INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

EIGHTH MEETING

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DOCUMENT SAC-08-10a

CURRENT AND PLANNED ACTIVITIES OF THE IATTC STAFF

CONTENTS

The work of the IATTC scientific staff is divided into four programs: Stock Assessment, Biology and Ecosystem, Data Collection and Database, and Bycatch and International Dolphin Conservation Program (IDCP). This document describes the current situation regarding the staff's activities in these programs, plus its capacity-building activities, and outlines future activities and planned improvements.

A. STOCK ASSESSMENTS

1. ROUTINE STOCK ASSESSMENTS

The stock assessment group's principal responsibility is to analyze and assess the status of the stocks of tunas and tuna-like species in the eastern Pacific Ocean (EPO) and provide scientific advice to the Commission to aid in its management decisions regarding these stocks. It prepares assessments of the principal species of tunas (bigeye, yellowfin, and skipjack) and other species for the meetings of the Scientific Advisory Committee (SAC) and the Commission's regular meetings; it also participates in the assessments of other species, particularly bluefin and albacore tunas, conducted by other organizations,

and conducts other analyses requested by IATTC Members. The group also conducts dolphin assessments for the AIDCP.

Three types of stock assessments are carried out: 1) **full assessments,** in which all the major assumptions are reviewed and improved; 2) **updated assessments,** in which new or updated data are analyzed, using the current assumptions; and 3) **exploratory assessments,** in which new assumptions are investigated, but are not used in the assessment on which the staff bases its management advice. In years in which exploratory assessments are conducted, management is based on updated assessments. Other less intensive methods, such as stock status indicators, are also used.

Preparatory work for the stock assessments in the schedule. Update assessments were conducted for yellowfin and bigeye tunas for this meeting. Indicators were investigated for skipjack tuna and the silky shark. Work during 2017-2018 will focus on a full assessment of bigeye tuna, to be presented at the Committee's meeting in 2018, also an update assessment for yellowfin tuna and indicators for skipjack tuna, as well as collaborative assessments of other species (Table 1).

2. RESEARCH

The IATTC staff conducts original research into a wide variety of matters related to the biology and population dynamics of tunas in the EPO, the fisheries that exploit those stocks, the ecosystem in the EPO, and other marine species affected by the fisheries.

2.1. Stock assessment research

2.1.1. Bigeye tuna assessments

Extensive research will be conducted during 2017-2018 to provide a basis for determining the base case assessment for bigeye tuna to be presented at the meeting of the SAC in 2018. Research will focus on the

TABLE 1. Assessments of tunas and other species carried out by the IATTC staff

Species	Last assessed	2017	2018	2019
IATTC				
Yellowfin tuna	2016	Update	Update	Full
Skipjack tuna	2004	Indicators	Indicators	Indicators
Bigeye tuna	2016	Update	Full	Update
Swordfish (south EPO)	2011			
Swordfish (north EPO)	Never as a separate stock			
Sailfish	2013			
Black marlin	Never			
Silky shark	Never	Indicators	Indicators	Indicators
Dorado	2016			
COLLABORATIONS				
Pacific bluefin tuna	2016		Update	
Albacore tuna	2014	Full		
Blue marlin[1]	2013 (full) 2016 (update)			
Blue shark	2014	Full		
Swordfish (north Pacific)	2014	Indicators	Full	
Striped marlin				Full
Silky shark (Pacific-wide)			Exploratory	
Shortfin mako shark			Full	

items described below. Natural mortality will not be considered in 2017-2018, as it will be addressed at the 2019 CAPAM workshop (Section 2.1.4).

2.1.1.a Spatial model

An initial two-area Stock Synthesis model for bigeye in the EPO, initiated in 2017, will be further developed. Movement will be estimated from tagging data, using analyses external to the model, and integrating the tagging data into the stock assessment model will be considered. The IATTC staff will also collaborate with staff of the Secretariat of the Pacific Community (SPC) to conduct research into a Pacific-wide assessment of bigeye tuna.

2.1.1.b Growth

A new model was developed in 2016 to represent the growth of bigeye based on both tagging data and otolith data. This model and alternatives will be further developed during 2017-2018, building also on the research presented at the 2014 CAPAM growth workshop.

2.1.1.c Selectivity

Research has been conducted on including more flexible and time-varying selectivity parameters in the assessment, and this will be further developed during 2017-2018, building also on the research presented at the 2013 CAPAM selectivity workshop.

2.1.1.d Recruitment

Lessons learnt from the 2017 CAPAM recruitment workshop will be applied to the bigeye assessment during 2017-2018.

2.1.1.e Spatio-temporal CPUE analysis

Longline CPUE data for bigeye will be analyzed using spatio-temporal models, to improve the indices of abundance. Spatio-temporal models will also be applied to purse-seine data to derive spatial maps of relative abundance for use in the analyses that estimate movement from tagging data. Data from multiple nations will be considered for inclusion in the analysis. This work will contribute to the 2018 CAPAM workshop on spatio-temporal modelling.

