**INTER-AMERICAN TROPICAL TUNA COMMISSION**

**SCIENTIFIC ADVISORY COMMITTEE**

# 15TH MEETING

**La Jolla, California (USA)**
**10-14 June 2024**

# DOCUMENT SAC-15 INF-E.a

## STAFF ACTIVITIES AND RESEARCH PLAN

This document is an update of Document IATTC-101-02a, which summarized the IATTC scientific staff's work plans for 2019-2023 and its current and planned research activities under the Strategic Science Plan. Projects proposed but pending funding are listed in Document SAC-15 INF-E.b.

## CONTENTS

| | |
|---|---|
| **INTRODUCTION** | |

This document presents the staff's research and work plans, as well as brief summaries of the 66 research projects that are currently under way, or planned for the near future and funded under the 5-year Strategic Science Plan (2019-2023). The summaries include, for each project, background information, a work plan, and a progress report, as well as details of its relevance and purpose, external collaborators, duration, and deliverables; also, for existing projects, an update on activities since the previous year's report (the 'reporting period'; March 2023- March 2024- in this report).

At its 101st meeting, the IATTC decided that the 2019-2023 SSP should be extended for one year (2024) so that the ongoing projects could be fully implemented, in particular the benchmark stock assessments for yellowfin, bigeye and skipjack, as well as a proposed harvest strategy for bigeye. All this work was planned

for 2024 when the Commission will discuss and adopt new conservation measures for tropical tuna. Considering that the 5-year cycle (2019-2023) of the current SSP had been planned to conclude in 2023, the staff had planned to propose the elements of the next SSP to the Commission in 2024. However, taking into to account the staff's heavy assessment workload planned for tropical tuna in 2024, the Commission supported that a new SSP be presented and discussed in 2025. This upcoming discussion should consider both the achievements and shortcomings of the previous 2019-2023 SSP.

Under the SSP, the staff's research activities are no longer structured in accordance with the Commission's four research programs[1], as they were prior to 2018. Instead, they are classified into the seven main areas of research, called *Themes*, of the Strategic Science Plan (SSP; IATTC-93-06a)*.* In addition to better accommodating a strategic planning approach, this new structure is intended to foster stronger collaboration among the different programs (recommendation 17 of the 2016 IATTC Performance Review), with researchers from different programs contributing to activities under a common *Theme*. The seven *Themes,* the strategic pillars of the SSP, are the following:

Data collection for scientific support of management
Life history studies for scientific support of management
Sustainable fisheries
Ecological impacts of fishing: assessment and mitigation
Interactions among the environment, ecosystem, and fisheries
Knowledge transfer and capacity building
Scientific excellence

Each *Theme* is divided into strategic *Goals*, and the principal tasks that will be carried out to achieve a particular goal within the SSP's five-year window are called *Targets* (IATTC-93-06a). The specific activities that the staff will carry out in order to fulfil those tasks are called *Projects*, which are in some cases grouped into *Work Plans* aimed at achieving a broad objective not limited to a particular *Theme* or *Goal*.

The general *Themes*, and the more specific *Goals*, reflect the staff's principal activities in carrying out the responsibilities it is assigned by the Commission, and form an integral part of the five-year SSP. The more focused *Targets*, and the concrete *Projects*, are generally of shorter duration, and operate on a biennial cycle. Whether any *Projects* are undertaken under a particular *Goal* or *Target* in any given period will depend on the staff's research priorities, the human, logistic, and financial resources available, and any specific instructions from the Commission.

A measure of the staff's activities is the presentation of its research and the resulting publications. Presentations and publications from 2019-2023 are listed in Section F.

Since the previous report to the Commission in 2023, the following projects have been completed; details in Section G. Details of previous research projects completed under the SSP can be found on the IATTC website here.

| C.1.a | Purse-seine catch composition bias estimation |
|-------|-----------------------------------------------|
| H.1.a | Improve the bigeye tuna stock assessment phase 2 |
| H.1.f | Improving the methodology of the risk analysis |
| H.7.b | South Pacific swordfish assessment |
| M.2.a | Evaluate the post-release survival of silky sharks captured by longline fishing vessels in the equatorial EPO, using best handling practices |

[1] Stock Assessment; Biology and Ecosystem; Data Collection and Database; Bycatch and International Dolphin Conservation Program (IDCP)

| L.2.b | Vulnerability assessment of elasmobranch bycatch in the EPO tuna fisheries using the EASI-fish approach |
|---|---|
| L.2.e | Vulnerability assessment and efficacy of potential conservation measures for the east Pacific leatherback turtle stock |
| M.5.a | Develop and test non-entangling and biodegradable FADs |
| X.1.a | Workshop on fisheries stock assessment good practices |

Proposals for projects pending funding are listed in Document SAC-15 INF-E.b.

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|---|---|
| **H.1.d:** Improve indices of abundance based on longline CPUE data | |
| **H.1.e:** Construct indices of abundance and composition data for longline fleets | |
| | |
| **H.3.a:** Analysis of recent skipjack tagging data | |
| **H.3.b**: Skipjack Stock assessment | |
| **H.3.c:** Estimate skipjack growth rates from recent tagging data | |
| **H.4.a:** Conduct routine stock assessments of tropical tunas | |
| **H.6.a:** Participate in assessments of shared species by the International Scientific Committee (ISC) | |
| **H.7.a:** Pacific-wide exploratory assessment for bigeye tuna | |
| **H.7.c:** Participate in south Pacific albacore assessment | |
| **H.8.b:** Second trial dolphin survey | |
| **H.8.c:** Cow-calf separation | |
| **I.1.a:** Conduct a Management Strategy Evaluation (MSE) for tropical tunas in the EPO | |
| **J.1.a:** Temporal trends and variability in the spatial distribution of tropical tuna purse-seine fishing | |
| **J.1.b (new):** Changes in catches and fishing strategies related to the Individual Vessel Threshold (IVT) program | |
| **J.1.c (new):** Evaluation of empirical and potential impacts of "El Corralito" | |
| **J.2.a:** Quantify the relationship between vessel operational characteristics and fishing mortality | |
| **J.2.b:** Identifying operational characteristics associated with mobulid bycatch in the eastern Pacific Ocean | |
| **J.3.a:** Developing alternative buoy-derived tuna biomass indexes | |
| **K.1.a:** POSEIDON project | |
| **4. ECOLOGICAL IMPACTS OF FISHERIES: ASSESSMENT AND MITIGATION** | 100 |
| **L.1.a:** Develop habitat models for bycatch species caught in the EPO to support ecological risk assessments (ERAs) | |
| **L.2.b:** Vulnerability assessment of shark bycatch in EPO tuna fisheries using the EASI-Fish approach | |
| **L.2.c:** Assessing the efficacy of potential management options for highly vulnerable shark species in the EPO | |
| **L.2.d:** Pacific-wide vulnerability assessment of pelagic shark species caught as bycatch in tuna fisheries | |
| **L.2.e:** Vulnerability assessment and efficacy of potential conservation measures for the east Pacific leatherback turtle stock | |
| **M.1.b:** Test sorting grids | |
| **M.1.c:** Acoustic discrimination to avoid purse seine catches of undersized yellowfin tuna | |
| **M.1.d:** Developing and testing bycatch release devices in tuna purse seiners | |
| **M.2.b:** Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation | |
| **M.2.c:** Manta and devil ray post-release survival, movement ecology, and genetic population structure | |
| **M.2.d:** Evaluating knowledge and data gaps to the implementation of best handling and release practices for vulnerable species in IATTC fisheries. | |
| **M.2.e:** Investigating post release survival of silky sharks captured in class 2-5 purse seine vessels | |
| **M.5.b:** Reducing losses, and fostering recovery, of FADs in the purse-seine fishery in the EPO | |

| | |
|---|---|
| **M.5.c:** Definition of guidelines to reduce the impact of lost and abandoned FADs on marine turtles | |
| **M.5.d (new):** Evaluation of new FAD biodegradable materials in the tropical marine environment | |
| **INTERACTIONS AMONG THE ENVIRONMENT, THE ECOSYSTEM, AND FISHERIES** | 132 |
| **N.1.b:** Investigate the effects of wind-induced microturbulence on yellowfin larval survival | |
| **N.1.c:** Developing dynamic species distributions models to inform conservation and management of non-target species and communities in the eastern Pacific Ocean | |
| **N.1.d (new):** Evaluate link between increased YFT catches environmental change | |
| **N.2.a.** Develop models of the effects of climate change on pre-recruit life stages of tropical tunas | |
| **N.2.b:** Supporting climate-ready and sustainable fisheries: using satellite data to conserve and manage life in the ocean and support sustainable fisheries under climate change | |
| **O.2.a:** Develop and implement analytical tools for understanding the trophic ecology of apex predators | |
| **O.2.b:** An updated ecosystem model of the tropical EPO for providing standardized ecological indicators for monitoring of ecosystem integrity | |
| **O.2.c:** Temporal network analysis of bycatch communities caught in purse-seine fisheries | |
| **O.2.d (new):** Develop a workplan for restructuring IATTC's *Ecosystem Considerations* into (1) an indicator-based EcoCard and (2) a complementary *Ecosystem Status Assessment* for the EPO | |
| **O.2.e (new):** Develop a workplan to promote climate resilient fisheries at IATTC | |
| **KNOWLEDGE TRANSFER AND CAPACITY BUILDING** | 149 |
| **P.1.a:** Fulfil requests for development of database and data processing applications for entities outside the IATTC | |
| **P.1.b:** Respond to requests for scientific analyses | |
| **Q.1.a:** Achotines Laboratory support of Yale University's Environmental Leadership Training Initiative (ELTI) in Panama | |
| **SCIENTIFIC EXCELLENCE** | 94 |
| **U.1.a:** Long-term plan to strengthen research at the Achotines Laboratory | |

## ASSESSMENTS OF TUNAS AND OTHER SPECIES CARRIED OUT BY THE IATTC STAFF

The staff's main responsibility is to analyze and assess the status of the stocks of tunas and tuna-like species in the EPO and provide scientific advice to the Commission to aid in its management decisions regarding these stocks. It prepares regular assessments of the principal species of tropical tunas (bigeye, yellowfin, and skipjack), and more occasional evaluations of other species, such as south EPO swordfish, silky shark and dorado, at the Commission's request. The staff also collaborates with the International Scientific Committee (ISC) for Tuna and Tuna-Like Species in assessments of North Pacific bluefin and North Pacific albacore tunas, and some billfish and shark species, and with other organizations, such as the SPC and WCPFC, for south Pacific albacore and Pacific-wide bigeye tuna assessment. It also conducts dolphin assessments for the AIDCP.

Three types of stock assessments are carried out: 1) **benchmark assessments** (previously called "full" assessments), in which all the major assumptions are reviewed and improved if necessary; 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 the latest benchmark or update assessment and indicators.

