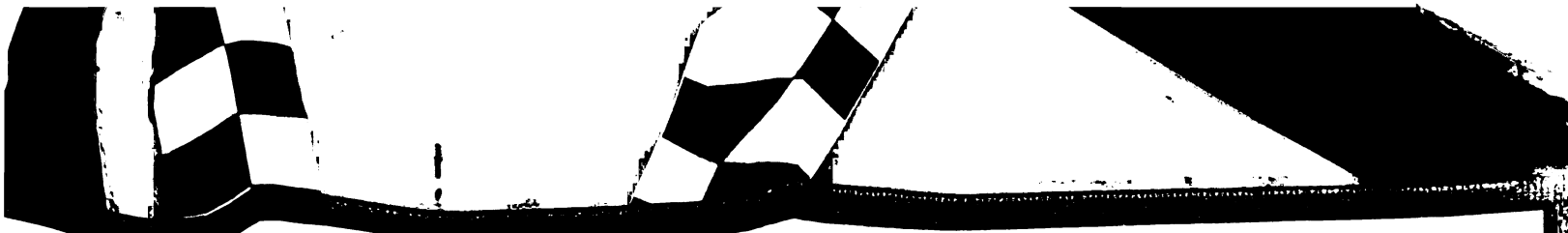
Decision-making by Consensus

The IATTC has frequently failed to fully implement the conservation measures, recommended by its scientific staff, in its resolutions because of the ability of any one government to veto a decision by the Commission. Many argue that not only is the process slowed down, but also the decision-making, the quality of the decision-making is largely diluted by virtue of having to give and take. Formal statements submitted by several delegations have explicitly stated that the lack of consensus generates impediments to the institutional adoption of resolutions.

"Consensus-it is in direct conflict with the greater good, which is the health of the resource." (Participant #306081)

"...in this forum it has to be on a consensus, if one party doesn't want to do something then it's not going to be done." (Participant #123075)

"...one of the great difficulties that [RFMOs] have is in achieving consensus...consensus as we can see on this particular occasion is delaying the process." (Participant #123073)



However, the contrasting viewpoint for consensus decision-making at this Commission, is the expression by some delegations of the critical value of resolutions taken by consensus.

> *"...consensus, that is very important because small countries through that mechanism have the possibility to, if they don't agree with something can just say no and there's no consensus and there's no resolution." (Participant #306083)*

Quality of Science and Suggestions for Improvements

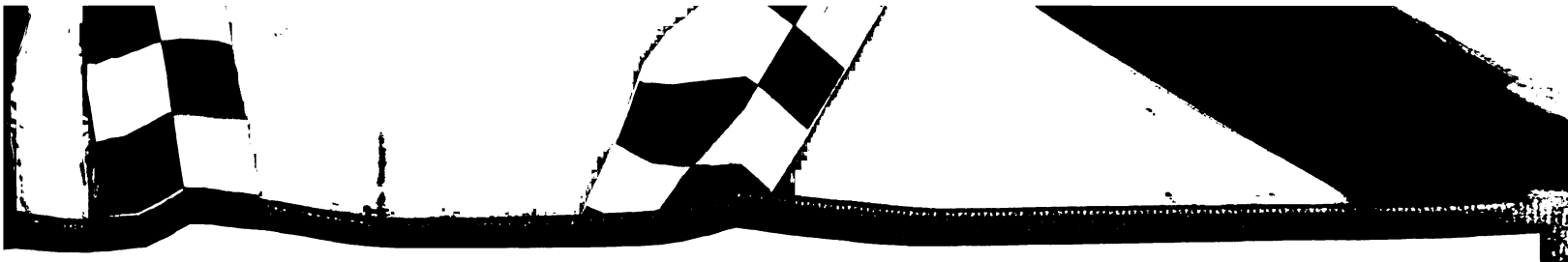
As discussed in previous sections, the IATTC is an example of a science secretariat where an independent and large permanent staff carries out a comprehensive research program to provide the management body with annual assessments of stock status and scientific advice for policy decisions. In their review of regional science arrangements, Ward et al. (1998) found that science secretariats establish centralized data sets of uniform quality, have better capacity to undertake biological research specifically designed to meet the information needs of the stock assessment and select staff based on merit with the tendency to attract fishery scientists that are world leaders in their fields. Given these attributes, the annual assessment of stock status generated by the IATTC staff would be expected to be of sound if not high quality.

The interviews confirmed the expectation and widely held belief that the quality of annual stock assessments at this Commission is high. Most of the participants assessed the quality as good or better, with nearly 60% having answered very good or excellent and less than 15% of the participants assessed the quality as fair or poor. Several used the

term "cutting edge" to characterize the stock assessment conducted by the IATTC staff. Despite the general view of very high quality stock assessments at the IATTC, having given the opportunity, the participants generated a long wish list of suggested ideas for improving the annual stock assessments. The suggestions fell into these major categories for improvement: better, more reliable data collection; other improvements related to stock assessments; better communication of assessment results; and increasing transparency. These suggestions if implemented can help contribute to IATTC's ability to deliver timely, coherent and relevant advice to the various fishery stakeholders, which can lead to building the trust of its stakeholders in the assessments and advice (Kesteven 1996).