2.1.1.f Post-stratification of purse-seine length-composition data and estimating of sample sizes

Software has been developed to post-stratify purse-seine catch and length-composition data. It will be used for developing the bigeye assessment for 2018, using the new stock and fishery areas. Work will continue on analyses to define new catch strata within these new areas and, once the purse-seine database has been fully updated, re-evaluate minimum sample sizes per catch stratum for catch estimation. Having the ability to revise the spatial strata that are used in the assessments as new information becomes available is an essential part of being able to adapt the assessments to the best scientific information on population structure. Appropriate weighting of the composition data in the stock assessment model is essential. Methods will be developed to estimate sample sizes for the composition data externally from the assessment.

2.1.1.g Data weighting

Research will be conducted to determine the most appropriate weighting of the different data sets used in the assessment. The developments will build on the research presented at the 2015 CAPAM workshop on data weighting.

2.1.1.h Diagnostics

Multiple diagnostics will be applied to aid in the construction of the assessment model.

2.1.2. Evaluation of factors affecting bigeye catch on FADs

Statistical analyses of purse-seine observer data will be continued, to study the characteristics of fish-aggregating devices (FADs) and determine which factors increase the catch of bigeye tuna.

2.1.3. Investigation of capacity and its relationship with fishing mortality (*F*)

Current management of tropical tunas takes into consideration changes in the fishing capacity of the fleet. There are a variety of measures of fleet capacity, and their calculation is complicated by vessels that only fish for part of the year. In addition, tropical tunas have different vulnerabilities to different set types, and assigning capacity to set types might be desirable. Therefore, an investigation of methods to more accurately represent capacity will be conducted. The relationship between capacity and fishing mortality will be investigated to determine appropriate methods to adjust capacity according to necessary changes in fishing mortality.

2.1.4. CAPAM[1] stock assessment methodology workshop series

The IATTC staff collaborated on several research projects presented at the CAPAM workshop on data weighting in 2015, which were published in a special issue of the journal *Fisheries Research* in 2017. Analyses and documents related to research on recruitment will be prepared for the upcoming workshop on recruitment in 2017. Workshops on spatio-temporal modelling of CPUE data and natural mortality are scheduled for 2018 and 2019, respectively.

2.1.5. Dolphin assessments

The IATTC hosted a workshop in 2016 on methods for assessing dolphin stock status. No fishery-independent surveys of dolphins have been conducted since 2006, so there are currently no reliable indicators with which to monitor the status of dolphin populations in the EPO. Experts in the fields of line-transect and mark-recapture surveys, abundance estimation and population modelling, and imagery, tagging, genetics data, and cetacean life history, discussed options for developing indices with which to monitor dolphin populations, and produced a report on methodological options for managing those populations. The staff are currently working to publish one of the background documents (a review of potential line-transect methodologies) in a peer-reviewed journal.

2.1.6. Management Strategy Evaluation (MSE) and reference points

The staff is participating in the Joint MSE Technical Working Group that was created during the Third Joint Meeting of Tuna RFMOs (the "Kobe process") in 2011 to support the implementation of the precautionary approach for tuna fisheries management. The group met in 2016; the objectives of the meeting were to: (i) review current MSE practice, successes, failures and potential areas for collaboration; (ii) discuss progress on MSE; and (iii) identify future actions, focusing on areas for collaboration. The group agreed to work intersessionally on method development and on case studies.

Preliminary MSE work has been conducted for bluefin tuna, bigeye tuna, and dorado. Methods using the assessments based on the Stock Synthesis modelling platform as operating models have been developed. After further development, funded in part by the International Seafood Sustainability Foundation (ISSF) and the European Union (EU), the MSE for bigeye was used to test the reference points and harvest control rule (HCR). The staff will collaborate with the International Scientific Committee (ISC) to implement MSEs for bluefin and albacore tunas.

2.1.7. Stock assessment of dorado

A preliminary stock assessment was conducted for dorado in the EPO. In addition, a 3rd Technical Meeting on dorado was held in Panama. Alternative approaches, including data-limited methods, were presented

at the meeting.

2.1.8. Trends in abundance of silky sharks

In 2017, purse-seine indices of relative abundance for the silky shark in the north and south EPO were updated with data from 2016. Based on preliminary results of comparisons of these indices to a silky shark index from the WCPO and to an index of variability in oceanographic conditions, it is hypothesized that the recent changes in the north EPO indices, particularly for small silky sharks, may be influenced by changing oceanographic conditions, and thus potentially biased. The staff will conduct further analyses to evaluate the magnitude of this bias and determine whether any bias corrections can be made.

B. BIOLOGY AND ECOSYSTEM

3. LIFE HISTORY OF TUNAS

3.1. Early life history

The early life history (ELH) group conducts research on the ecology, physiology, and pre-recruit dynamics of tunas. Research activities in 2017 and 2018 will be centered around the following projects, based at the IATTC's Achotines Laboratory in Panama, but also involving collaboration with other research organizations. For more detail on the work done at the Laboratory, see Document SAC-08-09c.