Stock assessment work since 2021 focused primarily on developing benchmark assessments of skipjack (SAC-15-04), bigeye (SAC-15-02) and yellowfin tunas for 2024. Unresolved issues with the yellowfin assessment prevented the completion of the benchmark assessment and an exploratory assessment was conducted (SAC-15-03). Management measures for tropical tunas were adopted for 2022-2024 (C-21-04). Stock status indicators are also available for the three tropical tuna species (SAC-11-05; SAC-15-INF-F). The risk analysis approach was applied to bigeye tuna (SAC-15-02).

| Species | SSP ref. | Last assessed | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| **IATTC** | | | | | | | | |
| Yellowfin tuna | H.4.a | 2024 exploratory 2020 benchmark | Indicators/ Update[2]/ Exploratory/ Review | Benchmark | Indicators | Indicators | Indicators, Exploratory assessment | Indicators, Exploratory assessment |
| Skipjack tuna | H.4.a | 2024 | Indicators | Indicators | Indicators, Review assessment methods | Interim assessment, indicators, Initial results of tagging analysis | Indicators, further analysis of tagging data | Benchmark assessment, tagging analysis, Indicators |
| Bigeye tuna (EPO) | H.4.a | 2024 | Indicators/ Exploratory/ Review | Benchmark | Indicators | Indicators | Indicators Exploratory assessment | Benchmark |
| Striped marlin | H.7 | 2010 | | | | | | |
| Swordfish (south EPO) | H.7.b | 2011 | | | | Benchmark | | |
| Sailfish | H.7 | 2013 | | | | | | |
| Black marlinP0 | | Never | | | | | | |
| Silky shark | H.7 | 2018 (EPO indicators/ Pacific-wide benchmark) | Indicators | Indicators | Indicators | Indicators | Indicators EASI-Fish vulnerability assessment | Indicators |
| Dorado | I.3.a | 2016 | Candidate RP and HCR | | | | | |

| Species | SSP ref. | Last assessed | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| **COLLABORATIONS** | | | | | | | | |
| Pacific bluefin tuna | H.6.a | 2024 benchmark | Projections | Benchmark | Projections | Update | Projections | Benchmark |
| North Pacific albacore tuna | H.6.a | 2020 | | Benchmark | | | Benchmark | |
| South Pacific albacore tuna | H.7.c | | | | Benchmark | | | Benchmark (ongoing) |
| Blue marlin | H.7 | 2013 benchmark/ 2016 update | | | Benchmark | | | |
| North Blue shark | H.6.a | 2017 | | | | | | |
| South Blue shark | | | | | | | | |
| Shortfin mako shark | H.6.a | 2018 | | | | | | |
| Swordfish (north Pacific) | H.7 | 2014 | | | | Benchmark | | |

## WORK PLANS

*Work Plans* combine research activities from different parts of the SSP to achieve certain broad scientific objectives that span more than one *Theme* or *Goal*. The following summary work plans list the specific *Targets* and *Projects* that are included, the time frame for carrying each one out, and their status.

## WORK PLANS TO IMPROVE STOCK ASSESSMENTS OF TROPICAL TUNAS

Assessing the status of the tropical tuna stocks is the scientific staff's main responsibility. The staff constantly seeks to improve both its conventional stock assessments and its stock status indicators. The workplan included external reviews of the assessments' data (RVDTT-01) and methodology (RVMTT-01) that were completed in 2023. New benchmark assessments are available for bigeye (SAC-15-02) and skipjack (SAC-15-04), and, due to unresolved issues in the yellowfin assessment, an exploratory assessment for yellowfin (SAC-15-03). A risk analysis was conducted for bigeye tuna to incorporate assessment uncertainty into the management advice (SAC-15-02) .

There are still some remaining issues with the yellowfin assessment and improvements can be made for the bigeye and skipjack assessments. In particular, the stock structure is still uncertain for the yellowfin tuna and needs to be addressed for the 2025 yellowfin benchmark assessment. The tagging analysis for skipjack can be improved and the method applied to bigeye and yellowfin.

Workplans were developed for each of the three species as outlined below to address the issues with the assessments and to allow improvements before the benchmark assessments were conducted in 2024 (updated to 2025 for yellowfin).

## WORK PLAN TO DEVELOP A STOCK ASSESSMENT FOR SKIPJACK TUNA

The staff completed a benchmark assessment for skipjack tuna in 2024.

Up until 2022, there was no stock assessment for skipjack tuna in the EPO and management advice was based on assumptions about the productivity and susceptibility of skipjack relative to bigeye tuna and the assessed status of bigeye. Management advice for skipjack was greatly improved when an interim assessment was available in 2022 (SAC-13-07). This year (2024) a benchmark assessment was conducted (SAC-15-04) and was an improvement over the interim assessment due to the inclusion of estimates of abundance from tagging data from recent tagging cruises (SAC-15 INF-G). The IATTC staff developed a workplan to implement the research needed to develop the tagging analysis and stock assessment. An index of abundance based on FAD echosounder buoy data has been developed (FAD-07-03, FAD-08-02) and was used in the stock assessment. A review of the skipjack assessment was conducted in 2022 (WSSKJ-01). The risk analysis will be applied to skipjack tuna in 2025.

**Main workplan deliverables**
2021 Review of assessment methods (SAC-12)
2022 Interim stock assessment and preliminary results of the tagging analysis (SAC-13)
2022 External review of the skipjack assessment and tagging analysis (WSSKJ-01)
2024 Benchmark assessment and results of the tagging analysis (SAC-15)
2025 Risk Analysis (SAC-16)

**TABLE 1.1.a.** Timeline for skipjack tuna workplan 2021-2024

| 2021 | | Status and reports |
|---|---|---|
| Fall: Initiate development of the tagging analysis | Project H.3.a | Initiated, SAC-13-08, SAC-14 INF-E |
| **2022** | | |
| Jan-Feb workshop on improving metrics and their scoring for the IATTC risk analysis and Nov-October workshop on model weighting. | Unfunded project H.1.g | Completed, WSRSK-01, WSRSK-02 |
| Conduct growth analysis | Project H.3.c | |
| Tagging cruise | | |
| May: Present interim assessment and preliminary results of the tagging analysis at SAC | | Completed, SAR-23 |
| Summer: Initiate development of the YPR analysis/stock assessment | Project H.3.b | Not done (perhaps delete or change to 2023 to improve assessment and integrate tagging results) |
| Summer/Fall: External review of stock assessment and tagging analysis | | Completed, WSSKJ-01 |
| **2024** | | |
| May: Present benchmark Assessment at SAC | | Completed, (SAC-15-04) |
| **2025** | | |
| May: Present Risk Analysis at SAC | | |

TABLE 1.1.b. Projects included in the skipjack tuna work plan, 2021-2024. **Green**: completed; **blue**: funded; **red**: unfunded; **pink**: partially funded (funded components completed, other components pending) **orange**: IATTC staff and/or collaborators. Text ~~struck through~~ indicates completed or terminated projects.

| SSP ref. | Target/Project | Timeframe & status | | | |
|---|---|---|---|---|---|
| | | 2021 | 2022 | 2023 | 2024 |
| | **1.  ASSESSMENT RESEARCH** | | | | |
| ~~H.3.a~~ | ~~Analysis of recent skipjack tagging data~~ | 🟩 | 🟩 | 🟩 | 🟩 |
| ~~H.3.b~~ | ~~Stock assessment~~ | | * | 🟩 | 🟩 |
| ~~H.3.c~~ | ~~Estimate skipjack growth rates from recent tagging data~~ | | 🟩 | | |
| J.2.a | Quantify the relationship between vessel operational characteristics and fishing mortality | 🟧 | 🟧 | | |
| ~~H.1.g~~ | ~~Workshop on improving metrics and their scoring for the IATTC risk analysis~~ | | 🟩 | | |
| ~~T.1.c~~ | ~~External review of skipjack assessment and tagging analysis~~ | | 🟩 | | |
| | **2.  NEW DATA SOURCES** | | | | |
| ~~E.4.a~~ | ~~IATTC Regional Tuna Tagging Program (RTTP) - EPO~~ | 🟩 | 🟩 | 🟩 | |
| | **3.  INDICES OF ABUNDANCE** | | | | |
| J.3.a | Developing alternative buoy-derived tuna biomass indexes | 🟧 | 🟧 | 🟧 | 🟧 |
| | **4.  ~~LIFE HISTORY DATA~~** | | | | |
| E.5.a | ~~Evaluate the Pacific-wide population structure of bigeye and skipjack tunas, using genetic analyses~~ | | 🟩 | | |

*Interim assessment conducted in 2022, benchmark in 2024

| WORK PLAN TO IMPROVE THE STOCK ASSESSMENT FOR YELLOWFIN TUNA |
|---|

The staff completed a benchmark assessment for yellowfin tuna in 2020 and another was planned for 2024. However, due to unresolved issues with the assessment, a benchmark was not completed in 2024 and an exploratory assessment was developed. A benchmark assessment is planned for 2025.

External reviews for data and modelling aspects of the tropical tuna stock assessments took place in 2023. Improvements in the yellowfin assessment were made to natural mortality, growth, and how fisheries are modelled. However, uncertainty remained in the stock structure. In 2024, an exploratory stock assessment was developed using these improvements that focus on data from the core area of the dolphin (DEL) fishery (SAC 15-03). Sensitivity to the assumption about the stock structure and the presence of large fish were also carried out. Stock status indicators based on DEL fishery and longline CPUE and mean length were evaluated for five areas to investigate the possibility of local depletion. Further research and data collection, particularly about stock and spatial structure, are needed to produce reliable assessments and management advice in the future. These research are outlined in the workplan timeline below.