Data Collection

Nearly two thirds of participants identified aspects of data as it relates to timeliness and quality as a way to see the biggest improvements to the stock assessments. Some wanted to see the Commission working towards getting real-time catch and effort information off the fleets utilizing existing technology such as Vessel Monitoring System (VMS) so that the stock assessments could "present a real-time, up-to-date picture of the status of the stock", instead of "using data that's sometimes two years old" (Participant #509073). Several participants mentioned the importance of getting information on total removals, including discards and not just the landings. Others emphasized the need to get more information on floating objects, FADS, the amount of FADS that are used in the fishery, the numbering of FADs and its influence on fish behavior and abundance. In general, the participants wanted to see some form of expansion of the data collection to



get more accurate, timely, and or pertinent catch statistics and biological information. However, as one participant noted, "the collection of data is fully a function of how much money or personnel you have to do it" (Participant #513085), so the more pertinent issue becomes whether improving the quality is or should be a priority for this Commission. In other words, how much is enough? Although many participants pointed out the need for better and more data collection, if the stock assessments are generally considered high quality, it's not clear whether additional costs or resources for improved data collection could be justified in light of other areas where improvements maybe possible without the additional burdens on the budget.

Stock Assessments

As participants discussed the quality of the stock assessment, several had comments or suggestions on improvements for conducting the assessment or modeling. Recognizing the complex nature of the ecological systems and the uncertainties and variability that are intrinsic to stock assessments, one of the suggestions wanted to see the staff move away from putting "emphasis on just one model but include in the analysis or in the discussions, the results of many other types of models" (Participant #509071) for comparison. Since all models have problems and weaknesses, "one complex model might not be the way to proceed" (Participant #509071). Also, because the way the fisheries are managed, one practical suggestion recommended not doing an annual assessment but one "every two or three years and in between those years, have research projects or reviews of the assessment methodologies" (Participant #513083).

The interviews confirmed that the Commission was moving towards a next generation assessment models, Stock Synthesis II. One explanation for the switch was "not necessarily because it is a better model but because there is more flexibility and the main thing is that it's better documented, used by lots of different scientists for different species around the world so it's easier for people to review it understand it" (Participant #513083). The explanation has implications for the complexity of the stock assessment information and the challenge of communicating the information not only to other scientists but the decision-body, compromised mostly of politicians and not scientists.

Delivery of Scientific Advice

The IATTC, not unlike other RFMOs, continues to grapple with uncertainty in the stock assessments. Especially in the last few years, delegates have expressed concern regarding the uncertainty about what the current stock status is and what the implications are of future harvesting on the stocks. The scientific staff at IATTC faces the challenge of more effectively communicating the uncertainty in the scientific advice to fishery managers as assessment methods become more complex. Back in the late 1990's Ward et al. (1998) found that most scientists interviewed at regional science arrangements believed that the level of interaction between science advisers and fishery managers were unsatisfactory. Unfortunately, that belief still holds true for some even after 10 years at the IATTC among scientists and nonscientists. Many participants were quick to point out that that the stock assessment reports are "highly technical and complex" and "could be improved in terms of communication" (Participants #510074). Compounding to the complex nature of the assessments is that many of the commissioners are "basically

politicians and are not scientists so they cannot understand the technical details" (Participant #804081) in the stock assessments. Consequently, the scientific staff has been encouraged to improve their communication at the 9th Stock Assessment Review Meeting in 2008. Even if the scientific work is good, it's not too transparent to the manager so suggestions on improving the delivery of scientific advice to the decision making body included providing a "clear message, which is scientific, but understandable to your target audience" (Participant #510074) and "more clearly laying out the uncertainties for the decision-makers" (Participant #509074) in the presentation of stock status. On a related note, a participant discussed "the propensity here to keep using newer and newer models with more and more parameters to fit", which is said to sometimes "create uncertainty on the part of the decision-makers when they see that a model was used this year that's different from last year" (Participant #509073). With regards to better communicating uncertainty, there is a risk however to more openly describing it, as it can be used by groups with diverging interests to cast doubts to evade measures considered unfavorable (Garcia 2005).

> *"...as these models and methods become more complex, the delivery is more difficult because you're now trying to describe things that are inherently complex, and it becomes more challenging to try to understand all the moving parts in these kinds of methods". (Participant #804081)*

Independence and Transparency of Scientific Advice

In Joseph and Greenough's (1979) review of the biological and political aspects of international management of tuna, science secretariats were found to be less prone to

external interference than in multinational approaches, where national scientists from member states develop and provide scientific advice for the management or decision-making body. Ward et al.'s (1998) findings confirmed that science secretariats such as IATTC are insulated from national politics, industry lobbying and conservationist interests, presumably without bias and not influenced by politics of a given nation. However, several participants brought up concerns about the IATTC scientific staff's bias or "political orientation" toward purse-seine fishing nations and expressed "doubts about the objectivity of the scientific work" at the Commission. In general, those that questioned the objectivity of the scientific work of the staff also preferred the multinational approach (used by ICCAT) to conducting and providing advice based on stock assessments and believed IATTC "should give the scientists from outside of IATTC full participation in the stock assessments" or at least publish the data like other RFMOs to "provide a chance for other scientists to analyze the data" (Participant #510072). Currently they felt that the scientists and the scientific advice at the IATTC are "not as independent as they should be and they're not as transparent as they should be" (Participant #513081).

These comments were made despite the fact that the IATTC annually conducts Stock Assessment Review Meetings (previously know as Meetings of the Scientific Working Group), which serve as a peer review meeting where scientists from contracting and non-parties can provide advice or critiques to improve the assessment. The primary complaint about these meetings was that the scientists outside the IATTC "do not have access to the data" (Participant #509072), thereby restricting the scope of the meeting. Some of the national scientists attending these meetings wanted the opportunity to run

their own analyses using the IATTC data. Furthermore, while some participants that brought up science arrangements at other RFMOs discussed "a higher standard of modeling [at IATTC] by concentrating your effort just with the staff at the cost of transparency" (Participant #510078), others argued that including many different national scientists would "harness a greater capacity" and "share the competencies" (Participant #509072), with much to "gain from contributions outside" and lead to improvements in the assessment. Another important reason for increasing national scientists participation was "so that there are no doubts about the work that's been done" (Participant #513081). The national scientists "know the data...know better the fishery" and work together to get the stock assessment result.