3.1.1. Studies of the reproductive biology and pre-recruit ecology of yellowfin tuna

Yellowfin have been spawning in captivity at the Achotines Laboratory on a near-daily basis since 1996. Investigations of the spawning dynamics and ecology of larval and early-juvenile yellowfin form the core of the research activities conducted at the Laboratory, and will continue during 2017 and 2018. Current areas of research focus include the effects of ocean acidity on spawning dynamics and of climate change on pre-recruit life stages, with an emphasis on the early-juvenile stage.

3.1.2. Comparative studies of the early life history of Pacific bluefin and yellowfin tunas

Funded by Japan International Cooperation Agency (JICA), Japan Science and Technology Agency (JST), and the IATTC; collaborators: Kindai University (KU) and the Autoridad de los Recursos Acuáticos de Panamá (ARAP).

This project commenced in June 2011 and was completed in March 2016. Joint supplementary research is continuing during 2017-2018. In November 2015, a final review of the project by a panel of the funding agencies gave the project a "High" rating for meeting research objectives. The project included: (1) comparative research on the early life history of Pacific bluefin and yellowfin, with experimental work conducted in Japan and at the Achotines Laboratory; (2) studies of the reproductive biology of Pacific bluefin (Japan) and yellowfin (Achotines); (3) development of recruitment prediction models for Pacific bluefin and yellowfin, and of forecasting tools for management of those stocks; (4) development of technologies for the cage culture of yellowfin juveniles and to provide research guidelines for the improvement of yellowfin mariculture in Central America. During 2015, yellowfin juveniles were transferred and reared in a sea cage near the Achotines Laboratory for the first time worldwide. Six publications summarizing the research results from the comparative studies have been developed jointly through 2016, and two additional publications are in press for 2017. Several joint research activities, including comparative investigations of larval growth and physiology, will continue during 2017-2018, and a proposal is pending for a new five-year project, to begin in 2018.

3.1.3. Ocean acidification impacts on tropical tunas

Funded by the Pelagic Fisheries Research Program (PFRP) of the University of Hawaii and the IATTC;

collaborators: Secretariat of the Pacific Community (SPC); Macquarie University, Australia; University of Gothenburg, Sweden; Max Planck Institute for Meteorology, Germany; and Collecte Localisation Satellites (CLS).

This project includes experimental research at the Achotines Laboratory (conducted during 2011), modeling studies conducted by the research group during 2015-2017, and ongoing analysis of genetic and physiological effects of ocean acidification. Objectives are: (1) quantify the effects of ocean acidification on egg, larval, and early-juvenile stages of yellowfin; and (2) incorporate the effects of egg and larval mortality associated with ocean acidification into models to forecast the integrated impacts of climate change on tuna population dynamics and distribution in the Pacific Ocean. Efforts are ongoing to secure funding for additional experimental and modeling studies on this topic. A joint manuscript (principal author, Donald Bromhead) describing the study results was published in the journal *Deep Sea Research Part II* in early 2015. A second manuscript (principal author, Andrea Frommel), describing histological analyses of the lethal and sub-lethal effects of ocean acidification on the internal organs of yellowfin larvae, was published in the *Journal of Experimental Marine Biology and Ecology* in 2016. A workshop was held in Sydney, Australia, in January 2016 to discuss future directions for the research, and the workshop results have been summarized in a publication that will be published in 2017 in the journal *Marine and Environmental Research.*

3.1.4. Joint IATTC-University of Miami workshop on yellowfin tuna

Every year since 2003, a workshop coordinated by the IATTC and the University of Miami, entitled "Physiology and Aquaculture of Pelagics, with Emphasis on Reproduction and Early Developmental Stages of Yellowfin Tuna," has been held at the Achotines Laboratory. Participants include selected tuna researchers and University of Miami graduate students, and fees paid by participants and students cover the expenses of the workshop.

3.1.5. Studies of improved rearing and ecology of early life stages of yellowfin tuna

Funded by the University of Miami, the IATTC, and Aqquua, Inc; collaborators: University of Miami Aquaculture Program.

During 2017-2019, the ELH group will collaborate with the University of Miami's Aquaculture Program (UMAP) in a three-year study of improved rearing methods and the ecology of early life history stages of yellowfin. Research will be focused on improved feeding and nutrition of larval and juvenile yellowfin, and analysis of growth and mortality dynamics of pre-recruit life stages. Research trials will be conducted at the UMAP experimental hatchery in Miami and the Achotines Laboratory.

3.1.6. Support for Environmental Leadership Training Initiative research programs

Funded by Yale University and the Arcadia Foundation; collaborators: Environmental Leadership Training Initiative (ELTI) of Yale University.

The ELTI program, which is based at Yale University but has a field office in Panama, aims to improve coastal water quality and protect mangrove forests, coral reefs, and estuarine and coastal resources by empowering people to restore and conserve tropical forests and watersheds. ELTI has asked the Achotines Laboratory to host the ELTI Panama program during 2018-2020; this would include local administrative support for two ELTI scientists and workshops and research activities at the Laboratory. ELTI will provide all necessary funding.