**Previous results and main expected work plan deliverables**
**2021:** CAPAM natural mortality workshop (Workshop report)
**2022:** Risk assessment methodology: 1. Model diagnostics (Workshop report), 2. Model weighting (Workshop report)
**2023:** 1st workshop on data improvement: industrial longline fishery Advance the understanding of the longline data of different fleets and potential indices of abundance (WSDAT-01); Spatiotemporal models; CAPAM stock assessment good practices workshop (presentations);
**2023:** Explore alternative hypotheses of stock structure and life-history for YFT in exploratory stock assessment models Yellowfin tuna stock assessment: conceptual model and exploratory analyses (SAC 14-06) document); 1st external review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean (RVDTT-01); 1st external review on modelling aspects for stock assessments of tropical tunas in the eastern Pacific Ocean External review (RVMTT-01); CAPAM workshop on Tuna stock assessment good practices Best practices in stock assessment (presentations)
**2024:** Exploratory assessment and stock status indicators for yellowfin tuna in the EPO stock assessment model (SAC 15-03); Yellowfin and skipjack catch trends relative to ENSO events (SAC-15 INF-L); Echosounder buoy derived tropical tuna biomass indices in the EPO (FAD-08-02)
**2025:** Benchmark assessment and risk analysis

**Main expected work plan deliverables**
**TABLE 1.2.a.** Timeline for yellowfin tuna work plan, 20211-2025

| 2021 | |
|---|---|
| CAPAM natural mortality workshop | Completed |
| Longline work (pending data availability) | Ongoing H.1.e (ext) |
| **2022** | |
| Workshop on improving metrics and their scoring for the IATTC risk analysis | Completed H.1.g (unfunded) |
| Longline work (pending data availability) | Not funded H.1.e. (ext) |

| | |
|---|---|
| Spatiotemporal models | Ongoing<br>H.1.f |
| Preliminary spatial models | Ongoing<br>H.1.b phase 2 |
| **2023** | |
| External review | Completed as RVDTT-01<br>and RVMTT-01<br>T.1.b phase 2 |
| Exploratory models | Ongoing<br>H.1.b phase 2 |
| **2024** | |
| Exploratory yellowfin assessment | Completed<br>(SAC 15-03) |
| **2025** | |
| Benchmark yellowfin assessment | |

**TABLE 1.2.b.** Projects included in the yellowfin tuna work plan, 2021-2024. **Green**: completed; **blue**: funded; **red**: unfunded; **pink**: partially funded (funded components completed, other components pending); **orange**: IATTC staff and/or collaborators. Text ~~struck through~~ indicates completed or terminated projects.

| SSP ref. | Target/Project | Timeframe & status | | | |
|---|---|---|---|---|---|
| | | 2021 | 2022 | 2023 | 2024 |
| **MONITORING STOCK STATUS AND MANAGEMENT ADVICE** | | | | | |
| H.4.a | Conduct routine stock assessments of tropical tunas and indicators | 🟧 | 🟧 | 🟧 | 🟧 |
| J.2.a | Quantification of the relationship between vessel operational characteristics and fishing mortality | | 🟦 | 🟦 | 🟦 |
| | **ASSESSMENT RESEARCH** | | | | |
| H.1.b | Improve the yellowfin tuna stock assessment phase 2: Explore alternative hypotheses of stock structure and life-history for YFT in exploratory stock assessment models | 🟧 | 🟧 | 🟧 | 🟧 |
| ~~X.1.c~~ | ~~CAPAM workshop on natural mortality~~ | 🟩 | | | |
| ~~H.1.g~~ | ~~Workshop on improving metrics and their scoring for the IATTC risk analysis~~ | | 🟩 | | |
| ~~T.1.b~~ | ~~External review of yellowfin tuna assessment~~ | | | 🟩 | |
| | **LIFE HISTORY DATA** | | | | |
| E.2.a | Investigate spatiotemporal variability in the age, growth, maturity, and fecundity of yellowfin tuna in the EPO | 🟩 | 🟧 | | |
| E.3.a | ~~Investigate geographic variation in the movements, behavior, and habitat utilization of yellowfin tuna in the EPO~~ | 🟩 | | | |
| | **INDICES OF ABUNDANCE** | | | | |
| H.1.e | Advance the understanding of the longline data of different fleets and potential indices of abundance | | 🟥 | 🟥 | |
| H.1.f | Workshop on improving spatio-temporal methods for tuna CPUE and length composition standardization | | 🟥 | | |
| | **NEW DATA SOURCES** | | | | |
| J.3.a | Developing alternative buoy-derived tuna biomass indexes | 🟧 | 🟧 | 🟧 | 🟧 |
| ~~E.4.a~~ | ~~Multi-year tuna tagging study~~ | 🟩 | 🟩 | | |

## WORK PLAN TO IMPROVE THE STOCK ASSESSMENT FOR BIGEYE TUNA

The staff completed a benchmark assessment and risk analysis for bigeye tuna in 2024 (SAC-15-02).

The previous benchmark and risk analysis had been completed by the staff in 2020. The 2020 risk analysis showed that the weighted management quantities were bimodal. An optimistic group of models suggested that the current fishing mortality was well above the target reference level while a pessimistic group of models suggested that the current fishing mortality had greatly exceeded the target reference level. The staff identified several desirable research projects that were to be conducted before the 2024 benchmark assessment to further improve the stock assessment of bigeye tuna. The staff conducted an exploratory analysis for the stock assessment of bigeye tuna in 2023 (SAC-14-05).

In brief, six major modifications have been made to the stock assessment models since the 2020 benchmark assessment was conducted. These modifications fall into three categories: fishery definitions, survey fleet characteristics, and fishery fleet characteristics. Model diagnostics indicate that, overall, the six modifications significantly improved the stock assessment models for bigeye tuna including an improved fit to data, reduced magnitude of recruitment shift, reduced data conflict, estimated more realistic initial conditions, and a better-performing age-structured production model. The improved stock assessment models for bigeye tuna resolved the bimodal pattern observed in management quantities.

### Main expected work plan deliverables
**2021:** CAPAM natural mortality workshop (Workshop report)
**2022:** Workshop on improving the risk analysis for the tropical tunas in the EPO (Workshop report)
    Advance the understanding of the longline data of different fleets and potential indices of abundance (Workshop report)
**2023:** Exploratory analysis for the stock assessment of bigeye tuna in the EPO (SAC-14-05)
    Risk assessment methodology (Workshop report)
    CAPAM tuna stock assessment good practices (Workshop report)
**2024**: Benchmark stock assessment model and risk analysis (SAC-15-02)


**TABLE 1.3.a.** Timeline for bigeye tuna work plan, 2021-2024

| 2021 | |
|---|---|
| CAPAM natural mortality workshop | |
| **2022** | |
| Workshop on improving the risk analysis for the tropical tunas in the EPO | H.1.a (unfunded) |
| **2023** | |
| Preliminary assessment models | |
| External review | T.1.a phase 2 |
| **2024** | |
| Benchmark stock assessment and risk analysis | Completed (SAC-15-02) |

TABLE 1.3.b. Projects included in the bigeye tuna work plan, 2021-2024. **Green**: completed; **blue**: funded; **red**: unfunded; **pink**: partially funded (funded components completed, other components pending); **orange**: IATTC staff and/or collaborators. Text ~~struck through~~ indicates completed

| SSP ref. | Target/Project | Timeframe & status | | | |
|---|---|---|---|---|---|
| | | 2021 | 2022 | 2023 | 2024 |
| **MONITORING STOCK STATUS AND MANAGEMENT ADVICE** | | | | | |
| H.4.a | Conduct routine stock assessments of tropical tunas and indicators | 🟩 | 🟩 | 🟩 | 🟩 |
| J.2.a | Quantification of the relationship between vessel operational characteristics and fishing mortality | | 🟦 | 🟦 | 🟦 |
| | **ASSESSMENT RESEARCH** | | | | |
| ~~H.1.b~~ | ~~Improve the bigeye tuna stock assessment~~ | 🟩 | 🟩 | 🟩 | 🟩 |
| ~~H.1.g~~ | ~~Workshop on improving the risk analysis for the tropical tunas in the EPO~~ | | 🟩 | | |
| ~~T.1.a~~ | ~~External review of bigeye tuna stock assessment~~ | | | 🟥 | |
| ~~X.1.c~~ | ~~CAPAM workshop on natural mortality~~ | 🟩 | | | |
| | **INDICES OF ABUDANCE** | | | | |
| H.1.e | Advance the understanding of the longline data of different fleets and potential indices of abundance | | 🟥 | 🟥 | |
| H.1.f | Workshop on improving spatiotemporal methods for CPUE and length composition standardization | | 🟥 | 🟥 | |
| J.3.a | Developing alternative buoy-derived tuna biomass indices | 🟧 | 🟧 | 🟧 | 🟧 |

| WORK PLAN FOR MANAGEMENT STRATEGY EVALUATIONS (MSE) |
| --- |

The process of developing MSEs, a major objective of the IATTC and other organizations, consists of two parts. One is highly technical, and is carried out by scientific experts, but the other, which involves defining objectives, performance metrics, and candidate management strategies, requires input and participation of managers and other stakeholders. Those two parts should evolve in synergy. Stakeholder participation throughout the MSE process is central to its success and will be facilitated by an understanding of the MSE process and its components, and by strengthening communication among scientists, managers, and other stakeholders. The work plan combines technical development of MSE for tropical tunas and a series of workshops for training and enhancing dialogue and communication among all interested parties regarding the MSE process for tropical tunas. The stakeholder dialogue component focuses on the three tropical species (BET, YFT, SKJ). The initial technical MSE work will continue to focus on bigeye tuna, and will move to the other species towards the end of current workplan. The rationale to focus the initial technical work on BET is based on it being the species that has historically needed the strictest management, the recent work to improve BET modeling toward building BET operating models, the recent development of assessment models for SKJ and the need for additional work on the YFT modeling to be able to incorporate relevant hypotheses for assessment and operating models. The work includes additional improvements to the bigeye stock assessment model, which is used as a basis for the operating model used in the MSE. The current MSE workplan for tropical tunas extends to 2025 and with funding for 2024 and beyond secured with the establishment of a new staff harvest strategies position. The IATTC staff is also collaborating with other organizations, such as the ISC, in Pacific-wide MSEs for albacore and Pacific bluefin tunas.

**Main expected deliverables** (see individual project reports for details):
**2018:** Improved bigeye assessment for use as spatial operating model (OM) (WSBET-02-09)
   Workshop on training, communication, and evaluation of management strategies for tuna fisheries in the EPO
**2019:** SAC-10: Report improvements to bigeye model for its use as OM; alternative reference points and harvest control rules (HCRs) for dorado (SAC-10-11).
   Introductory harvest strategies workshops for the EPO Tuna Industry
   Workshop for scientists-managers to elicit objectives, performance metrics (WSMSE-1)
**2020:** Work on alternative ways to incorporate uncertainty in parameters and model structure during the MSE modeling phase, including incorporating results from the risk analysis (SAC-11 INF-F)
**2021:** Workshop to discuss alternative HCRs and refine strategy elements from previous Workshops (WSMSE-2)
   SAC-12 and Annual Meeting: Report on revised MSE plan and outcomes of workshops (IATTC-98-INF-I)
   Technical development of MSE components and framework, testing.
**2022:** Workshop to show MSE preliminary results, gather feedback, plan additional evaluation work (WSMSE-3)
   SAC-13 and Annual Meeting: Report on revised MSE plan
   Technical implementation of MSE, evaluation work.
**2023:** Workshop to show MSE updated results, gather feedback, plan additional evaluation work.
   SAC-14 and Annual Meeting: Report on revised MSE plan (SAC-14-INF-F)
   Technical implementation of revised MSE, evaluation
**2024:** Workshop to discuss MSE results, plan for other tropical tunas
   SAC-15 (SAC-15-07, SAC-15-08) and Annual Meeting: Report and presentation of MSE results and plan for other tropical tunas.
   Technical implementation of revised MSE with new BET OMs, evaluation

Presentation of revised MSE results incorporating stakeholder input to IATTC Annual Meeting.