> *"During this kind of process, every country knows what happened, how you got your results. But IATTC is totally different. Their staff does all the [assessment modeling] work by themselves and we don't know what happened. That probably needs to be adjusted for transparency." (Participant #510072)*

But other participants pointed out that IATTC scientists work for the Commission and not for any one member country and so "don't have interest in the outcome of the assessment other than they are conducted correctly or through at least the best available science" (Participant #804081). Those that felt that the science secretariat approach was most appropriate for the IATTC believed that having the research carried out by the permanent staff not only ensured its impartiality, but also eliminated the inequalities that would result from having each country carry out its own research, since many of the member countries did not have the adequate scientific resources or capacity. The

following comment emphasized the importance and relevance of an independent and permanent secretariat staff of scientists at the IATTC.

> *"There are many countries that do not conduct science on tuna, but some are starting, some have some history. But that's why it's very important to have, I believe, a group of scientists that don't have a flag behind them to do the science for the different countries involved. If we use the ICCAT system, I believe we would be dominated by the science from developed countries and maybe one or two underdeveloped ones, but that would shift things...but maybe in the future, when science is developed in some of the countries, in all the countries then maybe we can shift to another system." (Participant #509071)*

Factors Influencing Adoption of Conservation Measures

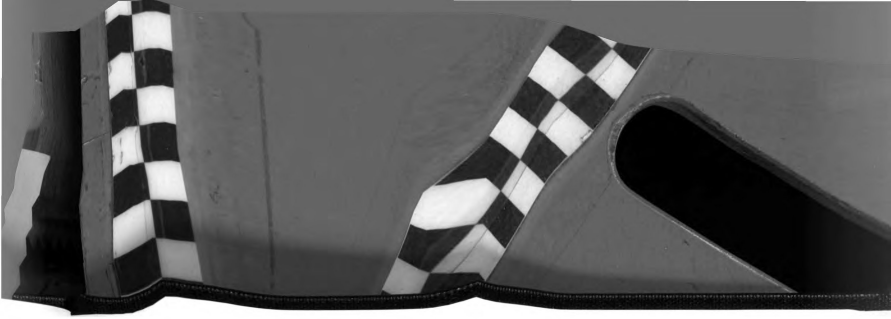
Consideration and Utilization of Scientific Information in Decision-making

Garcia (2008) discusses the general impression that exists in fisheries that fishery management decision making processes are strongly science-based institutions relying on a the large body of available literature and knowledge, scientific advancements from a few developed countries, and work of well-endowed regional fishery commissions. The tuna fishery in the EPO is recognized as one of the best-documented tuna fishery in the world, and in particular, the dynamics of the EPO yellowfin tuna stock are better understood than most other stocks of tuna (IATTC 2007c). The IATTC scientific staff has a long and productive track record contributing to the body of knowledge on tunas in the EPO and also in making improvements in data collection, biological research and techniques of stock assessment work and based on the interviews and other studies (Ward

et al. 1998) their work is well regarded by both those inside and outside the Commission. Consequently, it's not just an impression but an expectation and goal for a large, well-established, well-regarded and well-endowed RFMO like the IATTC to have science as the basis for management.

In recent years, the repeated failure to adopt conservation resolutions has challenged this notion and expectation that decision-making processes at the IATTC are science-based. This Commission simply has not been following the advice of the scientists. "If [Commissioners] can't agree on adopting measures then I guess science hasn't had much impact" (Participant #513082). The interviews confirmed that science is important for developing conservation measures and could be the basis of management decisions. When asked to describe how important they thought the staff's recommendation was in the adoption of conservation measure, nearly three quarters of those interviewed felt that it was important if not crucial to the adoption of measures. The other quarter thought science was less or not important or couldn't tell because "frequently the management action is not well correlated to the scientific advice" (Participant #513083).

Additionally, regardless of how the participants assessed the quality of the stock assessment, most found the information generated by the IATTC staff to be important and useful. In fact many delegations regarded the scientific advice to be authoritative and tried to make it the basis for their management decision. Others used it as a reference point to discern where management may be headed so they can inform and prepare their constituents. Some used it simply to stay current on the status of the stocks. Only a small



minority of the participants claimed they didn't pay much attention to it based the issue of reliability, credibility or bias.

> *"Well they [annual assessment of stock status and scientific advice reported by the secretariat] are critical to our delegation. I think as we're seeing around the table yesterday and today [during 77th Meeting of IATTC, March 2008], there are other factors that have to be considered and because we operate by unanimous consensus, it's hard to maintain a strong conservation recommendation, even if it's based on the best of science" (Participant #306074)*

Influence of Other Factors

Although science is an essential part, Policansky (1998) argued the need to recognize that science is only part of the equation in decision-making in fishery management and much of the equation lies outside science, involving economics, values, politics and other factors. He reported that the science segment is rarely, nor should it be, much larger than 25 percent. Indeed the interviews confirmed the importance of other factors in the decision-making at IATTC. Almost every interview participant identified economic factors as those that influenced decision-making. In fact most thought both economic and political factors drive the decisions affecting tuna sustainability. The participants were not asked to quantify the importance of factors, however they were asked to compare the importance of scientific advice relative to the importance of the various other factors that were identified and discussed. With the exception of two participants, who thought science is the most important, the rest of interviews revealed that science is less important or the least dominant of the factors identified.