4. INVESTIGATION OF AGE, GROWTH, AND REPRODUCTIVE BIOLOGY OF YELLOWFIN TUNA

An investigation is in progress of the age, growth, maturity, spawning frequency, and fecundity of yellowfin in the EPO. Biological samples taken in recent years by observers aboard purse-seine vessels and

by field office staff from landings by purse-seine vessels, from four geographical strata in 12 length-class intervals (40 to 160 cm FL), are being analyzed in the IATTC fish ecology laboratory in La Jolla.

Daily growth increments in otoliths are a proven way of determining the age of tunas. Otoliths obtained by IATTC field office staff in Mexico and Ecuador are currently being processed. The resulting age at length data will be used to derive an appropriate growth model. Statistical comparisons will be conducted of the growth, maturity, and fecundity functions obtained from these different spatial strata.

Also, for investigating the maturity and fecundity of yellowfin, samples of ovaries taken at sea by observers are being prepared for histological analysis to determine the reproductive condition of individual females, following the procedures developed by the IATTC staff for a previous study of the reproductive biology of yellowfin.

5. TUNA TAGGING STUDIES

The following activities related to tagging are planned for 2017-2018:

1. Continue cooperation with other tagging programs in the Pacific and elsewhere, facilitating the recovery of tags and associated recapture information.
2. Continue collecting and analyzing archival tag data for yellowfin released at several locations throughout the EPO, for describing the geographic variability in movements, behavior, habitat utilization, and plausible boundaries for putative stocks in the EPO.
3. Further evaluate tagging data for bigeye from throughout the Pacific, in collaboration with scientists from, among others, the SPC's Oceanic Fisheries Programme, for describing dispersion, mixing, and plausible boundaries for putative stocks in the Pacific.
4. Continue ongoing collaborations with scientists from the Marine Biological Association of the United Kingdom in analyses of archival tag data sets from bigeye and yellowfin tunas from the EPO, to evaluate behavior relative to environmental data sets.
5. Continue ongoing collaboration with scientists from the *Institut de recherche pour le développement* (IRD), Sète, France, in the utilization of archival tag data sets from the EPO and operational-level purse-seine fishing data for modeling the apparent abundance of bigeye tuna.
6. Continue to seek extra-budgetary funding for conducting an IATTC Regional Tuna Tagging Project for bigeye, yellowfin, and skipjack tunas throughout the EPO.

6. IDENTIFICATION OF MEASURES FOR REDUCING FISHING MORTALITY OF SILKY SHARKS

As a follow-up to a project, funded in 2016-2017 by the EU and ISSF, for determining the post-release survival rate of silky sharks captured in longline fisheries, the EU has requested a proposal for further experiments on this issue, and also research to define silky shark nursery grounds. The objective of this research is to identify effective mitigation measures for reducing the fishing mortality of silky sharks in the EPO.

7. POTENTIAL OF SHALLOW-DRAFT FADS FOR REDUCING FISHING MORTALITY ON SMALL BIGEYE TUNA

In a collaborative experiment initiated in 2015 with ISSF and NIRSA, an Ecuadorian fishing company, 50 pairs of shallow (5 m) and normal depth (36 m) FADs were deployed simultaneously to test for differences in the proportion of bigeye caught in sets on the two types of FADs. In 21 subsequent sets on the normal depth FADs and 16 sets on the shallow FADs, the quantities of tuna caught per set were similar for both types of FAD. In early 2017, 100 pairs of FADs were deployed in a second collaborative experiment, and statistical analyses of the data from the two experiments will be conducted in 2018.

8. ECOSYSTEM STUDIES

Ecological research at the IATTC has been focused on studies of food-web dynamics, the effects of the tuna fisheries on the ecosystem, and modeling of ecosystem processes in the EPO.

1. A chapter entitled "Bioenergetics, trophic ecology, and niche separation of tunas" was published in the book serial *Advances in Marine Biology* in 2016. The chapter is a collaboration by eight authors from various countries, led by an IATTC scientist. It reviews current understanding of the bioenergetics and feeding dynamics of tunas on a global scale, with emphasis on yellowfin, bigeye, skipjack, albacore, and Atlantic bluefin tunas in seven oceans or ocean regions.
2. In early 2017, a manuscript entitled "Global trophic ecology of yellowfin, bigeye, and albacore tunas: Understanding predation on micronekton communities at ocean-basin scales" was accepted for publication in a special issue of *Deep-Sea Research Part II*. This work is a result of the collaborative effort with CLIOTOP-IMBER aimed at moving from regional to macro-scale understanding of oceanic food webs.
3. A proposal to conduct a global comparative analysis of oceanic food webs using stable isotope compositions of yellowfin, bigeye, and albacore tunas was accepted by CLIOTOP's Scientific Steering Committee in early 2016. A manuscript on extending regional nitrogen isotope analyses to global scales is in preparation.
4. A notable increase has been observed in cephalopod occurrence in the diets of yellowfin tuna over a 50-year period, and in the diets of multiple predator species between the 1990s and 2000s. A manuscript on increased production of cephalopods as revealed by diets of top predators was submitted to a journal for publication in early 2017.