**2025:** Workshop to discuss MSE results, plan for other tropical tunas

SAC-16 and Annual Meeting: Report and presentation of MSE results and plan for other tropical tunas.

Presentation of revised MSE results incorporating stakeholder input to IATTC Annual Meeting.

**GREEN: COMPLETED; BLUE: FUNDED**

| SSP ref. | Target/Project | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | | 2023 | | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | | |
| | **1. SUSTAINABLE FISHERIES** | | | | | | | | | | | | | | | |
| | **Goal I:** Test harvest strategies using Management Strategy Evaluation (MSE) | | | | | | | | | | | | | | | |
| I.1. | Conduct a comprehensive MSE for bigeye tuna and plan MSEs for the other tropical tuna species | | | | | | | | | | | | | | | |
| I.1.a | 1. Stakeholder and technical MSE workshops | | | | | | | | | | | | | | | |
| | Technical meetings to agree on overall/revised MSE Plan by IATTC staff and collaborators | | | | | | | | | | | | | | | |
| | Stakeholder workshops on training and communication on MSE development and results | | | | | | | | green | | | | green | | blue | blue |
| | 2. Technical development of MSE, HCR, MP, outputs | | | | | green | green | green | green | green | green | green | green | blue | blue |
| | a. Improve the bigeye assessment for use as OM | | green | green | green | green | green | green | green | green | green | green | | |
| | b. Run preliminary simulations with spatial OM | | | | | green | | | | | | | | | |
| | a. Run preliminary MSE based on initial input from managers and stakeholders | | | | | | | | | | green | green | green | | |
| | b. Run final MSE based on revised input from managers and stakeholders | | | | | | | | | | | | | blue | blue |
| | c. Present evaluated HCR/MP to Commission, plan work for other tropical tunas | | | | | | | | | | | | | blue | blue |
| I.2. | Collaborate with ISC in Pacific-wide MSEs for albacore and Pacific bluefin tunas (*dependent on ISC scheduling) | ALB | green | green | green | green | green | green | green | green | green | green | | |
| | | PBF | | | green | green | green | green | green | green | green | green | | |

| WORK PLAN FOR THE FAD FISHERY: IMPROVE DATA COLLECTION AND MANAGEMENT, AND MITIGATE ECOLOGICAL IMPACTS |
|---|

The expansion of FAD fisheries worldwide poses several challenges for tuna RFMOs. First, with the expansion has come the need for improved data collection to provide better management advice on an ever-evolving fishery. Currently, much of the detailed data on the EPO FAD fishery is collected by observers aboard Class-6 vessels. However, new resolutions and technological advances offer the possibility of collecting additional detailed data on FAD-related activities, including information provided by fishing crews on FAD form 9/2018v2 (Resolution C-19-01), raw buoy data to be provided to the IATTC staff under Resolution C-21-04 , and the use of electronic monitoring and other technologies (e.g. smartphone apps employing AI, rapid genomic tests for improved species identification) to supplement data collected by on-board observers. Second, because the FAD fishery has different impacts on the ecosystem, in terms of marine pollution, impacts on sensitive habitats, bycatches of non-target species, and catches of juveniles of target species, than other components of the purse-seine fishery, there is an urgent need to develop and test conservation and management measures that will contribute to mitigate these effects, such as gear modifications, definitions of best handling and release of sensitive species, guidelines for new FAD designs, quantification and remediation of stranding events, and assessment of different types of spatial and temporal closures on target and non-target species, among others.

The IATTC staff is currently working on numerous projects related to the FAD fishery, and has submitted proposals for funding to help fill remaining data and knowledge gaps; these are shown in the work plan below.

**Main expected deliverables** (see individual project reports for details):
**2018**:  Reports summarizing current data gaps and potential improvements
**2018-2023**: Training workshops to expand and improve data collection
**2020-2024**: Pilot study on remote and electronic identification of FADs
        Data-driven recommendations for the implementation of electronic monitoring in the purse-seine fleet
        Quantitative evaluation of the relationship between the FAD fishery and fishing mortality
**2021-2024 and beyond**: Guidelines for state-of-the-art data-collection procedures for the purse-seine fishery; improved data quality and reporting procedures; better understanding of impacts of FADs on target and non-target sensitive species, as well as habitats and ecosystem; more ecologically-friendly and biodegradable FAD designs, and guidelines for their implementation and use; assessment of the effectiveness of different type of spatial and temporal closures on target and non-target sensitive species; a better understanding of climate change impacts on the FAD fishery.

**Green**: completed; **blue**: funded; **red**: unfunded

| SSP ref. | Target/Project | Timeframe & status | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
| **DATA** | | | | | | | | |
| **Goal B:** Identify and prioritize opportunities to improve data quality and expand data types and coverage | | | | | | | | |
| B.1.a | Improving smart species identification tools | | | | | | 🟦 | 🟦 | 🟦 |
| B.2. | Expand on-board data collection to small purse seiners: train observers and fishing crews | 🟩 | | | | | | |

| SSP ref. | Target/Project | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| **Goal C**: Facilitate the improvement of data quality, coverage, and reporting by CPC data collection programs | | | | | | | | |
| C.1. | Purse-seine fleet: Improve data reporting and content (Resolutions C-19-01 and C-21-04; SAC and WG-FADs recommendations) | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| C.2.b | Pilot study of electronic monitoring (EM) of the activities and catches of longline vessels | | | | ■ | ■ | ■ | ■ |
| **Goal D:** Investigate the use of new technologies to improve data quality | | | | | | | | |
| D.1.a | Exploring technologies for remote identification of FADs | | | | | ■ | ■ | ■ |
| D.2.a | Pilot study of electronic monitoring of the activities and catches of purse-seine vessels | ■(green) | ■(green) | ■(green) | ■(green) | | | |
| **Goal Q:** Provide training opportunities for scientists and technicians of CPCs | | | | | | | | |
| Q.3 | Workshops for vessel crews, industry, and national authorities on requirements of C-19-01 and C-21-04 (WG-FADs Recommendation endorsed by SAC) | | ■(red) | ■(red) | ■(red) | ■(red) | ■(red) | ■(red) |
| **CONSERVATION AND MANAGEMENT** | | | | | | | | |
| **Goal J:** Improve our understanding of the effects of the operational characteristics of the fishery on fishing mortality, stock assessments, and management advice | | | | | | | | |
| **J.1.a** | Temporal trends and variability in the spatial distribution of tropical tuna purse-seine fishing | | | | | ■ | ■ | ■ |
| J.1.b | Changes in catches and fishing strategies related to the Individual Vessel Threshold (IVT) program | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| J.1.c | Evaluation of empirical and potential impacts of "El Corralito" | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| J.2.a | Quantification of the relationship between vessel operational characteristics and fishing mortality | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **J.2.b** | Identifying operational characteristics associated with mobulid bycatch in the eastern Pacific Ocean | | | | | ■ | ■ | ■ |
| J.3.a | Pilot study on developing alternative buoy-derived tuna biomass indices | | | ■ | ■ | ■ | ■ | ■ |
| **Goal M:** Mitigate the ecological impacts of tuna fisheries | | | | | | | | |
| M.1.a | Evaluate the effect of the depth of non-entangling FADs on catches of tunas and bycatches of other species in the purse-seine fishery | ■(green) | ■(green) | ■(green) | ■(green) | | | |
| M.1.b | Test sorting grids (with emphasis on reducing catches of juvenile bigeye) | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| M.3.a | Estimate bycatch and discard rates at FADs, by species, and identify "hot spots" | ■(red) | ■(red) | ■(red) | ■(red) | ■(red) | ■(red) | ■(red) |
| M.5.a | Develop and test non-entangling and biodegradable FADs | ■(green) | ■(green) | ■(green) | ■(green) | ■(green) | | |
| M.5.b | Reducing losses, and fostering recovery, of FADs in the purse-seine fishery in the EPO | ■ | ■ | ■ | ■ | ■ | | |

| SSP ref. | Target/Project | Timeframe & status | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
| M.5.d | Evaluation of new biodegradable materials in the tropical marine environment, for the construction of FADs | | | | | | | ■ |
| M.1.d | Developing and testing bycatch release devices in tuna purse-seiners | | | | ■ | ■ | ■ | ■ |
| N.1.c | Developing dynamic species distributions models to inform conservation and management of non-target species and communities | | | | ■ | ■ | ■ | ■ |
| M.2.c | Manta and devil ray post-release survival, movement ecology, and genetic population structure | | | ■ | ■ | ■ | ■ | ■ |
| M.2.d | Evaluating knowledge and data gaps to the implementation of best handling and release practices for vulnerable species in IATTC fisheries | | | ■ | ■ | ■ | ■ | ■ |
| M.2.e | Investigating post release survival of silky sharks captured in class 2-5 purse seine vessels | | | ■ | ■ | ■ | ■ | ■ |
| O.2.c | Temporal network analysis of bycatch communities caught in purse-seine fisheries | | | | ■ | ■ | ■ | ■ |
| O.2.d | Develop a workplan for restructuring IATTC's Ecosystem Considerations into (1) an indicator-based EcoCard and (2) a complementary Ecosystem Status Assessment for the EPO | | | | ■ | ■ | ■ | ■ |
| O.2.e | Develop a workplan to promote climate resilient fisheries at IATTC | | | | ■ | ■ | ■ | ■ |
| N.2.b | Supporting climate-ready and sustainable fisheries | | | ■ | ■ | ■ | ■ | ■ |
| M.3.b | Spatial and temporal closures and the tradeoff between bycatch and target catches | | | | ■ | ■ | | |
| M.5.c | Definition of guidelines to reduce the impact of lost and abandoned FADs on marine turtles | | | | ■ | ■ | ■ | ■ |

| WORK PLAN TO IMPROVE DATA COLLECTION AND STOCK ASSESSMENTS FOR SHARKS |
| --- |

The IATTC has increasing responsibilities to ensure the sustainable impacts of its fisheries on sharks, both as target and bycatch species. Resolution C-23-07, among other things, requires the development of "…a draft list of shark species under the purview of the Commission in the Convention Area…".  In 2024, the staff prepared a draft species list (SAC-15-09, project L2.f), which was discussed with the SAC and recommended the Commission consider 19 shark species at its 102nd meeting to come under its purview. If adopted, the IATTC will be responsible for ensuring the sustainability of these 19 species, some of which are data-poor.

Further to this list, paragraph 1 of Resolution C-16-05 on the management of shark species requires that "*the IATTC scientific staff shall develop a workplan…, for completing full stock assessments for the silky shark … and hammerhead sharks* ...".