"Economic demand, politics. I think that's pretty much what is driving a lot of the management, unfortunately." (Participant #306082)

"...as demonstrated by the fact that this Commission routinely fails to accept the scientific advice and take those actions, it shows that political and economic considerations far outweigh the influence of science in this arena..." (Participant #509073)

"I think it's [science] very important, but I think it's important that they give lip service to it. They [Commissioners] all thank the scientific staff, but in the end a lot of the decisions are driven by kind of politics and industry pressure." (Participant #123076)

Influence of Science

As referred to in earlier section of this chapter, the fleet capacity for the EPO has reached its historic peak. This kind of fishing capacity ratcheting (Caddy and Guilland 1983) has often marginalized scientific information (Boesch 1999). Consistent to that finding, when asked why science advice is less or least important, the primary reason given was the unwillingness and inability of politicians to restrict the activities of their fishing fleets. The self-interest of the member countries apparently keeps them from making economic and or political sacrifices that may be necessary for the long-term sustainability of the tuna stocks.

"...the problem is that I am a decision-maker. Because each member should think

about their own national interests and so they think about their fisheries and their people... there are a lot of people that depend on these fisheries..." (Participant #123077)

"...politicians will ignore the scientific and technical information if they conflict with economic condition of their nation..." (Participant #510071)

"They don't think long-term (sustainability) because the politicians around the table are on to their next jobs." (Participant #123074)

Related to conditions that may marginalize the influence of science, the interviews also described conditions or scenarios when science may have more influence or be more relevant to decision-making. According to the interviews it would seem that the level of influence that science has on decision-making is proportional to level of economic impact that would result from the recommendation.

"It depends how painful it would be economically to adopt the scientific recommendations. If the pain is relatively slight, I think they'll take the science very seriously. It will be greatly important and I think they're willing to impose some burden, a relatively slight burden is done on science, but when push comes to shove and the economic impact will be greater, the scientific and technical information will be taken less than seriously." (Participant #123076)

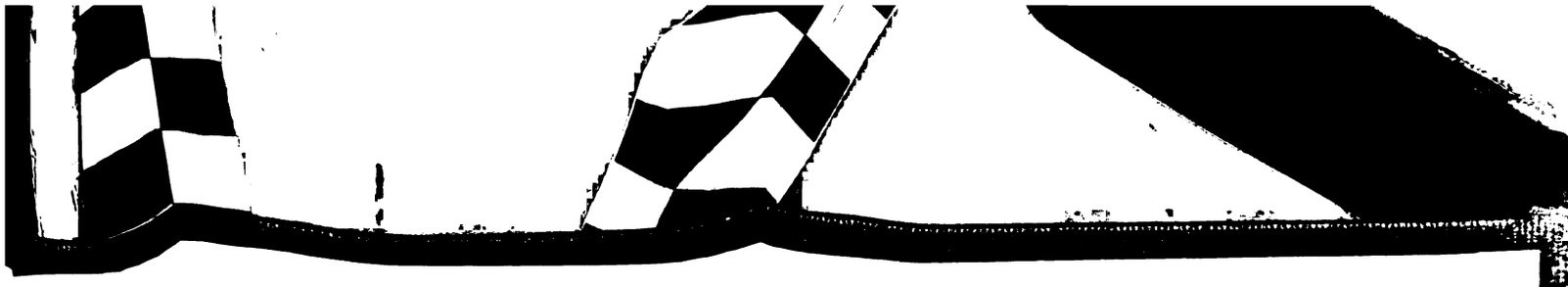
When stocks are in abundance or not yet fully exploited, it's easy to imagine science advice being more influential or adhered to in the adoption of measure. However, with two of the three major tuna stocks currently either fully exploited or overexploited, the science advice has been recommending reductions in fishing mortality with temporal closures, which most often leads to restricting economic activity and gain. Perhaps this is why the influence of science has taken a back seat to economic and political factors and priorities, because science "has been recently indicating an unpleasant alternative for the industry" (Participant #509073). Following this logic, it's easy to reason why a decision-making body would not or does not implement the scientific recommendation and delay and defer difficult decisions that would inflict economic pain.

ROLE OF SCIENCE IN DECISION-MAKING AND THE WAY FORWARD

The language in the 1949 Convention (IATTC 1949) had also intended the science generated by the IATTC ("gathering and interpretation of factual information") to "facilitate" the decision-making as to maintain populations of tuna at a level-which will permit maximum sustained catches year after year. But in recent years, one can argue that science has not necessarily enabled decision-making or made the process easier. If proof is in the adoption and enactment of conservation measures, science has failed to catalyze conservation actions that could ensure the sustainability of tuna stocks in the EPO. In the following sections, I discuss some key roles and limitations of science and the changes necessary for science to facilitate and influence the decision-making at the IATTC.

Science to Inform

The role of science in the decision-making at IATTC as one participant put it is "to inform the people making the decision with the best information they can about what's happening with the fish stocks so they are in a position to make the most use of them for management" (Participant #513082). That role to inform the decision-body has not changed much over the years. What has changed is quality of the scientific information provided by the IATTC staff to the decision-making body. The scientific information has been refined over time with improvements and availability of technologies and methods to collect and analyze the data. In fact the progressive improvements to science at the IATTC has contributed to the decision-makers' understanding of the stock status and awareness of problems associated with bycatch and overfishing. In doing so, science (specifically the stock assessments) at the IATTC has fulfilled two of the three roles for science identified by Ehrlich and Daily (1993) as it relates to sustainability: 1) problem perception and 2) explanation of causes and projection of consequences. The science conducted by the IATTC staff, presented via the reports on stock assessments, have over the years resulted in the widespread recognition that the bigeye tuna and yellowfin tuna populations are declining and the mean size of captured individuals is decreasing, and the carrying capacity of the purse-seine fleet is increasing. The stock assessments also routinely identify variability in recruitment and fishing mortality that explain past and current population levels. The assessments also forecast the effects of future fishing effort on the stock levels. In short, the stock assessments inform and help the Commission recognize status of and or problems with the stock.