8.1. Effects of fisheries on the EPO ecosystem

IATTC staff participated in the Joint Meeting of tuna RFMOs on the *Implementation of the Ecosystem Approach to Fisheries*, hosted by the FAO-GEF Common Oceans Program. The goals of the meeting were to (1) establish communication among members of each of the tuna RFMOs on the difficulties of implementing an ecosystem approach to fisheries (EAF), (2) summarize progress of EAF in each of the tuna RFMOs, and (3) propose potential case-specific solutions towards operational-level implementation of EAF. A report detailing the meeting outcomes is in development.

8.2. Ecological Risk Assessments

Long-term ecological sustainability is a requirement of ecosystem-based fisheries management. Assessing the effects of fishing on many of the species caught incidentally in the EPO tuna fisheries is difficult because their vulnerability to overfishing is unknown, and biological and fisheries data are severely limited for most of them. The IATTC staff's research on ecological risk assessment includes the following:

1. Productivity and susceptibility analysis (PSA) was previously tested for measuring vulnerability to overfishing in a preliminary analysis of a subset of species in the EPO purse-seine fishery.
2. A meta-analysis of longline data in the IATTC databases was undertaken (SAC-08-07b) as a precursor to a PSA for the longline fishery in the EPO. Specific objectives of the meta-analysis were to: (1) identify a list of species that interact with the longline fisheries; and (2) review catch and effort data to parameterize susceptibility attributes such as the geographic overlap of species with the fishery, gear selectivity, and post-release survival of discarded species.
3. A sensitivity analysis was conducted to identify potential redundancy of productivity attributes in ecological risk assessments. The results indicate that the assessments need include only one attribute

for describing: (a) the rate of population growth; (b) maximum size of the fish; (c) timing of reproductive maturity; (d) reproductive output; and (e) frequency of reproductive output (SAC-08-07c).

4. A preliminary PSA for the large-scale longline fishery in the EPO, using the same data as in the meta-analysis of the longline fishery and the productivity attributes determined by the sensitivity analysis, classified 19 species, primarily elasmobranchs, as highly vulnerable. However, these results are highly uncertain, given the lack of reliable biological and catch data on the species assessed (SAC-08-07d).

8.3. Work plan for 2017-2018

1. Develop databases for (a) improving ERAs for the large-scale longline fishery, and (b) parameterizing PSAs and ecosystem models.
2. Develop and update PSAs of fisheries in the EPO.
3. Develop species distribution models as base maps for future quantitative ERAs.
4. Prepare research proposals for: (a) field experiments on consumption and evacuation for key species, to improve biological data used in ERAs and ecosystem models; (b) a program to monitor key species identified by the ERAs; and (c) biological sampling (*e.g.* stomach and tissue samples for diet and stable isotope analyses) to assess predator-prey interactions and trophic levels.
5. Continue collaboration with the CLIOTOP-IMBER international research program, focusing on global analyses of isotope composition of top predators.
6. Continue collaboration with the FAO-GEF Ecosystem Approach to Fisheries project.
7. Routine reporting of bycatch estimates and aggregate indicators.

C. DATA COLLECTION AND DATABASE

9. DATA COLLECTION AND DATABASE PROGRAM WORK PLAN

At the 7th meeting of the SAC in 2016, a summary was presented of the work completed by the data group during the previous year, and of activities and objectives planned for future years. This report contains an update of the progress of previously proposed activities, as well as new projects that are planned for the near future.

9.1. Ongoing activities

1. As in previous years, additional improvements to the reporting workflow have been identified and are gradually replacing less efficient existing procedures. Automation of repetitive tasks is applied where possible, and refinements to existing procedures are constantly being implemented.
2. Conversion of existing data entry and editing computer programs from Visual Basic 6 (VB6) to the Microsoft dot net framework continues, since VB6 is no longer supported by Microsoft. This is a time-intensive project which will ultimately require thousands of hours to complete, and must be accomplished while simultaneously providing support for the normal activities of the data group, such as staff support, maintenance of existing computer programs, and fulfillment of data requests to IATTC member countries and scientific organizations. IATTC programmers are currently developing the new programs as standard Windows applications. The conversion of all tuna-billfish related VB6 programs is complete, and efforts are now concentrated on converting the observer VB6 programs, which is currently about 30% complete. All the national observer program databases have been modified to use the new programs.