As the staff has noted previously, improving shark fishery data collection in the EPO is essential if conventional stock assessments and/or other indicators of stock status are to be developed for sharks. An attempt to assess the status of the silky shark in the EPO using conventional stock assessment models was severely handicapped by major uncertainties in the fishery data, and stock assessment work on hammerhead sharks is currently not possible due to the scarcity of data for these taxa. As part of the work plan and the basis for upcoming research, the IATTC staff collaborated with the Scripps Institution of Oceanography and The Nature Conservancy to develop a conceptual model for silky sharks (Talwar et al. 2024, presentation EB02 5.c.2), and is planning to conduct similar studies for hammerhead sharks (unfunded project F.2.b), a task recommended by the Ecosystem and Bycatch Working Group and endorsed by the SAC. However, without reliable species-specific indices of abundance and catch data for all fisheries catching sharks in the EPO, any further attempts at conducting conventional stock assessments are problematic. In this regard, the lack of funding for Project C.4.b (see IATTC-93-06c) is also problematic. As a result of these data limitations the IATTC has developed the Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish) approach to assess data-limited species for the purposes of prioritization for research and management until such time as conventional assessments can be undertaken to provide more reliable information on stock status. In 2022, the IATTC scientific staff undertook a vulnerability assessment (SAC-13-11) for 49 species of sharks recorded to interact with industrial and artisanal pelagic fisheries in the EPO, of which 20 species exceeded biological reference points and classified as "most vulnerable". This assessment highlighted significant data deficiencies for the majority of shark species, including for silky and hammerhead sharks, for which some kind of stock assessments has been planned (i.e., CKMR). Therefore, the staff used EASI-Fish to assess the vulnerability of these species (SAC-14-12) under various hypothetical scenarios involving practical conservation and management measures (CMMs)—used in isolation and concert—to guide future research and management efforts.

The staff developed a work plan to improve data collection and stock assessments for sharks, focused on all EPO fisheries that interact with silky and hammerhead sharks, and obtained funds from FAO-GEF to improve data collection for the coastal longline and gillnet fisheries, which have the greatest deficiencies and are estimated to take a large fraction of the shark catches. The staff is developing an experimental design for a long-term shark fishery sampling program in the EPO, including a feasibility study for close kin mark recapture (CKMR), for presentation to the SAC and the Commission and hopes to deliver some form of stock assessments of silky and hammerhead sharks by the end of the next SSP time frame in 2029. The type of assessment applied to each species will depend on the data available but will most likely include genetic approaches like CKMR. In addition, the work plan involves bycatch mitigation activities aimed at reducing fishing mortality of sharks. In this line, the staff has also

developed best handling and releasing practices for sharks (SAC-15-11), which are expected to be adopted by the IATTC in its 2024 meeting.

**Main expected deliverables** (see individual project reports for details)**:**
**2019**: Proposal for long-term sampling program for shark catches by artisanal fisheries in Central America
**2023**: Assessments of silky and hammerhead sharks in the EPO

**Green**: completed; **blue**: funded; **red**: unfunded

| SSP ref. | Target/Project | Timeframe & status | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| | **DATA** | | | | | | | | | |
| | **Goal B:** Conduct a review of current IATTC/AIDCP data collection programs, identify and prioritize opportunities to improve data quality and expand data types and coverage | | | | | | | | | |
| B.1.a | Improving smart species identification tools | | | | | ■ | ■ | ■ | ■ | ■ |
| B.2. | Expand on-board data collection to small purse seiners | ■ | | | | | | | | |
| B.3.a | Individual Vessel Limit pilot study | ■ | | | | ■ | | | | |
| | **Goal C:** Facilitate the improvement of data quality, coverage, and reporting by CPC data collection programs | | | | | | | | | |
| | | ■ | | | | ■ | ■ | ■ | ■ | ■ |
| C.4 | Artisanal fisheries (coastal developing CPCs) | ■ | | | | | | | | |
| C.4.a | Improving data collection for Central American shark fisheries: develop sampling protocols for catch and effort estimation (FAO-GEF ABNJ project) | ■ | ■ | | | | | | | |
| | Identify all unloading sites and obtain order-of-magnitude estimates of total catch and effort | ■ | ■ | | | | | | | |
| | Design and test sampling protocols for species and size composition sampling | ■ | ■ | | | | | | | |
| C.4.b | Long-term sampling program for shark catches of artisanal fisheries in Central America | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **C.4.c** | Improving the monitoring and assessment of shark stocks in the Eastern Pacific Ocean: expansion to Ecuador, Mexico and Peru | | | | | ■ | ■ | ■ | ■ | ■ |

| SSP ref. | Target/Project | Timeframe & status | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| A.3.c | Series of workshops on improvements in data collection and provision to provide recommendations for updating the data provision Resolution C-03-05 | | | | | ■ | ■ | ■ | ■ | ■ |
| **Goal D:** Investigate the use of new technologies to improve data quality | | | | | | | | | | |
| D.2.a | Pilot study of electronic monitoring of the activities and catches of purse-seine vessels | ■ | ■ | ■ | ■ | | | | | |
| **LIFE HISTORY DATA** | | | | | | | | | | |
| F.2.a | Investigate the movements, behavior, and habitat utilization of silky sharks in the EPO | ■ | ■ | ■ | ■ | ■ | | | | |
| F.2.c | Developing conceptual models for sharks in support of assessment and mitigation of ecological impacts | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **MONITORING POPULATION STATUS AND MANAGEMENT ADVICE** | | | | | | | | | | |
| **Goal H:** Improve and implement stock assessments, based on the best available science | | | | | | | | | | |
| H.5 | Undertake the research necessary to develop and conduct data-limited assessments for prioritized species (Assessments of silky and hammerhead sharks in the EPO) | | | | | ■ | ■ | ■ | ■ | ■ |
| H.5.a | Revise trend estimation methods for purse-seine silky shark indices for the EPO | ■ | ■ | | | | | | | |
| **Goal L:** Evaluate the ecological impacts of tuna fisheries | | | | | | | | | | |
| J.2.b | Identifying operational characteristics associated with mobulid bycatch in the eastern Pacific Ocean | | | | | ■ | ■ | ■ | ■ | ■ |
| L.1.a | Develop habitat models for bycatch species caught in the EPO to support ecological risk assessments (ERAs) | ■ | ■ | | | | | | | |
| L.1.b | Develop a flexible spatially-explicit ERA approach for quantifying the cumulative impact of tuna fisheries on data-limited bycatch species in the EPO | ■ | ■ | | | | | | | |

| SSP ref. | Target/Project | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|
| L.2.a | Develop and update Productivity-Susceptibility Analyses (PSAs) of tuna fisheries in the EPO | ■ | ■ | | | | | | | |
| L.2.b | Vulnerability assessment of shark bycatch in EPO tuna fisheries using the EASI-Fish approach | | | | ■ | ■ | | | | |
| L.2.c | Assessing the efficacy of potential management options for highly vulnerable shark species in the EPO | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| L.2.f | Development of a draft list of shark species under the purview of the IATTC | | | | ■ | ■ | ■ (green) | ■ (green) | ■ | ■ |

**Goal N:** Improve our understanding of the interactions among environmental drivers, climate, and fisheries

| SSP ref. | Target/Project | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|
| N.1.a | Analyze EPO bycatch data to assess the influence of environmental drivers on catches and vulnerability | ■ | | | | | | | | |

**BYCATCH MITIGATION**

**Goal M:** Mitigate the ecological impacts of tuna fisheries

| SSP ref. | Target/Project | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|
| M.1.a | Evaluate the effect of the depth of non-entangling FADs on catches of tunas and bycatches of other species in the purse-seine fishery | ■ | | | | | | | | |
| M.1.d | Developing and testing bycatch release devices in tuna purse-seiners | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| M.2.a | ~~Evaluate the post-release survival of silky sharks captured by longline fishing vessels in the equatorial EPO, using best handling practices~~ | ■ | | | | | | | | |
| M.2.b | Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation | ■ | ■ | ■ | | | | | | |
| M.2.c | Manta and devil ray post-release survival, movement ecology, and genetic population structure | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| M.2.d | Evaluating knowledge and data gaps to the implementation of best handling and release practices for vulnerable species in IATTC fisheries | | | ■ | ■ | ■ | ■ (dark) | ■ (dark) | ■ (dark) | ■ (dark) |

| SSP ref. | Target/Project | Timeframe & status | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| M.2.e | Investigating post release survival of silky sharks captured in class 2-5 purse seine vessels | | | | | | | | | |
| M.3.a | Estimate bycatch and discard rates at FADs, by species, and identify "hot spots" | | | | | | | | | |

**CURRENT AND PLANNED PROJECTS, BY THEME**

**DATA COLLECTION FOR SCIENTIFIC SUPPORT OF MANAGEMENT**

**PROJECT A.1.a: Database and Observer Data Collection Program Regular Activities**

**THEME:** Data collection
**GOAL:** A. Database maintenance, preservation, and access
**TARGET:** A.1. Routine tasks
**EXECUTION**: Bycatch and IDCP Program
**STAFF CONTACT:** Sylvain Caillot

| | |
|---|---|
| **Objectives** | Continue observer data collection program regular activities required by the Antigua Convention and the AIDCP |
| **Background** | The AIDCP requires that all trips by Class-6 purse-seine vessels (carrying capacity > 363 t) in the EPO carry an observer aboard; the IATTC observer program covers 50% of trips, the remainder are covered by the national programs. |
| | Observer records are the primary source of data on the purse-seine fishery. |
| | The Antigua Convention and various IATTC resolutions require that observers collect information on the tuna purse-seine fishery. |
| | The Bycatch-IDCP program is instrumental in training observers from national programs and under agreements with other organizations. |
| **Relevance for management** | Observer data are a key element for scientific research and recommendations by the IATTC scientific staff. |
| **Duration** | Continuous. |
| **Workplan and status** | Continue to process new data. Seek opportunities to improve data collection and processing. |
| **External collaborators** | Coordination with national and regional observer programs is essential and required. |
| **Deliverables** | IATTC staff processed data from 497 observed trips initiated during 2021. |

**PROJECT A.1.a: Routine activities of the Bycatch and IDCP Program**

**Reports/publications/presentations**
Presentations for the AIDCP seminars were updated with new resolution requirements relevant to operators, and made available to the national programs.

