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COMMITTEE ON ADMINISTRATION AND FINANCE

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FISCAL YEAR 2016 RESULTS AND BUDGETS FOR FISCAL YEARS 2018 AND 2019 (1 JANUARY-31 DECEMBER)

APPENDIX I: PROPOSALS FOR RESEARCH PROJECTS

CONTENTS

Introduction

There has been considerable interest, both in the Scientific Advisory Committee (SAC) and among IATTC Members, in the scientific staff conducting investigations not included in its current or planned research activities and/or that require collaboration with scientists from member countries. Several specific requests and recommendations have been made, but, although such investigations and collaborations could be important for improving the assessment and management of the tunas and other species that share their ecosystem, the staff does not have the necessary resources, financial or human, to carry them out.

However, the staff prepared a series of proposals to address some of these requests and recommendations and facilitate the search for potential sponsors, and these are summarized in this document. Once funding is obtained, these activities will be integrated into the staff's research program. Most of these proposals involve hiring researchers to carry out the bulk of the additional work, but existing staff members will be involved to varying degrees, as reflected in the budget summaries. The cost of the administrative support required for these projects, in terms of staff time, is not included in the proposals.

1. MANAGEMENT STRATEGY EVALUATION (MSE) FOR TROPICAL TUNAS IN THE EPO

1.1. Background

Management of many fish stocks is transitioning from the traditional stock assessment approach towards increasing use of harvest control rules (HCRs), reference points (RPs) and management procedures. Reference points are benchmarks used to determine the status of fishing stocks relative to desirable (target) and undesirable (limit) states. Both target and limit reference points can be implemented by using harvest control rules that specify management actions to be taken if a stock approaches either reference point. This transition is in part due to the fact that many stock assessments are highly complex, and that the inherent uncertainty should be taken into consideration when implementing management actions. Another important transition is towards pre-agreed management procedures that avoid arbitrary changes in management when stock assessment results are controversial. This new approach can be tested using management strategy evaluation (MSE), which is a formal procedure for identifying assessment methods and HCRs that are robust to uncertainty while attaining management objectives. MSE involves using simulation analysis to test alternative management procedures and their elements, such as HCRs and RPs, under different possible states of nature.

The IATTC has recently adopted target reference points (TRP), limit reference points (LRP) and a harvest control rule (HCR) for tropical tunas (yellowfin, bigeye, and skipjack) (Resolution C-16-02). The TRPs are S_{MSY} and F_{MSY} (the spawning biomass (S) and fishing mortality rate (F), respectively, corresponding to the maximum sustainable yield (MSY)). The LRPs are those associated with a 50% reduction in recruitment under a conservative assumption about the stock-recruitment relationship (steepness = 0.75). The goal of the HCR is preventing F from exceeding F_{MSY} by applying the following rules: 1) if $F > F_{MSY}$, reduce F to F_{MSY}; 2) if the probability that F will exceed the LRP is greater than 10%, implement measures that have a probability of at least 50% of reducing F to the TRP or less, and a probability of less than 10% that F will exceed the LRP; 3) if the probability that S is below the LRP is greater than 10%, implement management measures that have a probability of at least 50% of restoring S to the TRP or greater, and a probability of less than 10% that S will fall below the TRP in 2 generation-times or 5 years, whichever is greater.

1.2. Statement of the problem

The recently-adopted HCR of reducing F to F_{MSY} if the fishing mortality of bigeye or yellowfin exceeds their respective estimated F_{MSY} is essentially the same as the informal rule used previously by the IATTC, but now defines the action to be taken if the LRP is exceeded. Simulation testing of the informal HCR was performed for bigeye, but the recently-adopted HCR has not been evaluated yet, nor have alternative management measures associated with stock status relative to the adopted or alternative TRP and LRP. Additionally, in-depth analyses of the adopted TRP, LRP and HCRs and alternatives are needed to guide the Commission in adopting a permanent HCR and its components.

1.3. Objectives

The objective of this work is to test the current HCR with respect to the adopted RPs and alternatives under different sources of uncertainty. This project will further develop simulation analyses to evaluate the HCR for bigeye with respect to the adopted RPs and alternatives, taking into consideration the principal sources of uncertainty (relationship between stock size and recruitment (steepness), size of the oldest fish, and natural mortality). The project, which will be coordinated with similar initiatives in other tuna RFMOs, will be carried out by an outside contractor, with guidance and supervision by the IATTC staff. The tools developed in this project will be the basis for future Management Strategy Evaluation (MSE) research.