3. Development of the new IATTC website is in progress. The IT staff began work on the use of a modern Content Management System (CMS), with the help of limited consulting by experienced users of the CMS, but progress has been limited due to the staff's other responsibilities, and additional involvement by the consultants will be required to complete the project. The new web site will have a fresh image and improve access to information by making navigation easier, enhancing search features, and automating various aspects of content management. Once operational, selected areas of the site will be delegated to staff directly responsible for its contents, further expediting updates.
4. Development of a documentation library is still in progress. All the processes for creating the Best Scientific Estimate, Length Frequency and Stock Assessment databases have been documented, and have been added to the documentation library. We are also exploring the possibility of incorporating the functionality of the documentation library into the new IATTC website, so that the information is available to outside organizations.
5. The documentation of all internal data processing continues, so that all the procedures are clear and comprehensive.
6. With the implementation of resolution C-15-04 on mobulid rays in August 2016, a new dedicated data form was created for observers, and a corresponding database was developed. This required also developing instructions for observers, coordinating databases and instructions with all national programs, and modifying the form, instructions and database related to the implementation of measures adopted by the IATTC.
7. The staff completed the data entry and editing of 528 trips by purse-seine vessels covered by IATTC observers that departed during 2016. Data from an additional 355 purse-seine trips covered by observers of national observer programs were incorporated into the IATTC database, along with summarized data from 12 trips sampled by WCPFC observers.

9.2. Planned work

1. A dedicated Vessel Register database and application redesign, proposed at the SAC meeting in 2011, is scheduled. The current design is workable, though it is labor-intensive. This project has not yet been initiated as it has a lower priority than other tasks assigned to the development group.
2. Development of a data request management application was not initiated due to limited staff resources.
3. A front-end user interface based on R is planned for use with the Best Scientific Estimate (BSE) program. Most IATTC researchers are very familiar with R as an analysis tool, so this addition will greatly facilitate access to the program by the scientific staff. Once development is complete, these same improvements may be applied to other IATTC programs.
4. The Length Frequency data management database and application will be modified to make them more flexible for temporal changes in area stratification. This will include other algorithms which interact with the length-frequency program, such as the process of estimation by flag. An analysis of the importance of flag within strata will be useful for improving this process. This work will be initiated once conversion of VB6 programs to the Microsoft dot net framework is complete.

D. BYCATCH AND INTERNATIONAL DOLPHIN CONSERVATION PROGRAM (IDCP)

10. BYCATCH STUDIES

This section includes activities conducted in support of the Agreement on the International Dolphin Conservation Program (AIDCP), as well as other bycatch issues.

10.1. Bycatches on FADs

1. The staff of the Bycatch Program is working on an EU-funded project to identify means of constructing non-entangling FADs from biodegradable materials, not only to decrease mortality of non-target species but also minimize contributions to ocean debris and pollution by commercial tuna fishing. The durability of these FAD designs was tested first at the Achotines Laboratory, and then at a nearby beach, and the best will be tested in regular fishing operations. Preliminary results show that the FADs stayed afloat for 60-65 days, about half of what was expected, due to loss of buoyancy resulting from colonization by epibiota. The staff of the Bycatch Program is continuing research on alternative non-entangling and biodegradable materials to extend the durability of the FADs. In parallel experiments carried out by the industry with the collaboration of the staff of the Bycatch Program, FAD designs stayed afloat for more than two months.
2. Under the provisions of Resolution C-16-01 on FADs, the staff helped the working group established by the resolution to develop a dedicated logbook for collecting the required data. The staff will continue to work in 2017 on developing a database to provide feedback to the working group.
3. Also under the provisions of C-16-01, the IATTC staff developed a system of marking FADs, and made it available to all CPCs for use by their vessels when deploying FADs. The aim of the system is to not only obtain information about the number of FADs deployed during a trip, but to enable the usage of individual FADs to be tracked across more than one trip.
4. Continue studies describing the characteristics of the FADs and fishing operations involving FADs. Continue the collection of data needed to develop FAD management programs and to propose modifications that could reduce bycatches.
5. Continue studies and communication with other tuna RFMOs to harmonize and improve the quality of the data collected by observers, with the aim of improving data quality and supporting comparative studies.

10.2. Sea turtles

The dissemination of information on techniques for releasing captured, hooked, or entangled sea turtles, with the objective of increasing their survival, continues. This work is done mainly for the purse-seine fleet, but also for industrial and artisanal longliners, in cooperation with the countries of the region, and others whose flag vessels fish the area.

10.3. Sharks and mobulid rays (Manta and Mobula spp.)

The studies that informed Resolution C-15-04 have continued.

1. Data on bycatches of mobulid rays in the purse-seine tuna fisheries will be used to develop habitat models for the main species. The work will be carried out by a post-doctoral researcher from AZTI, Spain, during a two-year fellowship at IATTC.
2. The researcher will also study the effects of climate change on mobulid habitats, using models of future conditions, and current habitat preferences.
3. Currently, all mobulid rays caught are classified as mortalities. A tagging experiment to estimate the survival of released mobulid rays is planned, in collaboration with the Monterey Bay Aquarium, the University of California at Santa Cruz (UCSC), and Scripps Institution of Oceanography. Several tuna companies have offered to participate; this will be coordinated with researchers from ISSF, in whose programs the companies participate.
4. A program of biological sampling of captured mobulid rays to confirm species identification, study

stock structure, and collect trophic information is planned with the same group of cooperating institutions. Observers on tuna vessels will collect biological samples for analysis at the UCSC DNA Laboratory. Funding is being sought for this project.