During the period of this report, three AIDCP Captains and crew instructional seminars were held in the following locations.

| Date | Program | Location | Number of attendees |
|---|---|---|---|
| 29 Sep 23 | IATTC | Manta, Ecuador | 46 |
| 12 Jan 24 | IATTC | Manta, Ecuador | 50 |
| 12 Jan 24 | PNAAPD | Mazatlan, Mexico | 60 |

During the period of this report, an IATTC general informative seminar for all fishery sectors was held On-line on January 10-11, 2024, as described in the following table.

| Date | Program | Location | Number of attendees |
|---|---|---|---|
| 10-11 Jan 24 | IATTC | On-line | 121 |

| PROJECT A.3.a. Conversion of all remaining Visual Basic 6 (VB6) computer programs to Visual Basic Net (VB.net). | |
|---|---|
| THEME: Data collection | |
| GOAL: A. Database maintenance, preservation, and access | |
| TARGET: A.3. Standardize and automate data submissions | |
| EXECUTION: Data Collection and Database Program | |
| STAFF CONTACT: Sylvain Cailllot | |
| **Objectives** | Re-write in VB.net all Visual Basic (VB) version 6 computer programs still in use by the IATTC and supported national observer programs. Work with national programs to install and test in the local environments, and train national program staff. |
| **Background** | IATTC staff developed customized data entry and editing programs using VB. Microsoft has terminated support for VB6, so the development environment no longer runs on current Microsoft operating systems. The code must be re-written in a supported programming language. |
| **Relevance for management** | At some point the compiled VB6 programs will cease to work, and data required for stock management would not be available. |
| **Duration** | 2 more years – planned completion in 2021 |
| **Work plan and status** | Late 2014: project initiated. March 2020: conversion 75% complete. April-December: Continue conversion, prioritizing the most important computer programs. |
| **External collaborators** | Existing staff are completing the project, rather than hiring outside programmers. |
| **Deliverables** | Completion of conversion of all VB6 computer programs. Replacement of all VB6 computer programs in IATTC and national programs with VB.net programs. Provide technical support to national programs during transition. |

| **PROJECT A.3.b: Develop databases of biological and fisheries parameters to support Ecological Risk Assessment and ecosystem models** | |
|---|---|
| **THEME:** Data collection | |
| **GOAL:** A. Database maintenance, preservation, and access | |
| **TARGET:** A.3. Standardize and automate data submissions | |
| **EXECUTION**: Data Collection and Database Program, Biology and Ecosystem and Bycatch Program | |
| **STAFF CONTACT:** Shane Griffiths | |
| **Objectives** | Develop a comprehensive database of best-available biological and fisheries data to provide key parameters for Ecological Risk Assessment (ERA) and ecosystem models |
| **Background** | The Antigua Convention requires the IATTC to ensure the sustainability of target, associated, and dependent species affected by EPO tuna fisheries, and the ecosystem to which they belong. <br> ERA and ecosystem models, used by IATTC staff to assess the ecological impacts of tuna fisheries in the EPO, require information on biological, physiological and trophodynamic characteristics of thousands of species in the EPO ecosystem. <br> A database with the most up-to-date information for impacted species is required to expedite the initial parameterization, or updating, of future models. |
| **Relevance for management** | The database will contain data needed for ERAs and ecosystem models, used to identify and prioritize data collection, mitigation, and/or management measures for vulnerable species. <br> The databases could be shared with scientists of CPCs. |
| **Duration** | 2018–2024 |
| **Workplan and status** | Biological and ecological literature searches for species that have been documented to interact with EPO tuna fisheries. <br> Identify fishery-related susceptibility parameters for bycatch species. <br> Update length-weight relationships and average weight by species to facilitate various staff activities and reporting (*e.g.*, Fishery Status Report). |
| **External collaborators** | Scientists from CPCs interested in contributing to and/or using the databases |
| **Deliverables** | Comprehensive life history and susceptibility database with fishery-specific information that can be shared with IATTC CPCs for those wishing to develop ERAs for a particular region and/or fishery. |

| **PROJECT A.3.b: Develop databases of biological and fisheries parameters to support Ecological Risk Assessment and ecosystem models** |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>A preliminary life-history database has been developed for all species reported to have interacted with industrial purse-seine, and longline fisheries as well as the predominant small-scale coastal longline and gillnet fisheries.<br>Values for fisheries-related susceptibility parameters have been obtained for about 50 of the 110 bycatch species that interact with EPO tuna fisheries. Since the initial development of the database in 2018, a significant update for 32 shark species was undertaken in 2022 for the first EASI-Fish assessment for sharks in the EPO, and a further update was undertaken for silky and three species of hammerhead sharks for a focused EASI-Fish assessment examining potential CMMs.<br>A similar initiative has been developed by the SPC and discussions are underway to develop a Pacific-wide life-history database.<br>New task: update length-weight relationships and average weight of bycatch species to improve various staff activities and reporting (*e.g.*, Fishery Status Report). |
| **Challenges and key lessons learnt**<br>     The main challenge is sourcing datasets for rare/infrequently caught bycatch species with sufficient sample sizes across a wide size spectrum. |
| **Reports/publications/presentations**<br>Eight manuscripts that use these life-history and susceptibility data have been prepared for submission to scientific journals or IATTC presentations:<br>Griffiths, S.P., Siu, S., Hutchinson, M., Lopez, J., Aires-da-Silva, A. 2023. Vulnerability assessment and simulation of potential conservation and management measures for silky and hammerhead sharks caught in eastern Pacific Ocean pelagic fisheries. *14th Meeting of the Scientific Advisory Committee of the IATTC, 15-19 May 2023, La Jolla, California, USA. Document SAC-14-12.*<br>Griffiths, S.P., Fuller, L.M., Potts, J., Nicol, S. 2022. Vulnerability assessment of sharks caught in eastern Pacific Ocean pelagic fisheries using the EASI-Fish approach. *13th Meeting of the Scientific Advisory Committee of the IATTC, 16-20 May 2022, La Jolla, California, USA. Document SAC-13-11*.<br>Griffiths, S.P. and Lezama-Ochoa, N. 2021. A 40-year chronology of spinetail devil ray (*Mobula mobular*) vulnerability to eastern Pacific tuna fisheries and options for future conservation and management. *Aquatic Conservation: Marine and Freshwater Ecosystems* 31.<br>Griffiths, S.P., Kesner-Reyes, K., Garilao, C., Duffy, L.M., Román, M.H., 2018. Development of a flexible ecological risk assessment (ERA) approach for quantifying the cumulative impacts of fisheries on bycatch species in the eastern Pacific Ocean. *9th Meeting of the Scientific Advisory Committee of the IATTC, 14-18 May 2018, La Jolla, California, USA. Document SAC-09-12*.<br>Griffiths, S.P., Lezama-Ochoa, N., Román, M.H., 2019. Moving towards quantitative ecological risk assessment for data-limited tuna fishery bycatch: application of "EASI-Fish" to the spinetail devil ray (*Mobula mobular*) in the eastern Pacific Ocean. *9th Meeting of the IATTC Working Group on Bycatch, 11 May 2019, San Diego, California, USA. Document BYC-09-01*.<br>Griffiths, S.P., Kesner-Reyes, K., Garilao, C., Duffy, L.M., Román, M.H., 2019. Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish): a flexible vulnerability assessment approach to quantify the cumulative impacts of fishing in data-limited settings. *Marine Ecology Progress Series* 625, 89-113.<br>Griffiths, S.P., Wallace, B., Swimmer, Y., Alfaro-Shigueto, J., Mangel, J.C., Oliveros-Ramos, R., 2020. Vulnerability status and efficacy of potential conservation measures for the east Pacific leatherback turtle (*Dermochelys coriacea*) stock using the EASI-Fish approach. *10th Meeting of the IATTC Working Group on Bycatch, 10 September 2020, La Jolla, California, USA. Document BYC-10-01*. |

Griffiths, S.P., Fuller, L.M., Potts, J., Nicol, S., 2022. Vulnerability assessment of sharks caught in eastern Pacific Ocean pelagic fisheries using the EASI-Fish approach. 13th Meeting of the Scientific Advisory Committee of the IATTC, 16-20 May 2022, La Jolla, California, USA. Document SAC-13-11, 80.

**Comments:**
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| PROJECT A.3.c: Series of workshops on improvements in data collection and provision to provide recommendations for updating the data provision Resolution C-03-05 | |
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| THEME: Data collection for scientific support of management<br>GOAL: A. Database maintenance, preservation, and access<br>TARGET: A.3. Standardize and automate data submissions<br>EXECUTION: Stock Assessment Program, Ecosystem and Bycatch Program, Data Program, Policy Program<br>IATTC CONTACT: Leanne Fuller | |
| **Objectives** | To hold a series of workshops, by gear type, on data provision to develop standardized reporting templates. The ultimate goal is to update Resolution C-03-05 to align data reporting requirements with the Antigua Convention, and to harmonize them, where possible, with FAO and other tuna Regional Fisheries Management Organization's (t-RFMOs) data collection and reporting standards (SAC-12-16 see section B.3. "General Data Provisions"). |
| **Background** | The Antigua Convention has been in force for over a decade, but the pace of data provision of the data types required by the staff to adequately meet the obligations under the Convention, as well as its objectives and those of the ongoing IATTC's Strategic Science Plan (2019-2023, IATTC-93-06a) has lagged.<br>Resolution C-03-05 constitutes the foundation of staff's scientific research to demonstrate ecological sustainability within the scope of the Convention.<br>Stock assessments of tuna and tuna-like species have been hampered by restricted access to high resolution, set-by-set, time-series data (see, for example, recent technical challenges in SAC-11-06; SAC-11-07; IATTC-95-05).<br>Ecological analyses have been hampered by the lack of quality data on species caught as bycatch in the various fisheries, with limited to no data available for fisheries other than large purse-seine vessels (IATTC Class-6; fish carrying capacity > 363 t) that carry observers onboard for each trip (e.g. see SAC-13-10, SAC-13-11).<br>Documents SAC-12-09 and WSDAT-01-01 provide background information on the rationale for improved data collection and outline the data deficiencies for the various fisheries that must be addressed in order for the staff to perform the research necessary to meet their diverse responsibilities.<br>This project was initiated in response to a staff recommendation endorsed by a SAC recommendation to hold a series of workshops by gear type to improve data collection (SAC-12-RPT, SAC-12-16 see section B.3. "General Data Provisions") |
| **Relevance for management** | Improvements in the scope and quality of data are fundamental to the staff's ability to undertake scientifically defensible analyses that can be used to provide sound advice on conservation and management measures (CMMs) for stock, ecological and vulnerability assessments. |
| **Duration** | 2022-2026 |
| **Work plan and status** | 2022: Collaborations with colleagues at the other t-RFMOs and individual CPCs to prepare for the 1st Workshop on Data Improvement C-03-05: Industrial Longline<br>Jan 2023: Held the 1st Workshop on Data Improvement C-03-05: Industrial Longline<br>May 2023: Present the staff's recommendations, revised with input from workshop participants, for updating Resolution C-03-05 at the 14th meeting of the SAC.<br>Jun 2023–Oct 2024: Discussions and workshop preparations for improving data provision for small purse seiners.<br>Oct 2024: Propose the 2nd Workshop on Data Improvement C-03-05: Small Purse Seine. |

| | May 2025: Present the staff's recommendations, revised with input from workshop participants, for updating Resolution C-03-05 for small purse-seine vessels at the 16th meeting of the SAC. |
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| | Jun-Dec 2025: Discussions and workshop preparations for improving data provision for longliners operating in the coastal regime ('artisanal' sector). |
| | Jan 2026: Propose the 3rd Workshop on Data Improvement C-03-05: Short-Medium Range Longline. |
| | May 2026: Present the staff's recommendations, revised with input from workshop participants, for updating Resolution C-03-05 for the 'artisanal' sector at the 17th meeting of the SAC. |
| | Jun-Dec 2026: Prepare a draft proposal for an updated Resolution C-03-05 based on stakeholder input from workshops. |
| | May 2027: Present the staff's recommendations for revising Resolution C-03-05 for all gears. |
| **External collaborators** | CPCs, colleagues at SPC/WCPFC, ICCAT, IOTC |
| **Deliverables** | Background documents and reports for each workshop (e.g. WSDAT-01-01); SAC recommendations for updating Resolution C-03-05 for each gear type. |