Another feature that has changed at the IATTC as it relates to the role of science is the larger and more diverse audience that science informs. What started out as a bilateral agreement now has 16 contracting members and six countries with cooperating non-party status. Delegations representing the 16 member countries were in attendance at the 78th Meeting of the IATTC along with observers representing the six cooperating non-party countries, five international organizations, and eight non-governmental organizations (IATTC 2008c). As more countries with economic or conservation interests joined the Commission and increased their investment and involvement in the fishery, the range of interests that contributes to but also are affected by the scientific findings of the secretariat staff has increased. With a larger range of interests and stakeholders represented at the IATTC meetings, it's not surprising that there has been more interest, debate and discourse about what's happening with the stocks. The challenge for science lies in having to inform and influence multiple and potentially conflicting interests.

Science as a Shield

To some extent, with the increased sophistication of the scientific information, there has been a growing complexity and uncertainty with respect to the assessment methods and assumptions that are made in fitting the model parameters. Modern statistical stock assessment models are inherently uncertain and complex. Even though scientific certainty itself would not prevent overexploitation of fisheries resources (Ludwig et al. 1993), the lack of certainty on the status of fish stocks has shown to significantly impair decision-making (Johnson 2007). However, based on the interviews,

the questioning or contesting of scientific information seemed more politically motivated than a genuine concern about the lack or absence of quality information to provide certainty. The casting of science in the role of a shield is not new and Ozawa (1996) pointed out that when a set of policy or management recommendation advocates a position using scientific information to support a preferred measure, countervailing forces move to undermine their position by discrediting the scientific basis of that position. Despite the use of an independent, "politically neutral" permanent scientific staff, the interviews indicated that politics is not separate from science. The politics that is introduced into the science or hidden behind it is revealed in the following statements.

> *"I understand that for the industry, fisheries industries, it is always difficult to adopt measures that almost always restrict their economic activity and that the only tool that a politician can use to convince and to somehow impose this measures is to make sure that there is solid scientific advice behind him. If you don't have this solid scientific advice, there are doubts around it, then the role of the manager, the politician, is especially tough." (Participant #513081)*

> *"...certain people are or nations are systematically questioning and torpedoing some of the scientific data..." (Participant #123073)*

> *"Usually, when the science as it has been recently indicating an unpleasant alternative for the industry, some of the member nations trot out the general old criticisms, 'oh well, we don't really know what natural mortality is; there's no direct measure'; 'it's oceanographic events that are really influencing this' or*

'fish stocks continue to go up and down regardless of what we do'." (Participant #509073)

"Occasionally there are challenges directly to the science. Those are viewed at least by my delegation as being a smoke screen behind which you can hide other agendas." (Participant #306084)

Science that Facilitates and Influences Decision-making

Boesch (1999) in his commentary about the role of science in ocean governance argued that science needs to move beyond making known problems and consequences of our actions to the living resources but meet its potential as a valued and influential component for sustainable governance. Some of the suggestions to improve the quality of science can help decision-making from the point of view of removing some uncertainty and making it more difficult for some delegations to question its legitimacy or credibility but whether improving the science will make it more influential in decision-making is questionable at best. So what needs to happen so that science can facilitate countries with different interests and objectives for the fishery to come to agreement and adopt conservation actions? What can help science be more central in the adoption of measures? Since deciding to adopt conservation measures is a political act, increasing the influence of science may require more than applying some new fisheries management tools but possibly seeking governance solutions as suggested by the interviews.

Management Strategies Evaluation

There is a tool or method used in fishery management called Management Strategies Evaluation (MSE), intended to resolve management characterized by multiple or conflicting objectives, multiples stakeholders with divergent interests and uncertainty about the dynamics of the resources being managed. MSE involves the assessing the consequences of a range of management options and explicitly presenting the trade-offs in performance across a range of management objectives (Smith 1994).

> *"The simulation models [of MSE] are able to test what the effects are to resource if management does not takes place, if conservation measures aren't adopted. You can evaluate the impact over years if this situation happens. So through these analyses, you come out with management proposals that are more robust to the failures. That would be a very powerful tool." (Participant #804082)*

The recommendations to conduct this type of strategic evaluation at the IATTC are consistent with the importance of strategic assessment, the third role of science with respect to sustainability (Ehrlich and Daily 1993). Undertaking strategic assessment would round out and complement the stock assessments that provide the decision-body with much of the information necessary to understand current stock status and implications of fishing pressure on the stocks (problem recognition, mechanistic understanding). Ehrlich and Daily's (1993) definition of strategic assessment as the detailed, scientific evaluation of how the problem would evolve under various courses of actions or inaction, including the consideration of costs and benefits, pretty nicely sums up MSE.