1.4. Work plan

Unlike previous studies, which used estimation models based on a simplification of the current assessment model, this study will attempt to use the full Stock Synthesis (SS) stock assessment model, which is currently used for the bigeye assessments, to build both the testing set of operating models and the estimation model for the simulation analyses. The probability of exceeding the LRPs, the time that the stock is below the LRP, and the impact on catch will be used as performance measures. The proposed activities and timeline for the project are as follows:

1. Month 1. Convert the bigeye assessment model to the latest SS version (3.3), to take advantage of a major update that allows for better modelling of recruitment, among other processes.
2. Months 1 to 3. Further develop the current work by the IATTC staff on a spatially-structured model for bigeye for consideration as operating model.
3. Months 2 to 5. Resolve other potential model misspecification of the assessment model before using it as an operating model. For example, the current model includes a two-regime recruitment shift that is likely a model misspecification due to the expansion of the FAD fishery and this might be corrected using a spatial model.
4. Months 3 to 6. Explore a systematic way to evaluate the parameter and model structure uncertainty by putting probabilities on alternative models conditioned to data.
5. Months 6 to 12. Test alternative harvest strategies, focusing on actions at limit and target reference points. Conduct simulations using a simplified or full assessment model, depending on re-evaluation of performance after fixing components of the model as in (3).

The majority of the work will be conducted by a dedicated researcher, but the Stock Assessment Program staff will supervise the project and have substantial input into its design.

1.5. Deliverables

The project will produce an evaluation of candidate reference points and harvest control rules, expanding on the existing Stock Synthesis simulation model for bigeye, and a report summarizing the results, to be presented to the SAC.

1.6. Challenges expected

The bigeye stock assessment is complex and computationally demanding, and may require prohibitive amounts of computational time to conduct the simulations using a full assessment model. It may therefore be necessary to simplify the assessment model or purchase more cloud-based computational resources.

1.7. Management benefit

The results of the project are expected to inform the Commission about the appropriateness of the current TRPs, LRPs and HCR compared to alternatives, and to help guide the Commission in the adoption of a permanent HCR and its components. The tools developed during the project will useful for future MSE research that could include yellowfin and an evaluation of yellowfin and bigeye combined, to better simulate the current HCR.

1.8. Budget

Project: Management Strategy Evaluation		**Duration: 1 year**	**Cost**
Item	**Detail**		**(US$)**
Full-time researcher			132,000
Computer equipment			20,000
Travel			10,000

Total (excluding staff time)		**162,000**
Staff time	Definition of the testing set of operating models; guidance and supervision	10% FTE[1]

2. RELATIONSHIP BETWEEN VESSEL OPERATIONAL CHARACTERISTICS AND FISHING MORTALITY

2.1. Background

The constantly increasing capacity of the purse-seine fleet in the EPO requires more stringent management measures. Extending the closures of the fishery, in force since 2004, beyond the current 62 days is not acceptable to all Members of the Commission, and alternative measures have been investigated. In 2017, catch limits by purse-seine set type have been applied, in addition to the closure.

2.2. Statement of the problem

The staff has recently received a growing number of requests for further analyses of alternative management measures. In addition, the measure of fishing capacity used to determine the days of closure needed to meet the conservation target is somewhat simplistic, and a more precise measure of capacity, and the relationship between capacity and fishing mortality, need to be investigated. Also, the relationship between the number of FADs deployed and catches needs to be better understood. The staff has conducted some initial analyses, but does not have the time or resources to undertake the in-depth investigations necessary to meet these requests. More thorough analyses need to be carried out, and the most effective solution would be to hire a full-time researcher to address several related projects that require quantitative analysis, described below. This will take at least two years, because it takes time to understand the data, determine appropriate methodologies, and carry out the analyses.

2.3. Objectives

This proposal aims at responding, through an integrated investigation, to a series of management-related research requests recently made to the IATTC staff:

1. Evaluate the reliability of the data obtained on identification of FADs (per paragraphs 2-4 of Section 1 of Resolution C-16-01).
2. Investigate methods to determine purse-seine set type from data currently collected by the AIDCP On-Board Observer Program, from vessel logbooks, from canneries, and from the IATTC port-sampling program (per recommendation of the meeting of the Ad Hoc Working Group on FADs in May 2017).
3. Evaluate the relationship between catch and number of FAD deployments (a continuation of work presented in Document SAC-08-06d).
4. Investigate more precise measures of fishing capacity that take into consideration days fished, set type, and vessel efficiency (related SAC Recommendation 13, Document IATTC-92-04c).
5. Investigate the relationship between fishing mortality and fleet capacity (related to SAC Recommendation 13, Document IATTC-92-04c).
6. Evaluate alternative management measures such as closed areas, individual vessel limits, and gear restrictions (related to SAC Recommendation 13, Document IATTC-92-04c).

2.4. Work plan

The work will be carried out over two years by a new full-time fixed-term employee in the Stock Assessment Program, starting in January 2018. The two-year period is necessary to allow the researcher to initially become familiar with the data and carry out the analyses. Initial analyses of the data during the first year will lead to new insights and to further analyses to improve the staff's management advice

[1] Full-time equivalent

in the second year. Recommendations for additional data collection may also result from this work.