| **PROJECT A.3.c**: Series of workshop on improvements in data collection and provision to provide recommendations for updating the data provision Resolution C-03-05 |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period** |
| In preparation for the 2023 workshop, staff conducted surveys with colleagues at other t-RFMOs to compare types of data submitted to each t-RFMO and to draft species lists for consideration in data submission with the goal of harmonizing data collection and reporting across t-RFMOs. The 1st Workshop on Data Improvement C-03-05: Industrial Longline was held virtually 09-10 Jan 2023. |
| Recommendations for updating Resolution C-03-05 based on input from workshop participants and individual consultations with CPCs were presented at the 14th meeting of the SAC (see SAC-14 INF-Q) and subsequently recommend by the SAC to the Commission (IATTC-101-03, 7.1. Resolution C-03-05). |
| Preparations for the next workshop in the series, on small purse-seine vessels, began in 2023 and will continue through 2024, including a background document summarizing data sources, data gaps, and incentives and recommendations for improving data collection. This workshop is planned for the latter half of 2024. |
| **Challenges and key lessons learnt** |
| Industrial longline data are the most important data source for improving stock assessments, yet it is challenging for some CPCs to provide operational-level, set-by-set, logbook data due to various issues such as domestic legal constraints. |
| Making the submission of some species (e.g. sharks) compulsory is challenging due to potential misidentification by fishers not versed in taxonomy; quality of logbook data needs to be improved for species composition and overall accuracy. |
| Obtaining size composition data is challenging for species that reach large sizes and cannot be brought onboard. |
| **Reports/publications/presentations** |
| SAC-12-09 |
| WSDAT-01-01 |
| Workshop Report |
| SAC-14 INF-Q |
| **Comments:** |

| PROJECT B.1.a: Improving smart species identification tools | |
|---|---|
| THEME: Data collection<br>GOAL: B. Review IATTC/AIDCP data collection programs<br>TARGET: B.1. Improve data collected by the purse-seine On-Board Observer Program<br>EXECUTION: Data Collection and Database Program, Ecosystem and Bycatch Program<br>STAFF CONTACT: Jon Lopez | |
| Objectives | Develop smart tools for accurately identifying prioritized species |
| Background | Researchers of Michigan State University, Texas A&M University, and St. Anselm College have been funded by the National Science Foundation to develop smart tools for identifying species in diverse fisheries contexts.<br>Tools under development consist of: i) a smartphone application that employs artificial intelligence (AI) to perform species identification using user-supplied photos or video, and ii) genomic tests to perform genetic species identification in the field.<br>Together, these tools could make rapid and highly accurate species identification possible without the need for specialized training or equipment.<br>Due to a variety of reasons, accurate species identification in the field (i.e., landing sites) or by observers or cameras on-board (e.g., purse-seines, longlines) is not always possible.<br>Therefore, tools that improve species identification of prioritized species in a rapid and accurate manner are desirable. |
| Relevance for management | Improved species identification during data collection programs will increase data quality provision to enhance stock assessments and other biological and ecological studies for prioritized species performed by the IATTC staff, reducing uncertainty in the scientific-advice and decision making.<br>A trained AI model could increase the effectiveness of algorithms to review records collected by Electronic Monitoring (EM) equipment in a rapid and accurate manner, and help implement EM-programs in the region. |
| Duration | Year start – year end (36 months) |
| Workplan and status | Year 1: Sampling and collection of tissue, photo and video collection of prioritized species by technicians in the field and on-board observers or EM-cameras to improve genetic analysis and the training of the AI model, respectively.<br>Year 2: Beta testing of smartphone application and rapid genetic tests.<br>These activities will require the collaboration of national authorities and fishing industry. |
| External collaborators | Michigan State University, Texas A&M University, and St. Anselm College, fishing industry, CPCs |
| Deliverables | Improved smartphone application that employs an AI model to perform species identification using user-supplied photo or video.<br>Improved genomic tests to perform genetic species identification in the field.<br>Improved AI algorithm to review EM data in a rapid and accurate manner.<br>Dissemination material (e.g., reports, presentations) for the Ecosystem and Bycatch Working Group, the SAC, the Tuna Conference, and other meetings of interest. |

| PROJECT B.1.a: Improving smart species identification tools |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>A beta version of the smartphone app is currently being finalized and will be tested by IATTC observers beginning in spring-summer 2024.<br>Tissue sampling, footage storage and tagging protocols have been compiled and consolidated to match IATTC's existing methods.<br>Sampling kits are being prepared and will be ready for IATTC observers beginning in spring-summer 2024.<br>IATTC's Central American Shark Programs' (ABNJ1, Project C.4.b) existing footage has been reviewed, processed by species, and shared with collaborators.<br>The IATTC staff coordinated and  shared images to support the development of a field guide for the identification of mobulid rays captured in Pacific Ocean tuna fisheries. Staff also developed a photo library to assist with the coordination of footage provided to the iCatch program.<br>IATTC staff has translated the Mobulid field guide into Spanish to support IATTC observers and crew members. Several guides have been printed and are ready for dispersal to the field offices. The guide will also be made available electronically to support CPCs and their observer programs with training materials.<br>The IATTC staff provided support to collaborators for funding applications. |
| **Challenges and key lessons learnt**<br>Obtaining a significant amount of species-specific footage to train AI models is difficult, especially for rare bycatch species. |
| **Reports/publications/presentations** |
| **Comments:** |

| PROJECT B.3.a: Individual Vessel Threshold (IVT) pilot study | |
|---|---|
| THEME: Data collection<br>GOAL: B. Review IATTC/AIDCP data collection programs<br>TARGET: B.3. Purse-seine<br>EXECUTION: Stock Assessment Program<br>STAFF CONTACT: Cristina De La Cadena | |
| **Objectives** | Develop sampling designs for estimating well-level and trip-level catch composition to be used in the IVT enhanced port-sampling program in 2023-2024. |
| **Background** | At the 98th Meeting of the IATTC, the Commission established an IVT program for bigeye tuna catches (Resolution C-21-04), which was to include a special port-sampling program (Enhanced port-sampling Monitoring Program, "EMP") for trips considered to have caught a significant amount of bigeye tuna.<br>To implement the EMP, the sampling protocol of this program needed to be tailored to estimation of well-level and trip-level catch composition.<br>The sampling protocol of the current IATTC port-sampling program is not appropriate for this task because it was designed for estimation of fleet-level catch composition and was based on results of studies conducted prior to the expansion of the fishery on fish-aggregating devices in the 1990s.<br>Given this, as outlined in SAC-13 INF-E, an IVT pilot study was planned for the second half of 2022 to: 1) collect extensive well sampling data for a simulation study to test sampling designs for well-level and trip-level catch composition estimation; and, 2) field-test the best sampling designs from (1) to identify and mitigate any logistical issues in advance of the initiation of the EMP in 2023. |
| **Relevance for management** | Development of sampling designs for estimation of catch composition for individual vessel trips is essential to the success of the enhanced monitoring program and to the IVT Program, more generally. |
| **Duration** | 6 months, September 2022 – February 2023 |
| **Work plan and status** | September – December2022: collect extensive well sampling data and conduct a simulation study to test sampling designs.<br>January – February 2023: Field-test sampling designs developed in the simulation study, to identify and mitigate any logistical issues. |
| **External collaborators** | Government of Ecuador<br>National observer programs<br>Purse-seine fleet |
| **Deliverables** | Reports for the SAC and the Commission; publications in peer-reviewed journals. |

| PROJECT B.3.a: Individual Vessel Threshold (IVT) pilot project |
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| **Updated**: March 2023 |
| **Progress summary for the reporting period** |

The pilot study concluded in February 2023. The main results of the pilot study can be summarized as follows:

a) A simulation study using the sample data determined that a systematic sampling protocol with 3.33% coverage of "units" (containers or virtual containers; see SAC-14-10, SAC-14 INF-I) of fish unloaded from a well should be a reasonable compromise between low error and practicality. In actual implementation, this within-well sampling protocol is as follows: sample one out of every 30 units of fish unloaded from a well, from the beginning to the end of the unloading of the well, starting at a randomly selected unit in the first 30 units unloaded.

b)Taking into consideration results from a second simulation study, which was used to determine the number of wells to sample per trip, the following two-stage sampling protocol will be used by the EMP: 1) at least 6 wells will be sampled per trip, selected at random for the primary catch stratum (or strata) of interest; and, 2) one systematic sample will be collected per well, using the protocol described above, where for each unit of fish sampled, the species identification of every fish, and length or weight for every tropical tuna, in the unit will be obtained.

c) This preliminary EMP protocol, which was tested during the latter part of the pilot study, produced reasonably reliable estimates of trip-level BET catch for the primary catch strata of interest, with coefficients of variation largely between 0.22 and 0.39

d) The data collected during the pilot project will be useful for other scientific investigations in support of tuna management, including studies on possible improvements to the sampling protocol of the Commission's regular port-sampling program for estimation of fleet-level catch composition

| **Challenges and key lessons learnt.** |
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The use of "chinguillos" (large cargo nets) for unloading fish from inside individual wells represented a challenge during the sampling. It will be necessary to look for alternatives to the current EMP protocol to sample these types of unloadings, which will surely require additional collaboration from the fleet representatives and delays in the unloading process.

Good communication with fleet representatives is key for proper coordination and collaboration during the sampling.

The use of tools such as voice recorders and scales can improve the sampling process and make it more cost-efficient.

| **Reports/publications/presentations** |
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SAC-14-10

SAC-14 INF-I

Publication currently submitted to the peer-reviewed journal Fisheries Research titled "Within-well patterns in bigeye tuna catch composition and implications for purse-seine port-sampling and catch estimation for the Eastern Pacific Ocean", with co-authors Lennert-Cody, De La Cadena, McCracken, Chompoy, Vogel, Maunder, Wiley, Altamirano Nieto, and Aires-da-Silva.