One of the strengths of the MSE method is that it does not seek to prescribe an optimal strategy or decision but provides decision-makers with information on which to base rational management choices, given a set of differing objectives, preferences, and values (Smith 1999). Another key benefit touted for the approach is that it is consultative, requiring the input of all stakeholders for candidate management options and scenarios. And finally, displaying the range of strategic options available could enable allocation of responsibility and liability within the management body (Garcia 2005). However, the approach demands clear objectives to do the evaluations against, forcing the stakeholders to be explicit about their objectives so that it can specify performance indicators that are in the context of what the parties value (CSIRO 2009). If IATTC is to consider the use of MSE, as other RFMOs like the International Whaling Commission and Commission for the Conservation of Antarctic Marine Living Resources have, it must first openly discuss and reset objectives for management to reflect its large range of stakeholders with multiple and possibly conflicting interests.

Clear Objectives and Goals for the Tuna Fishery and IATTC

Maintaining tuna stocks in the EPO at levels that permit maximum sustainable yield (MSY) is the main objective of the IATTC. Maunder and Harley (2006) evaluated the management objectives of the IATTC from a stock assessment perspective and highlighted that the objectives were vague and problematic in terms of MSY. To some extent, they attributed the vagueness and problems with the interpretation of MSY to the problems they are seeing with the bigeye tuna in the EPO. Because MSY cannot be

achieved for all species and gear types simultaneously, they reported that attempts to maximize the sustainable yield for skipjack tuna in the EPO has reduced the yields of bigeye tuna while reducing longline effort and increasing purse-seine effort on FADS has increased the relative fishing mortality for small bigeye. Aside from the problems with MSY from a stock-assessment perspective, they also noted that objectives held by individual member countries are not documented and is evidenced only by their actions in the decision-making process.

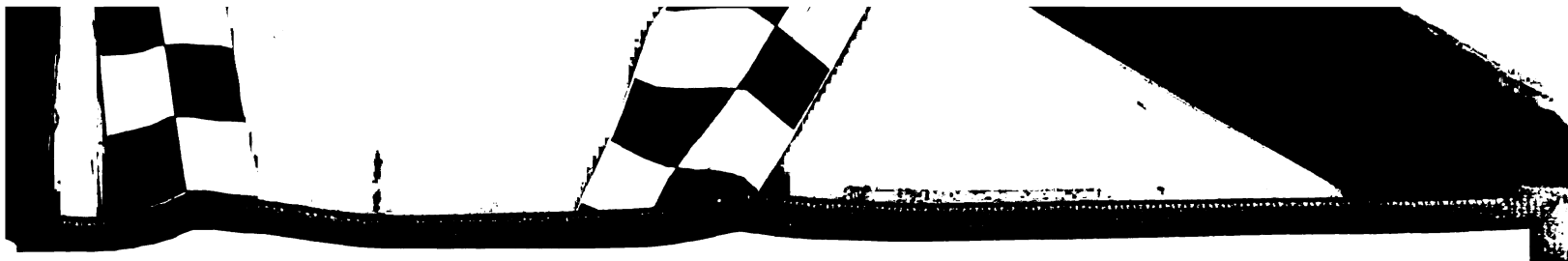
> *"I think the thing that would make science more central would be if the commission had adopted clear objectives for the fishery. The way its interpreted is that you should keep stocks at MSY level with the existing mix of fishing gear. But countries haven't been able to say, what is it we want, is it worth it to us to preserve large big eye tuna in the fishery for whatever reason or is it better for us to maximize our catches of skipjack and allow large bigeye to disappear? The secretariat does pose that question quite often but without much effect. Organizationally as a commission these questions need to be asked to establish the objective." (Participant #513082)*

This key but previously ignored recommendation is consistent to Policansky's (1998) prerequisite for usefulness of science in decision-making. He argued that for science to facilitate decision-making and management, the stakeholders' agendas, values, and goals must be explicit. He stated, "as long as the various goals are not articulated and discussed openly, the managers and the scientists who advise them will often be unable to provide appropriate advice and take appropriate action, and debates over management

policies will be more acrimonious and less productive than they need to be". In addition to the findings of Policansky (1998), Ozawa (1996) found that for science to play the role of facilitation, the agenda for negotiations must clearly set aside a period for addressing explicitly political concerns. She thought this was critical to discourage participants in the negotiations from "stubbornly posturing behind technical positions that they believe will afford them political gain". If resetting objectives, even has the slightest potential to ensure that appropriate management action are taken without having to hold additional futile meetings, then the Secretariat should move to revisit, and repose the question of openly vetting and clarifying objectives for the fishery and the organization. Besides, resetting objectives may also discourage delegations' use of science as a shield in decision-making, essentially killing two important birds with one stone.

Broader Research Scope

In this chapter, the science as discussed in the context for the work conducted by IATTC scientific staff has been limited to the data and analyses concerned with the biology of tunas, population dynamics and stock assessment and the presentation of biological advice on which to base conservation recommendations. But as one participant argued, the science at the IATTC needs to be more comprehensive "because reality is not biology, reality is fishing" (Participant #510076). The argument for looking at more than just at biology is based on the perspective that fishing is fundamentally an economic activity, which has a market with its scope and scale, determined by and specific to the social and financial condition of each fishing nation. In his review of fisheries science in support of decision-making, Garcia (2005) called for the full integration and



consideration of social, economic, and policy-oriented disciplines and their contributions. The suggestion for a more comprehensive approach to fishery science will be a challenge both financially and in terms of capacity building for the Secretariat, as there are currently only two out of 63 staff members with specialization in policy. Contracting social scientists or hiring them as part of the permanent staff will no doubt stress the already stretched finances but perhaps socioeconomic and governance analyses, are what may be called for as potential inputs for the MSE approach and more importantly, to facilitate decision-making at the Commission.