Preliminary results related to the objectives considered most important will be presented at the meeting of the Scientific Advisory Committee (SAC) and the Commission's annual meeting in 2018, and the final results at the corresponding meetings in 2019 and 2020.

2.5. Deliverables

Multiple reports for the meetings of the SAC and the Commission, including recommendations on tuna conservation and possibly on improvements to data collection. Software will be created that can be used to update the analyses with new data and/or alternative assumptions and new methods.

2.6. Challenges expected

The data may not be sufficient to meet the research objectives. For example, the FAD identification data may not allow FADs to be tracked reliably over their lifetime. In such cases, recommendations will be provided to improve the data collection for future analyses.

2.7. Management benefit

The results of the project will enable the staff to develop alternative recommendations for managing tropical tunas in the EPO, and provide the Commission with additional tools when developing management measures.

2.8. Budget

Project: Vessel characteristics and fishing mortality	**Duration: 2 years**	**Cost (US$)**	
Item	**Detail**	**Annual**	**Total**
Full-time researcher		104,000	208,000
Travel		5,000	10,000
Computer equipment		-	5,000
Total (excluding staff time)		**109,000**	**223,000**
Staff time	Guidance on data, analyses; report writing	20% FTE	40% FTE

3. WORKSHOP TO ADVANCE SPATIAL STOCK ASSESSMENTS OF BIGEYE TUNA IN THE PACIFIC OCEAN

3.1. Background

Properly accounting for the spatio-temporal distribution of both fishing effort and fish abundance has been one of the largest sources of uncertainty ignored in most stock assessments, which typically assume a closed, well-mixed population. Of particular concern are changes in spatial distribution over time due to movement of the stock, recruitment dynamics, and/or local depletion. Substantial progress has been made in both the statistical methodology and the practical implementation (*e.g.* software) of spatial stock assessment models: for instance, the Western and Central Pacific Fisheries Commission uses spatial models to develop management advice for its major fisheries.

Tagging data show substantial directional movement of bigeye tuna in the EPO. However, the current stock assessment model for bigeye lacks spatial structure, and does not explicitly take local depletion into account, thus resulting in apparent regime shifts in the estimated recruitment. Therefore, a spatial model should be investigated for assessing the bigeye stock.

3.2. Statement of the problem

The staff is developing a spatial stock assessment model for bigeye, but there are specific issues related to the use of such models and their performance that have to addressed, which could benefit from experience gained in other applications. Focused discussions and coordinated research among

experienced researchers are needed to make the most of this modelling technique.

3.3. Objectives

The objective of the workshop is to bring together researchers to present and discuss the development and application of spatial stock assessments.

The staff will apply the knowledge gained about the use of spatial models for assessing other stocks or species, and any subsequent coordinated research, to the development of a spatial assessment model for bigeye tuna in the EPO, which could be used in the future to assess other tuna stocks.

3.4. Workplan

The workshop, to be held in fall 2018 at the Southwest Fisheries Science Center in La Jolla, will form part of the successful series organized by the Center for the Advancement of Population Assessment Methodology (CAPAM). The format will be similar to previous workshops, with invited speakers, ample presentation and discussion time, focus questions, and an expert chair, but the topic will be more focused and the number of participants smaller. It will include five talks by invited speakers (1 hour each, including questions), and several presentations relevant to the topic by other speakers (30 minutes each, including questions). There will be ample time for discussion after each presentation, and dedicated discussion sessions for each topic. The staff will develop focus questions prior to the workshop, help promote discussions, maintain focus on the topic, and coordinate writing the workshop report. The presentations and discussions will take two to three days, with two additional days dedicated to applying the methods to one or more stocks. After the conclusion of the workshop several manuscripts will be prepared for a special issue of a scientific journal.

3.5. Deliverables

The staff will develop a workshop report as a permanent record of the presentations, discussions, and recommendations. Research presented at the workshop will be published in a special issue in a peer-reviewed journal.

3.6. Challenges expected

Not all the preferred invited speakers may be able to attend, due to other commitments, scheduling conflicts, etc. Alternative invited speakers on each topic will be identified.

3.7. Management benefit

The knowledge gained will be used to improve the stock assessments of tunas in the EPO, and thus enable the staff to provide more accurate management advice to the Commission.

3.8. Budget

Project: Workshop on spatial stock assessments	**Duration: 1 week**	**Cost (US$)**
Item	**Detail**	
Workshop expenses	Invited speakers, travel and accommodation	
	Incidental meeting costs	
Total (excluding staff time)		50,000
Staff time	Organizing and coordinating workshop	20% FTE

4. ANALYSES OF THE EFFECTS OF FISHERIES TARGETING ON LONGLINE CPUE STANDARDIZATION

4.1. Background

The EPO stock assessments for bigeye tuna and yellowfin tuna depend critically on indices of relative

abundance computed from longline data, in part because of the difficulty of accurately estimating fishing effort for the purse-seine fishery. Previously these indices of relative abundance have been computed from aggregated longline data of the Japanese fleet, which provide only limited information on fishing gear characteristic and no information on vessel behavior. However, recent analyses of operational-level longline data have identified potential changes in targeting that may affect the indices of relative abundance computed from aggregated data, thereby compromising the management advice provided based on assessment results. The changes in targeting appear to be related to changes in longline gear configuration. Evaluating and adjusting for changes in targeting is an essential aspect of CPUE standardization to obtain reliable indices for stock assessment modeling and to improve the quality of management advice provided by the IATTC staff to the Commission.