10.4. Dolphins

1. The staff continues to conduct research on the tuna-dolphin association. Previous collaborative work has shown that the association occurs in certain oceanographic conditions and likely lowers the risk of predation for the tuna. Continuing research is focused on the effects of changing climate and El Niño/La Niña cycles on the association of spinner dolphins and yellowfin tuna.
2. The staff is also conducting collaborative research on potential cryptic mortality of dolphins associated with the purse-seine fishery. Previous studies have examined stress-related changes in blood samples. Continuing research with the US National Marine Fisheries Service (NMFS), and possible future research with the Mexican fishing industry, is focused on determining whether dolphin calves become separated during the chase preceding purse-seine sets.
3. The staff prepared and edited documents for the Workshop on Methods for Monitoring the Status of Eastern Tropical Pacific Ocean Dolphin Populations, held in October 2016 (Section 1.4). The last comprehensive cetacean survey in the eastern tropical Pacific was conducted in 2006, and the Workshop endeavored to identify alternative methods for monitoring the population status of dolphins and compare the estimated costs and effectiveness of the different methodologies. A background paper was prepared in conjunction with scientists from the US National Oceanographic and Atmospheric Administration (NOAA), the Norwegian Institute of Marine Research, and the Scripps Institution of Oceanography to describe the diverse data available, or potentially available, for monitoring dolphin populations. Reviews on population abundance methodology and cetacean assessment models were prepared by invited experts.

10.5. Seabirds

1. Cooperate with the Agreement for the Conservation of Albatrosses and Petrels (ACAP) to maintain the set of mitigation measures adopted up to date, according to the most recent scientific studies and experimental results.
2. Improve observer training to determine whether the individuals taken are juveniles or adults.

11. ON-BOARD OBSERVER PROGRAM UNDER THE AIDCP

The AIDCP requires that 100% of the trips by Class-6[1] purse-seine vessels carry an observer aboard, and that the IATTC observer program cover at least 50% of the trips. These observer records are the primary source of data on the purse-seine fishery.

With three exceptions, observers from the AIDCP On-Board Observer Program accompanied every trip by Class-6 vessels during 2016. Table 2 shows the number of trips covered by IATTC observers in 2016. Under a Memorandum of Cooperation between the IATTC and WCPFC, vessels operating in either Convention Area may be accompanied by observers from either program.

Table 3 shows trips by Class-5[2] vessels required to carry an observer under certain provisions of the AIDCP and by Class-4[3] vessels that voluntarily carried an observer during a closure of the purse-seine fishery. It does not include 9 trips by Class-4 vessels and 10 trips by Class-5 vessels that voluntarily carried observers

[1] Carrying capacity > 363 t
[2] Carrying capacity 273-363 t
[3] Carrying capacity 182-272 t

from the Ecuadorian national observer program as part of a short-term experimental program. The IATTC program did not cover any of these trips, but was provided with the data from them by Ecuador.

TABLE 2. Coverage of Class-6 purse-seine vessels by the IATTC and WCPFC observer programs, 2016

Class 6		2016			
Flag	Total trips	Coverage			
		IATTC		WCPFC	
		Trips	%	Trips	%
Colombia	45	21	(47)	-	-
Ecuador	350	231	(66)	-	-
El Salvador	14	14	(100)	-	-
European Union (Spain)	13	6	(46)	-	-
Guatemala	4	4	(100)	-	-
Mexico	212	102	(48)	-	-
Nicaragua	23	12	(52)	-	-
Panama	76	38	(50)	-	-
Peru	21	20	(96)	-	-
United States	54	40	(74)	12	(22)
Venezuela	45	26	(58)	-	-
Total	**857**	**514**	**(60)**	**12**	**(1)**

TABLE 3. Coverage of Class-4 and 5 purse-seine vessels by the IATTC observer program, 2016

2016	Class 4			Class 5		
Flag	Total trips	IATTC Coverage		Total trips	IATTC Coverage	
		Trips	%		Trips	%
Colombia	1	1	(100)	3	1	(33)
Ecuador	18	12	(67)	-	-	-
Total	**19**	**13**	**(81)**	**3**	**1**	**(33)**

E. CAPACITY BUILDING, TRAINING AND TECHNICAL SUPPORT

12. TRAINING

12.1. AIDCP observer training

The IATTC staff, which provides the Secretariat for the AIDCP, conducts training courses for observers, mainly for the IATTC program, but with occasional attendees from national programs. Two courses were held during 2016 (Table 4).

TABLE 4. Observer training courses, 2016.