Increase participation of the stakeholders with IATTC

The interviews suggested a closer participation of stakeholders with the IATTC. Perhaps this suggestion is the result of the recent trend of holding closed sessions (one delegate per member country and no observers). The lack of transparency in the decision-making at the IATTC has been called into question by the Conservation NGO community and they have recommended that IATTC make greater effort to include conservation organizations on the delegations (IATTC 2008a). This is a reasonable request given that industry and national fishery management are represented in almost every delegation. Alcock (2001) in his examination of stock assessment failures in New England and Newfoundland, found that when decision-making organization are recognized as broadly representative of the full range of interests affected by policy decisions, embedded stock assessments, such as the kind conducted by science secretariats, is more influential in decision-making. Conversely he found that when the decision-making body is perceived as biased and do not adequately encompass the full range of competing interests,

disembedded stock assessments represented in this chapter by the multinational approach, is more appropriate and influential. Consequently, if the IATTC is not ready or willing to move away from its science secretariat approach to conducting the assessments, perhaps it should heed the recommendation of the NGOs and take it a step further by requiring or requesting wider representation of interest groups in the make-up of the Commissioners. The results of Alcock's comparative analysis may not transfer to an international decision-making body, but I would think given the degradation of decision-making process over the last few years, it would be in the best interest of the sustainability of tuna stocks and the credibility of Commission to be more inclusive.

Alternative Decision-making Processes

The IATTC, like most other RFMOs, requires consensus in order to adopt regulations. Consequently, decision-making is protracted, and decisions are often diluted as compromises to satisfy the lowest common denominator. Decision making by consensus was identified and discussed as a key issue for the long-term sustainability of the Commission and was brought up again when asked to identify what can make science more central to the adoption of conservation resolutions. Many in the Commission would like to see alternate decision-making approaches to adopting resolutions.

> *"I think any time when we've got an agreement that requires unanimous consensus, you're going to have to live with the economic and political considerations of those that are on the minority side. If we had decision making by something other than unanimous consensus by super majority or you could*

subtract one or two, we might make more serious progress in the conservation world." (Participant #306084)

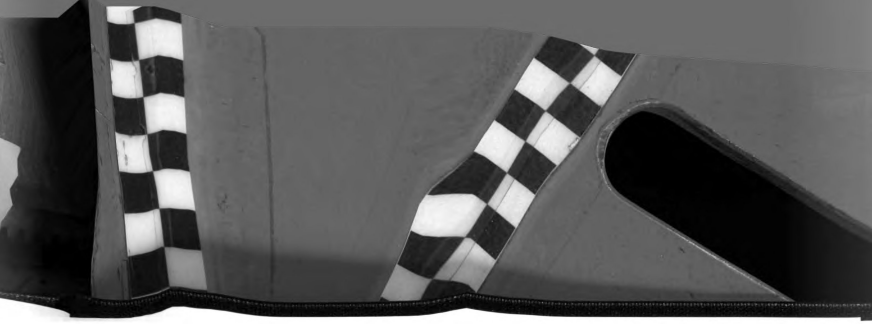
"If you're going to be joining these organizations, you must and come to some kind of consensus or voting, which I think is one of the things that we should be leaning more towards" (Participant #123074)

Another suggestion regarding an alternate approach to decision-making was modifying the process so that the default for not coming to agreement would be the adoption of the scientific recommendation presented by the Secretariat. Currently, if consensus is not reached on conservation recommendations, the fishing continues without the joint implementation of any management measures.

"A decision making mechanism by which the default would be the adoption of the scientific advice of the secretariat unless the objectives are articulated clearly in writing, may force them to more generally adopt the advice of the Director, as a counter to the consensus decision making to scheme." (Participant #123076)

The Promise of the Antigua Convention

To reverse the trend of increasing pressure on the bigeye and yellowfin tuna stocks and decreasing influence of science, it may take more than new tools and objectives or interdisciplinary science. As Boesch (1999) advocated, it may require regional institutions and frameworks capable of integrating scientific information into political and economic decisions. It's not yet clear whether the Antigua Convention will



serve as the new framework that will enable IATTC to move beyond status quo and translate science into conservation actions. The Antigua Convention has not yet entered into force but when it comes into effect after August 2010, the new Convention will usher in two key provisions relating to science in decision-making at the IATTC: application of the precautionary approach and the Scientific Advisory Committee. One of the principles of the precautionary approach, that the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures (IATTC 2009b), should minimize if not eliminate the use of science as a shield and downplay legitimate or illegitimate concerns about doubts, uncertainty or inadequacies of the scientific advice. Another significant provision for science in decision-making is the reliance on the Scientific Advisory Committee, who will review assessments, analyses, research or other work and recommendations prepared by the scientific staff; set the staff's research agenda and priorities; and most notably provide the technical advice and recommendations regarding conservation and management measures to the Director of the secretariat. The Scientific Advisory Committee under the Antigua Convention will consist of representatives designated by each member, with qualifications suitable for the nature of the Committee and meet at least annually (IATTC 2009b). This hybrid model of a science secretariat utilizing a multination approach for its advisory body will likely increase the transparency as well as the perception of independence of the science conducted by the staff. As the IATTC begins to implement the Antigua Convention, an important starting point for improved governance of the EPO tuna fishery, the Commission could increase the prospects for the sustainability of tuna stocks by monitoring and learning from the outcomes of policy changes resulting from

the new Convention or any one or more of the above mentioned suggestions and adapting with appropriate feedback as suggested by Ostrom et al. (2007).