4.2. Statement of the problem

There are two issues with respect to development of improve indices of relative abundance from longline data. First, the longline data for the EPO that are currently provided to the IATTC are aggregated and do not contain all the gear information that needs to be taken into consideration when developing the best models for CPUE standardization. Operational-level longline data are only made available in La Jolla to IATTC staff during visits by a National Institute of Far Seas Fisheries (NRIFSF) scientist. Second, there is presently inadequate subject-matter knowledge about details of recent longline configurations and fishing practices, and how different combinations of variables such as branchline length, floatline length, distance between hooks and number of hooks between floats, can lead to substantive changes in the targeting potential of a longline. In combination, these two issues make it impossible to evaluate and adjust for any recent changes in fishing behavior on the indices of relative abundance for bigeye and yellowfin tuna used in the EPO stock assessment models.

4.3. Objectives

There are two objectives of this study. The first is to develop a solid subject-matter understanding of longline configurations and how those may potentially allow for targeting of different species. The second objective is to evaluate the effect of potential changes in targeting on the indices used in the EPO stock assessment models by conducting a thorough analysis of Japanese longline operational-level data.

4.4. Work plan

Fall 2017 – The NRIFSF will conduct a survey of longline fishermen to develop a better understanding of recent changes in longline gear configurations and how the fishermen adapt the various components of longline gear to target different species. Anticipated cost: US$ 2,000.

January – March 2018 Detailed analysis of operational-level longline data by IATTC and NRIFSF staff at the IATTC office in La Jolla[2]. Anticipated cost: US$ 21,000 for one NRIFSF scientist to spend three months

[2] In using the longline operational data, IATTC acknowledges that IATTC staff can use the data under the following conditions;

1. Participants in the collaborative work:
   Dr. Keisuke Satoh (staff of National Research Institute Far Seas Fisheries, Japan); Email: kstu21@affrc.go.jp
   Dr. Cleridy Lennert-Cody (IATTC staff); Email: clennert@iattc.org
   Dr. Carolina V. Minte-Vera (IATTC staff); Email: cminte@iattc.org
2. The usage of the data is strictly limited to the purpose of this collaborative work;
3. The data can be used only during this collaborating work;
4. The data shall be held in one PC of each participant listed in 1, and any copy of the data from the PCs is not permitted except for the condition indicated below 5;

in La Jolla.

4.5. Deliverables

May 2018: A document will be presented at the IATTC SAC Meeting that summarizes the results of the fishermen survey and the detailed analysis of the operational-level longline data.

4.6. Challenges expected

The operational-level longline data base is very large and it is anticipated that creative data analysis and computational methods may be necessary, given the time constraint of three months to conduct the analyses.

4.7. Management benefits

Improved indices of relative abundance, that are not compromised by changes in targeting, will result in more reliable stock assessments and hence better management advice.

4.8. Budget

Project: Targeting and CPUE standardization	**Duration: 3 months**	**Cost (US$)**
Item	**Detail**	
NRIFSF scientist visit to IATTC HQ	Travel and 3 months' accommodation	21,000
Survey of fishermen		2,000
Total (excluding staff time)		**23,000**
Staff time	Guidance on data, analyses; report writing	25% FTE

5. IMPROVING DATA COLLECTION AND STOCK ASSESSMENTS FOR SHARKS IN THE EPO

5.1. Background

In the EPO sharks are caught in a large variety of fisheries, as targeted or incidental catch in the multi-species and multi-gear artisanal fisheries of coastal nations, and as bycatch in the industrial tuna purse-seine and distant-water longline fisheries. Therefore, under the Antigua Convention, some species of sharks are subject to monitoring, assessment, and if warranted, conservation and management by the IATTC. Specifically, Resolution C-16-05 requires the scientific staff to "*develop a work plan…, for completing full stock assessments for the silky shark … and hammerhead sharks ...*"

Because of their life history characteristics, shark populations are particularly vulnerable to fishing pressure, and thus there is a critical need for stock assessments of some species of sharks to better inform their management and conservation in the EPO. The IATTC staff has attempted to develop conventional stock assessments and/or simpler data-limited approaches (*e.g*. stock status indicators, Ecological Risk Assessment (ERA)). However, these efforts have been greatly handicapped by major data deficiencies, particularly species-specific catch and key biological parameters.

Without reliable catch estimates, indices of abundance, and size composition data, by species, for all fisheries catching sharks in the EPO, any attempts at future assessments are problematic. Therefore, improving shark fishery data collection in the EPO is essential.