Date	Location	Attendees	
		IATTC	Nat'l
23 May-9 June	Manta, Ecuador	10	7
21 November- 8 December	Panama City, Panama	6	4
Total (2 courses)		**16**	**11**

12.2. WCPFC-IATTC observer training

Under a Memorandum of Cooperation, the IATTC and WCPFC programs cross-endorse their observers, enabling them to work in the Convention Areas of both organizations. Observers must meet the training requirements of both organizations for collecting data at sea, and so an IATTC staff member participated in a WCPFC training course for 21 observers in Port Vila, Vanuatu, on 8-12 August 2016.

12.3. AIDCP seminars for crew, vessel managers, and government officials

The AIDCP requires that the crews and captains of vessels operating with a Dolphin Mortality Limit (DML) receive approved training. The IATTC conducts training seminars, which cover matters related to dolphin mortality, AIDCP requirements, IATTC resolutions and other information to promote efficient management of resources and adoption of good fishing practices.

During 2016 the staff held three such seminars, with 76 attendees (Table 5).

TABLE 5. AIDCP seminars, 2016.

Date	Location	Attendees
12 January	Manta, Ecuador	38
2 February	La Jolla, USA	1
3 August	Manta, Ecuador	37
Total (3 seminars)		**76**

12.4. Alignments of dolphin safety panels

Another requirement of the AIDCP for vessels operating with a DML is to "*perform a periodic net alignment to ensure the proper location of the dolphin safety panel during the backdown procedure*". In 2016 the IATTC staff participated in seven such alignments, carried out during a trial set in which the vessel tests its gear prior to departing on a trip, all in Manta (Ecuador).

13. TECHNICAL SUPPORT AND ADVICE TO GOVERNMENTS AND OUTSIDE ORGANIZATIONS

Staff of the Bycatch Program were involved in providing advice and technical support to organizations involved in sustainable fisheries management such as ISSF, the Marine Stewardship Council (MSC), the Seafood Watch Program, and others. The staff is providing advice to the efforts by several fleets and organizations to meet the MSC standards for certification in Ecuador, Mexico, and Spain.

An ongoing activity is the organization of workshops on reducing dolphin mortality, under the AIDCP, and on reducing bycatches in the FAD fisheries, supported by, and conducted in cooperation with, ISSF.

In addition to its obligations to the Commission, the staff also provides scientific advice to member governments. For example, a staff member chairs the Pacific Scientific Review Group, which provides advice to U.S. government agencies on marine mammals in U.S. waters off the Pacific coast and Central Pacific islands. Travel expenses for such activities are typically paid by the organizers, but IATTC staff are not otherwise compensated for their participation.

13.1. Shark fisheries

The staff will provide appropriate assistance to developing IATTC Members in:

13.2. Sampling

1. Continue the development of, and promote the adoption of, standardized data collection forms (catch, effort, biological data) for sharks and rays, in cooperation with other regional and subregional organizations, member nations and, if possible, with organizations collecting data in the Western

Pacific.

2. Develop and disseminate sampling designs for landings of sharks and rays, and for observer programs where available, and support the creation and maintenance of databases. In particular, develop experimental designs and implement a pilot shark fishery sampling program in Central America (phase two of the IATTC work on sharks under the FAO-GEF Common Oceans Tuna and Biodiversity Project).
3. Continue support to in-port collection of data on shark catches, size distributions, and effort, and development of standardized methods to identify shark species, including from body parts (*e.g.* fins or trunks) or incomplete specimens.

13.3. Workshops on stock assessment of sharks

Participation in shark stock assessment workshops, which will include, among their research topics, stock assessment and management of sharks. A workshop on data-limited methods for sharks will be conducted in summer 2018 under the FAO-GEF Common Oceans Tuna and Biodiversity Project.

13.4. Data reporting

Continue to improve the Members' capability to report data on catches and effort by gear type, landings, and shark trade, in accordance with IATTC reporting procedures, including available historical data. This assistance will likely include the development of observer programs covering different fisheries. We plan to have one training course per year, dedicated to the development of standardized national observer programs.

13.5. Biological parameters

Continue to conduct research on stock structure and biological parameters such as age, growth, natural mortality, diet, and reproduction. This assistance will likely include, as part of the general training course on data collection, training in biological sample collection and analysis methods.

13.6. Fisheries data studies

Continue to conduct research on the spatial-temporal characteristics of shark catches, including identification of nursery grounds and of specific areas and seasons that contribute to the majority of catches. This assistance will likely include a general training course on quantitative methods in fisheries data analysis, which will also cover methods for estimating fisheries quantities, such as fishing mortality, and inputs for stock assessment (*e.g.*, total catch, standardized trends of CPUE).

13.7. Development of landings database in collaboration with OSPESCA

IATTC staff, in collaboration with the Organization for Fisheries and Aquaculture in Central America (OSPESCA), continued assistance in the development of data collection forms for artisanal fleets operating from ports in Central America. The second and final form, for collecting summarized landing and trip data, has been completed, along with the associated user manuals, database, and data entry/editing program. The database features many data entry-friendly features and a comprehensive error-checking routine. Potential users of the database include fisheries managers in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and the Dominican Republic.

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