Moving Beyond Science

At its 80th Meeting held in June 2009, the IATTC moved beyond the impasse and finally adopted conservation measures that would provide some conservation benefits by reducing fishing pressure by about 20% over three years (?). The conservation proposal by the scientific staff recommended 30% but the Commission was able to at least agree on a resolution, which it has not been able to do for almost three years. What happened? Tuna industry insiders have written (Seafood.com News 2009a) that the International Seafood Sustainability Foundation (ISSF) played a key role in putting pressure on key delegations that were objecting to previous conservations recommendations. The ISSF was launched in March of 2009 as a collaboration between leaders in the tuna industry with prominent figures in the marine science and NGO conservation communities (ISSF 2009a). The consortium was formed on the initiative of major canners, prompted by failures on the part of RFMO's to take actions necessary to effectively manage tuna stocks and the ISSF website notes that the RFMO's "parliamentary procedures too often allow the short-term economic and political interests of some of their member nations to trump good science" (ISSF No date). The ISSF had agreed to not purchase and use EPO bigeye tuna after September 1, 2009 unless the IATTC enacts science-based conservation measures prior to that date (ISSF 2009b). The potential business disincentive of not being able to sell tuna to purse-seine tuna canners, representing 70% of global capacity (Seafood.Com News 2009b), may have forced the hand of the nation(s) that previously

did not have the political will to follow the advice of the scientific staff. Unfortunately, it was not the greater influence of science that forced the hand but rather a market disincentive that resulted in adopting conservation measures that hopefully will sustain bigeye tuna and other tuna species in the EPO.

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APPENDICES

APPENDIX A

Interview Protocol

Inform participant of the purpose of the study
Provide participant with the consent form
Turn on tape recorder and begin interview

Please describe your affiliation with IATTC.

What is your occupation and role in involvement with the IATTC?

Describe your training and experience in preparation for this role?

How long have you been engaged with activities/meeting of IATTC?

What do you think are some key issues in ensuring the long-term sustainability of IATTC? …the long-term sustainability of tuna stocks in the EPO?

How do you think the role of scientific and technical information has changed since the time of the original convention?

How would you assess the quality of the annual stock assessments? Where/how do you think improvements are possible (in the collection of data; in the stock assessments; delivery of information)?

In what ways do you think that the annual assessment of stock status affects information on the status and trend of tuna populations in the EPO?

How does your organization consider and use the scientific information generated by the secretariat staff?

Please describe how important you think the annual assessment of stock status and scientific advice reported by the secretariat is in the adoption of the management measures. How about in the establishment of compliance controls?

What factors (such as science, economic analyses, political considerations, other factors) influence the sustainability of tuna stocks in the EPO? How does scientific and technical information compare in importance to those factor(s) or interact with other information?

What happens when the scientific and technical information conflicts with other data or factor(s)? Who resolves the conflict and what factor(s) have you seen or experience that normally wins out? Why do you think that is?

Do you have suggestions on how or what can make science more central to the adoption of management measures or establishment of compliance controls?

Is there anything else you'd like to talk about regarding the role of science in the decision making at the IATTC?

Additional Questions (specific to IATTC staff)

What is your position/ working title at IATTC? Please describe what your position responsibilities?

How long have you worked for IATTC; in your current position?

How does your position aid/facilitate the overall mission of the Commission (to maintain the populations of tuna and other species taken by tuna vessels in the Eastern Pacific Ocean and to cooperate in the gathering and interpretation of factual information to facilitate maintaining the populations of these fish at a level which permits maximum sustainable catches year after year)?

Do you attend the annual meetings or the stock assessment review meetings? If so, how many meetings of each have you attended?

Suppose more support is provided to improve the science available to the commissioners. Do you think it would make it easier for the Commissioners to adopt management measures?

Do you think the Commissioners and the delegates understand the science that is being presented during the annual review of stock status presented by the Director?

What do you think is the purpose of the stock assessment review meetings (previously known as meetings of the working group on stock assessment)? What do you think is the role of the member countries' or CP's technical staff at the stock assessment review meetings?

Do you think participants of the stock assessment review meeting understand the science that is being presented?

Do you think that the Antigua Convention will change the relevance of science or input of science at IATTC? If so, why and how? When the Antigua Convention is implemented, how do you envision your responsibilities changing? Do you think it will change the way the secretariat does business?

APPENDIX B

Interview Consent Form

As part of my research at Michigan State University, I will be conducting interviews from spring 2007 through summer of 2008 in order to gain a better understanding of the role and value the IATTC community attributes to science.

This interview will take about 30-45 minutes. Participation in this interview is voluntary. You may choose not to participate at all, or you may refuse to answer certain questions or discontinue this interview at any time. I will keep all data collected as confidential, and you will not be identified by name or other specifically identifying characteristic.

There is always the possibility of unforeseeable risks. Your signature below indicates your consent as a participant in this study insofar as your response will be audio-tape recorded and analyzed and used to help guide the evaluation of the role of science at the IATTC. Participating in this study is voluntary and your privacy will be protected to the maximum extent allowable by law.

I appreciate you taking the time to participate.

I voluntarily agree to participate in this study.

Name:

Date:

<or>

You indicate your voluntary agreement to participate by beginning this phone interview.

If you have any questions or comments please contact my advisors (Gary Sakagawa, 858-546-7177, gary.sakagawa@noaa.gov; Bill Taylor, 517-353-0647, taylorw@msu.edu) or myself (Shauna Oh 858-229-4168, shaunaoh@ucsd.edu. If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish, Peter Vasilenko, Ph.D., Director of the Human Research Protection Programs (HRPP) at Michigan State University: (517) 355-2180, fax: (517) 432-4503, email: irb@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.