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5. After the end of collaborative work period, all operational data (except that of attendee's originally own) and intermediate work files which can reconstruct operational data should be completely deleted from the PCs indicated on above 4, and NRIFSF staff copy those data and work files to external portable file storage for use in subsequent collaborative analysis; and
6. Any document or presentation derived from the result of this collaborating work should be provided beforehand to Japanese Fishery Agency and NRIFSF scientist.

The IATTC staff has identified four general fishery components in the EPO that catch shark species of conservation concern to the Commission (Resolution C-16-05): (1) longline and gillnet fisheries of EPO coastal Members (SAC-07-06b(iii); SAC-08-07e); (2) large-scale distant-water tuna longline fishery (SAC-08-07b; SAC-08-07e); (3) small[3] purse-seine vessels (SAC-08-06a); and (4) large purse-seine vessels (SAC-08-07a). The AIDCP On-Board Observer Program currently provides catch data for fishery component (4). Although the staff has reiterated recommendations for data collection for fishery components 2-4, improving data collection for fishery component (1) is the top priority due to the apparent dominance of these fisheries in terms of the total EPO shark removals.

Some progress towards obtaining comprehensive, reliable data for fishery component (1) has been made through a project funded by the FAO-GEF Common Oceans (ABNJ) program. During the first phase (2014-2016) of that program, the staff created a database to store existing data for this fishery component from all sources that could be found, identified a series of challenges for collecting shark data in the EPO, and provided recommendations for improvement (SAC-07-06b(iii)). The database greatly increased the knowledge of the general magnitude of shark catches by fishery component (1), but it is still incomplete with respect to species-specific catch information. During the second phase (2017-2018) of the project, a design for a long-term shark fishery sampling program in the EPO will be developed, and presented at the SAC meeting in 2019.

5.2. Statement of the problem

The question as "to what extent is sustainability being embedded in project activities and results?" was raised at the most recent mid-term evaluation of the FAO-GEF project. The tuna-RFMO is expected to "own and sustain" the project results after its completion. At present, no funds are available to implement and sustain the sampling design for fishery component (1) that will be delivered by the staff in late 2018. Without such funding, the design cannot be implemented, which in turn means that conventional stock assessments and data-limited approaches for developing stock status indicators will still face great challenges. The staff is seeking funds to implement a 4-year catch sampling program for fishery component (1) to begin in 2019 following the conclusion of the FAO-GEF project. Data from this sampling program will be used to improve conventional assessments and data limited approaches for developing stock status indicators.

5.3. Objectives of study

The three specific objectives of the study are:

1. Implementation of the recommendations for a long-term shark sampling program for the Pacific longline and gillnet fisheries in Central America;
2. Development of a conventional stock assessment for the silky shark;
3. Development of ERA tools and stock status indicators for hammerhead sharks.

5.4. Work plan

Task 1: Implementation of the sampling design in Central America (2019-2022), as recommended in Document SAC-07-06b(iii), following the design to be developed in component (2) of the FAO-GEF project.

Task 2: Development of conventional stock assessments and stock status indicators for the silky shark (2022).

Task 3: Development of ERA tools and stock status indicators for hammerhead shark species, using the Sustainability Assessment for Fishing Effects (SAFE) approach (2020-2022). This will involve developing

[3] Carrying capacity ≤ 363 t

models of species distribution relative to fishing effort, using data collected in Task 1 and existing catch records across all fisheries in the EPO. The outcome will be a quantitative measure of risk, using clearly defined biological reference points. An ERA graphical user interface (GUI) will be developed and made available to the public.

5.5. Deliverables

Task 1: IATTC-OSPESCA database with data collected during the four-year sampling program in Central America, to be made available for stock assessment and/or ERA/indicator work;

Task 2: Conventional stock assessments and stock status indicators for the silky shark;

Task 3: Quantitative ERA for data-limited species, particularly hammerhead sharks

5.6. Challenges expected

Ideally, stock assessments of sharks should be based on long time series of data, due to the longevity of many shark species. The IATTC staff will attempt to construct a historical time series of catches for the silky shark for at least one generation, using existing data sources. However, these data are incomplete, and thus a conventional stock assessment may still be problematic. In addition, logistical challenges may arise during the implementation of the new sampling program.

5.7. Management benefit

A properly designed and implemented sampling program for shark fisheries in Central America will provide comprehensive, reliable data for conventional stock assessments, ERAs and fishery indicators for silky and hammerhead sharks in the EPO. Since the shark fisheries in the EPO catch other species of interest to the IATTC, the data will also provide a scientific basis for management of such species.

5.8. Budget

Project: Shark data collection & assessments	**Duration: 4 years**	**Cost (US$)**	
Item	**Detail**	**Annual**	**Total**
Task 1[4] (2019-2022)	Implementation of sampling design for shark fisheries in Central America	238,000	952,000
	External consultant to develop ERA GUI	-	60,000
Total (excluding staff time)			**1,012,000**
Staff time:			
Task 1 (2019-2022)	Supervision	10% FTE	40% FTE
Task 2 (2022)	Develop conventional stock assessment for silky shark		25% FTE
Task 3 (2020-2022)	Develop quantitative ERA for data-limited species, particularly hammerheads		25% FTE

6. EVALUATION OF POTENTIAL REFERENCE POINTS FOR DORADO (*CORYPHAENA HIPPURUS*) IN THE EPO

6.1. Background

Dorado (*Coryphaena hippurus)* is widely distributed throughout the tropical and subtropical waters of the world's oceans. It is one of the most important species caught in the artisanal and recreational fisheries of the coastal nations of the EPO, from Chile in the south to Mexico in the north. Recent annual catches of dorado in the EPO are around 71 thousand metric tons (t), representing between 47 and 70%

[4] Estimates obtained from the operation of the ongoing FAO-GEF shark sampling program

of the total world catches of this species. The IATTC staff, at the request of coastal State Members, facilitated collaborative regional research that resulted in three technical meetings in 2014, 2015, and 2016. The available data were considered sufficient to conduct an exploratory stock assessment for the "core" of the dorado stock (SAC-07-06a(i)), as well as an exploratory management strategy evaluation (MSE) for the South EPO (SAC-07-06a(ii)). The data for the North EPO are more limited, handicapping the use of conventional stock assessments. The staff has developed a monthly depletion estimator approach that could be used as a basis for management advice in such data-limited situations if CPUE data are available.

6.2. Statement of the problem

The precautionary approach to fisheries management provides a basis for the sustainable management of marine resources. The development of reference points (RPs) and harvest control rules (HCRs) in fisheries worldwide has been motivated by both the precautionary approach and by Marine Stewardship Council's (MSC) criteria for certifying fisheries. Some coastal State Members of the IATTC, are interested in obtaining MSC certification for their dorado fisheries, and have requested guidance in developing of RPs and HCRs. Other Members are seeking guidance regarding data collection, research efforts, and management options.

6.3. Objectives

The objective of this project is to build upon the previous collaborative work, continue to develop stock assessment methodologies, and expand the MSE for dorado by evaluating alternative reference points and harvest control rules.

6.4. Work plan

The performance of alternative assessment methods, HCRs and RPs will be evaluated by simulation methods, using the Stock Synthesis platform, building on work to date. Candidates for the different components of a management strategy (data, assessment method, HCR, RPs) and the performance measures to judge such strategies will be identified. Some harvest strategy options will include minimum size limits, with and without precautionary lower CPUE levels that would trigger management actions. Alternative RPs will be developed with yield-per-recruit considerations, as well as alternative expected reductions of recruitment without fishing (R_0) and unfished biomass (B_0). Other alternatives could also be evaluated.

The work will be conducted during a 6-month period, mostly by a researcher hired for the project, but the IATTC Stock Assessment Program staff will have substantial input into the design of the project.

6.5. Deliverables

The study will produce:

1. a list of candidate RPs and HCRs to be tested using a management strategy evaluation (MSE) framework;
2. a simulation study to evaluate candidate HCRs and RPs;
3. a written report summarizing the results; and
4. a presentation of the report to the SAC meeting in 2018.

The tools developed during the project will be used in future MSE research.

6.6. Challenges expected

Although significant progress has been made towards understanding the dynamics of the dorado stock, fishery, and management, there is uncertainty regarding the relationship of stocks south and north of

the equator. Also, management could be complicated by potential differences among the Members regarding the implementation of HCRs and RPs.

Given the expected timeline for the project and budget constraints, this proposal does not include a research plan to address stock structure hypotheses, or a substantive consultative process necessary to develop candidate HCRs and reference points that can be agreed to be implemented to manage the fisheries (other than travel by project members). However, alternative RPs and HCRs will be evaluated, and their respective advantages and disadvantages will be discussed, to assist Members considering the implementation of reference points and harvest control rules for dorado.

6.7. Management benefit

The results of the project, such as alternative estimates of stock status (*e.g.* assessments, depletion estimator), reference points, and harvest control rules, could be used by the Commission, or by individual Members, in developing, adopting, and subsequently modifying as necessary, a harvest strategy for dorado.

6.8. Budget

Project: Evaluate reference points for dorado	**Duration: 6 months**	**Cost (US$)**
Item	**Detail**	
Full-time researcher		66,000
Computer equipment		5,000
Travel		10,000
Total (excluding staff time)		**81,000**
Staff time		10% FTE

7. ELECTRONIC MONITORING OF PURSE-SEINE VESSEL ACTIVITIES AND CATCHES

7.1. Background

For the IATTC to meet its scientific responsibilities for management under the Antigua Convention, high-quality data on vessel activities and on catches of target and non-target species are needed for all purse-seine fleets operating in the EPO. The AIDCP On-Board Observer Program collects detailed data for all trips by Class-6 (“large”) purse-seine vessels. However, trips by Class 1-5 (“small”) vessels are rarely sampled by observer programs, and the vessel logbook and cannery data do not provide information on tuna discards, are not available in near real-time, and do not always include complete non-target species catch data. This lack of information for small vessels hampers the near real-time monitoring efforts necessary to evaluate compliance with management measures and to conduct assessments for non-target species. Furthermore, increasing the amount of data collected by observers for compliance purposes impacts the observers’ ability to collect the basic biological and catch data that are essential for assessments for both target and non-target species.

The use of Electronic Monitoring (EM) systems to record the activities of ocean fishing fleets is increasing around the world. The technology is evolving rapidly, and using EM to assist with collection of fishery data could significantly improve compliance monitoring and the availability of catch and bycatch data for all components of the purse-seine fleet.

This proposal addresses a proof-of-concept EM project for the EPO purse-seine fishery, to be carried out during 2017-2019. EM is also being successfully used in longline fisheries in other oceans, and could therefore be a viable alternative to increasing observer coverage for the longline fleet in the EPO. Pilot studies of EM systems could be undertaken at the national level for both high-seas and coastal longline fleets.

7.2. Statement of the problem

The accuracy of EM for monitoring purse-seine catches and bycatches has not been unequivocally established. Comparisons of EM and onboard observer data from purse-seine fisheries in other oceans have shown a high correlation between counts from the two methods for large-bodied species, but a low correlation for small-sized species. Therefore, it is necessary to further evaluate what types of data can be reliably collected by EM aboard purse-seine vessels.

In addition, it remains to be determined whether small purse-seine vessels have suitable locations for placing EM equipment such as cameras. Previous studies have all been conducted aboard large purse-seine vessels, where there is sufficient space to place cameras aimed at wells being loaded via conveyor belts, and less chance of crew or structure obstructing the recording. Cooperation from fishers and vessel owners is key to the success of this project; in this regard, it will be very important to establish a good working relationship with fishers so as to benefit from knowledge they may have regarding placement of EM equipment aboard the vessels that will allow for optimum data collection and equipment life expectancy.

7.3. Objectives of study

The objectives of this EM project for purse-seine vessels are:

1. Identify what types of data can be collected by EM for compliance monitoring and catch and bycatch estimation, including data from cameras and various types of sensors;
2. Identify locations aboard large and small purse-seiners for mounting EM equipment, taking into consideration different brailing strategies and equipment configurations, and the types of sets typically made by the vessels;
3. Collect data aboard a variety of small and large purse-seine vessels using both EM and an on-board observer simultaneously;
4. Compare EM and observer data to obtain a preliminary evaluation of the utility of EM in the purse-seine fishery in the EPO;
5. If EM appears promising, develop a sampling design for a pilot study using EM for both small and large purse-seine vessels.

7.4. Work plan

The estimated timeline for the project is as follows:

1. October 2017: Hire researcher to assist with this project;
2. November 2017-January 2018: Investigate the capabilities of the various EM systems from different manufacturers and establish what types of data can be collected;
3. February-July 2018: Survey brailing procedures and equipment configuration of all purse-seine vessels, identify vessels willing to participate in the study, purchase EM equipment;
4. August 2018-January 2019: EM and observer data collection trips aboard small and large purse-seine vessels;
5. February-May 2019: Processing of EM data;
6. June-October 2019: Statistical comparisons of EM and observer data, writing of project report;
7. November-December 2019: Design pilot project, if warranted.

7.5. Deliverables

May 2018/2019/2020: documents/presentations for SAC meeting on project progress and findings.

November 2019: Project report.

January 2020: If applicable, a document describing the proposed pilot sampling design.

7.6. Challenges expected

Estimating catch composition by size and species is expected to be problematic because of the methods used to load fish into the vessel wells from the net. Different options for EM equipment and its placement will be considered to explore all possibilities.

7.7. Management benefit

The results of the project may be used by the Commission or its Members in the development of improved data collection options and compliance monitoring for all fleet components operating within the EPO.

7.8. Budget

Project: Electronic catch monitoring	**Duration: 2 years**	**Cost (US$)**	**Staff time**
Item	**Detail**		
Full-time researcher (one year)	Salary	55,000	
	Travel	16,500	
A. Preparatory work	Nov 2017 – July 2018		
Investigate equipment	Travel	9,000	15% FTE
Survey vessels	Observer salaries	4,500	25% FTE
	Travel	9,000	
Purchase equipment	EM equipment	78,000	
B. Data collection	Aug 2018 – Jan 2019		25% FTE
Observers	Travel	8,000	
	Salaries	9,000	
C. Data processing & analysis	Feb-Oct 2019		
Data, training, salaries		18,000	30% FTE
Statistical comparisons, writing report			40% FTE
Nov-Dec 2019 (if warranted): Design pilot project			30% FTE
TOTAL		**207,000**	

8. TESTING THE POTENTIAL OF SORTING GRIDS FOR REDUCING THE MORTALITY OF SMALL TUNAS AND OTHER SPECIES IN THE PURSE-SEINE FISHERY IN THE EPO

8.1. Background

The purse-seine fishery for tropical tunas is based on three types of sets: on dolphins, on unassociated tunas, and on floating objects. Sets on tunas associated with dolphins catch almost exclusively large yellowfin tuna, with little bycatch of small fishes. Sets on unassociated schools of tuna catch a wider range of sizes of tunas and of other species, while sets on floating objects frequently catch significant quantities of small tunas, as well as many other species often found associated with the floating objects.

Sorting grids are devices designed to allow individuals below a certain size to escape from a purse-seine net. They consist of a framework of horizontal and vertical separators, forming a grid, with the height and width of the "cells" of the grid determined by the characteristics of the individuals that will pass through it. When tunas are captured, then individuals below the size dictated by commercial or regulatory conditions should be able to pass through the grid and escape. Fish may be injured in the process and not survive passing through the grid, therefore experiments to quantify survival rates are also necessary.

8.2. Statement of the problem

In purse-seine sets, catches of small tunas, and bycatches of non-target species, pose both practical and conservation problems. Small tunas are less valuable commercially than large fish, and many bycatch species have no commercial value; also, catching small tunas can adversely affect the sustainability of the fishery, and potentially of the stock in question. It would therefore be desirable to be able to release these unwanted fish from the net alive, while not losing the catch of larger, more valuable fish, particularly in sets on floating objects.

However, the main target of the floating-object fishery is skipjack tuna, the smallest of the tropical tunas, and the adults of that species are often smaller than the juvenile bigeye and yellowfin generally caught in that type of set, so size-based selection by a sorting grid would not reduce the catches of those juveniles. However, sorting grids could still have benefits to mitigate impacts of the fishery by allowing smaller bycatch species to escape.

Sorting grids have been tested in the past, and useful information is available on their design and use, but not in properly-designed comparative experiments with controls, and statistical analyses of the results are hampered by low sample sizes and variability in the design and use of the grids.

8.3. Objectives

The main objective is to develop a modification of the purse-seine net that could be used in sets on floating objects to allow the escape of small tunas and of non-target species. The questions to be answered are: a) is the proportion of small tuna lower in sets in which a sorting grid is used?; and b) are the bycatches different in tonnage, species composition, or size composition if a sorting grid is used?

8.4. Work plan

The aim is to start testing sorting grids on at least 10-15 purse-seine vessels fishing in an area and at a time with a high range of variability in tuna sizes (initially the Equatorial region, west of the Galapagos Islands, in the second semester of 2018) to produce a sample of at least 100-150 sets during June-October. The choice of vessels and time periods will be determined by the need to get experimental and control samples in the same time-area strata.

The estimated timeline for the project is as follows:

1. November 2017: Hire a project coordinator, to begin work in May 2018. Meet with vessel captains who have used sorting grids of different designs (materials, construction, location, dimensions), and select a design to use in the experiment (other designs may be tested in the future).
2. May-June 2018: Build replicates of the experimental unit and install in those vessels and at those times that will meet the need for experimental and control samples in the same time-area strata.
3. July-December 2018: Observers on experimental and control vessels collect data on catches and bycatches. Length-frequency data will be collected in port. Underwater video cameras will be used in a sample of experimental trips to record the performance of the grid.
4. August-November 2019: Data analyses and reporting. If supported by the results, consider alternative designs, and plan a second experiment.

8.5. Deliverables

May 2018/2019/2020: documents/presentations for SAC meeting on project progress and findings.

A document presenting the results of this study will be published in late 2019-early 2020.

8.6. Expected challenges

Previous tests with sorting grids were of limited value because the design, location in the net, and use of the grids were not standardized, so statistical analysis of their effectiveness was not possible. Also, no controls were available for comparisons.

Fishing captains will not accept using the grids if they impair the vessel's maneuvers or weaken the net, or if the conditions for their use affect catches. Therefore, communication with captains and vessel owners is key to the success of the project. Also, observers will need additional training to monitor and report on the use of the grids.

8.7. Budget

Project: Sorting grids	**Duration: 2 years**	**Cost (US$)**
Item	**Detail**	
Local coordinator	Salary (May 2018-Feb 2019)	18,000
Port sampler	Salary (May 2018-Feb 2019)	18,000
Office and electronic equipment		8,000
Field equipment		4,000
Underwater cameras (3)		7,000
Observer training and training materials		3,000
Construction of grids, materials and labor		15,000
Travel, La Jolla staff		21,000
Local expenses		6,000
Total (excluding staff time)		**100,000**
Staff time:		
Data analyses and reporting, consideration of alternative designs, plan second experiment		40% FTE
Observer training, coordination with industry		10% FTE