Other publications for peer-reviewed journals are in preparation.

| **Comments:** |
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| **PROJECT C.1.b: Sampling design evaluation for the BSE of tropical tuna catch composition** | |
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| **THEME: Sustainable fisheries** | |
| **GOAL:** C. Facilitate the improvement of data quality, coverage, and reporting by CPC data collection programs. | |
| **TARGET:** C.1. Purse-seine fleet | |
| **EXECUTION**: Stock Assessment Program | |
| STAFF CONTACT: Cristina De La Cadena | |
| **Objectives** | Extensively sample the catch of vessel wells in port to obtain data for simulation studies. Through simulation, explore improved port-sampling protocols for the fleet-level Best Scientific Estimate (BSE) of tropical tuna catch composition and its variance |
| **Background** | Through its regular port-sampling program, the IATTC has been sampling the length distribution of yellowfin (YFT) and skipjack (SKJ) tunas caught in the Eastern Pacific Ocean tuna purse-seine fishery since 1954, Pacific bluefin tuna since 1973, and bigeye tuna (BET) since 1975. In 2000, this length-frequency sampling program was broadened to include collection of independent samples of the species composition of the catches. The sampling protocol implemented was based in part on the results of simulation studies conducted in the early 1990s using data collected in the late 1980s from 6 wells with dolphin-associated (DEL) and unassociated (NOA) tuna catches. However, the performance of the protocol for the present-day fishery has not been fully evaluated, largely due to a lack of appropriate data. In particular, the fishery on floating objects (OBJ) has expanded considerably, yet the performance of the current sampling protocol for that fleet component has not been adequately studied. |
| **Relevance for management** | In conjunction with work done during the IVT pilot study (Project B.3.a) and data generated by the Enhanced Monitoring Program (EMP), will generate data with which to explore options for improvements to the regular port-sampling designs for the BSE of catch composition for all purse-seine fleet components. Improved sampling designs for fleet-level catch composition will result in greater precision of the catch composition estimates, among other things, which would be beneficial for stock assessments. Results will likely benefit sampling programs of other tuna Regional Fisheries Management Organizations |
| **Duration** | January – December 2024 |
| **Work plan and status** | January – October 2024: collect high-frequency well sampling data in ports of Mexico and Ecuador, focusing on 1-single set OBJ wells, NOA wells and DEL wells. September – December 2004: conduct a simulation study to evaluate potential improvements to fleet-level sampling designs. November 2024: Conduct an external review of potential sampling design improvements. |
| **External collaborators** | National observer programs Purse-seine fleet Funding for sampling in Mexico and Ecuador provided by the United States |
| **Deliverables** | Reports for the SAC and the Commission; publications in peer-reviewed journals. |

| PROJECT C.1.b:  Sampling design evaluation for the BSE of tropical tuna catch composition |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>Since January, a 3-person team has been sampling in the port of Manta, Ecuador. To date they have sampled 10 wells of 8 trips, 7 with catch from NOA sets, 2 with catch from DEL sets and with catch from a single OBJ set. Also, a training workshop was held at the start of March in Mazatlan, Mexico, to prepare the 2-sampler team, which will begin sampling in that port this month. |
| **Challenges and key lessons learned.** |
| **Reports/publications/presentations** |
| **Comments:**<br>- |

| PROJECT C.2.b: Pilot study of electronic monitoring (EM) of the activities and catches of longline vessels | |
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| THEME: Data collection<br>GOAL: C. Improve quality and expand coverage of data-collection programs<br>TARGET: C.2. Longline fleet<br>EXECUTION: Ecosystem and Bycatch Program<br>STAFF CONTACT: Marlon Román | |
| Objectives | Establish what data EM is capable of collecting aboard longline vessels greater than 20 meters length with as much precision as the observer as for target and non-target catch data by size and species, discards, transshipments, and the potential augmentation of data for science purposes. |
| Background | Tuna CPUE modelling requires high resolution spatial-temporal size composition data to estimate relative abundance indices.<br>Current observed EPO fishing effort coverage of 5% by longline fishing vessels greater than 20 meters length, established by Resolution C-19-08 has been considered low by the IATTC staff and the IATTC Working Group on Bycatch. Instead, it's been suggested to be raised to 20%.<br>Logistical, financial and space constrains have caused the observer placement onboard longline vessels to be difficult.<br>Shortage of human observer coverage could be achieved by electronic monitoring systems (EMS).<br>Trials on EM for longline fishing vessels have been fully developed in other regions of the Pacific Ocean, except in the EPO. |
| Relevance for management | Improved indices of relative abundance for tuna stocks will improve tuna stock assessments and therefore advise to management.<br>Size-based stock status indicators for species not monitored with assessments will improve management decisions for those species. |
| Duration | Feb 2021 – May 2024 (38-40 months) |
| Work plan and status | [M 1-2] Solicit bids from EM companies for equipment, installation and data archiving services.<br>[M 3-5] Identify vessels willing to participate in the study. Purchase EM equipment.<br>[M 6-16] Trips with simultaneous collection of EM and observer data aboard longline vessels.<br>[M 17-21] Processing of EM data.<br>[M 22-26] Statistical comparisons. If next activity not implemented, submit report.<br>[M 27-28] If implemented, develop a sampling design for a pilot study using EM aboard longline vessels, and submit report. |
| External collaborators | Fishing industry, technology companies. |
| Deliverables | Reports for the SAC and the Commission, with recommendation of minimum data fields that can be reliably collected by EM. |

| **PROJECT C.2.b: Pilot study of electronic monitoring (EM) of the activities and catches of longline vessels** |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period** <br> **Tasks achieved:** <br> August 2021-February 2024: <br> The participation of three longline vessels in the project has been confirmed: Two Chinese-Taipei flag vessels (*Yi Rong No.168 and Huang Fu*), and one Ecuadorian flag vessel (*Altar 10*). The corresponding MOUs have been signed. <br> A second Ecuadorian flag vessel (*Altar 21*) was incorporated in the study in August 2022. <br> EM equipment was purchased and installed on the participant vessels. <br> EM records and observer data started being collected aboard the participant vessels. <br> EM analysis commenced. <br> Conversations started with other longline fleets in the region to conduct similar pilot studies. <br> January 2022: A problem was detected with two cameras that were recording the catch activities on board one of the vessels. The period of sampling for that vessel was extended accordingly. <br> May 2022:  General aspects of the project were presented at the IOTC 2$^{nd}$ Working Group on EM Standards and at a Global EM Symposium organized by PEW. <br> June 2022: Human observer data started being received. <br> August-September 2022: After 6 months collecting EM records, the vessel *Altar 10* was replaced by the vessel *Altar 21* due to changes in fishing gear and fishing target on the former vessel. <br> February 2023:  EM analysis process started being made by the EM review center. <br> October 2023: EM and observer data processing started with EM data available. <br> November 2023: Received all the human observer longline data. <br> January 2024: Cumana IATTC field office staff initiated the EM analysis with remaining EM records. <br><br> Tasks pending: <br> June 2024: Continuation of processing of EM data (i.e., EM analysis). <br> May 2024: Start statistical comparisons between EM and observer data and report writing. <br> October 2024: If data allows, begin with the development of a sampling design for using EM aboard longline vessels. |
| **Challenges and key lessons learnt** <br> Vessel owners' cooperation is key for the success of the project, and in particular for data collection using both EM equipment and observers. <br> Changes in vessel participation caused the need for one-year EM records collecting for the replacement vessel (*Altar 21*), which further extended the project schedule as a result. <br> Being able to cover all the elements of the longline fleet in terms of fishing operativity, fishing strategies and vessels' infrastructure is also key to obtain a meaningful representation of longline vessels and their operability. Because of this, the IATTC staff is in conversations with other longline fleets operating in the region to potentially expand these efforts. <br> Cameras' malfunction occurred during one trip. Problem could be temporarily solved by programming commands sent remotely by the EM provider. This inconvenient caused the sampling period for that vessel to be extended accordingly. <br> The long duration of the longline fishing trips made it impossible to receive the EM records in a timely manner which can impact the work schedule of the project. Different strategies were discussed and implemented to receive the EM records before the end of the regular fishing trip. Despite some of these efforts, the time taken to obtain the EM records was significant in most of the cases. |

| EM analysis process was affected due to malfunctions in the EM analysis equipment in the IATTC headquarters, causing the EM analysis to be developed by an external EM review center, and by an IATTC field office (Cumana), which also derived in delays in the EM analysis process due to customs related issues, installation, and training |
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| **Reports/publications/presentations** <br> May 2023: Progress report presented at [SAC-14](). <br> 2021-2024: A number of presentations are expected to inform the series of EM workshops the staff is organizing as well as EM working groups, including IATTC and other t-RFMOs EM WGs. |
| **Comments:**  The staff is currently preparing a project extension proposal for a total of 46 months due to matters related to malfunctions with the EM equipment, delays in EM records retrieval, changes in the participation of one longline vessel, and delays in the EM analysis due to several issues with the EM analysis equipment and training. |

| PROJECT C.4.c: Improving the monitoring and assessment of shark stocks in the Eastern Pacific Ocean: expansion to Ecuador, Mexico and Peru | |
|---|---|
| **THEME:** Data collection<br>**GOAL:** C. Improve quality and expand coverage of data-collection programs<br>**TARGET:** C.4. Artisanal longline fleet<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Contribute towards the development and implementation of a regional shark fishery sampling program in the EPO, providing data for several types of stock assessments at IATTC (e.g. data-limited assessments, Close Kin Mark Recapture assessments, and conventional assessments). |
| **Background** | In 2014, the FAO-GEF Common Oceans program (ABNJ), funded a project to improve data collection for shark fisheries in the eastern Pacific Ocean (EPO), beginning with a focus on Central America. The project (phase 1), carried out in 2014-2018 by the IATTC and OSPESCA, was a first step towards the development of a long-term EPO regional data-collection program for sharks. During Phase 1, the data available for these fisheries were identified and compiled, and recommendations were formulated for improving data collection. Also, three workshops were held on data collection, assessment methods for shark species, and designing a pilot sampling program.<br>A Phase 2 of the project (2018-2021), build upon the results of Phase 1 developed sampling designs for shark fisheries in Central America, and tested them via a pilot study. As a result, the IATTC staff put forward proposed sampling designs for a long-term sampling program for shark fisheries in Central America (IATTC-98-02c). Despite these recent advancements, shark stock assessments in the EPO demand similar improvements in other coastal states of the region where shark fisheries are well developed. This is the case of Ecuador (Martinez et al. (2015), Mexico (Bizarro et al, 2008; Smith et al, 2008) and Peru (Alfaro-Cordova et al., 2017; Gonzalez-Pestana et al., 2019).<br>Although there is already some form of shark fishery data collection in Ecuador, Mexico and Peru, and more data could be available than in Central America, the quality of those data and their value for stock assessments are limited and vary across countries. Except for Central American nations, there is limited harmonization of shark data collection methods across EPO coastal nations, and no sampling designs for shark fisheries have been developed that take into consideration the highly migratory and trans-boundary nature of these stocks within the vast EPO region.<br>Because of this, the FAO funded (2023-2026) an expansion of the project to cover Mexico, Ecuador and Peru. |
| **Relevance for management** | The planned activities and results of the project will contribute towards the development and implementation of a regional shark fishery sampling program in the EPO, providing data for several types of stock assessments at IATTC. |
| **Duration** | 36 months (April 1, 2023 – March 31st, 2026) |
| **Work plan and status** | 2023: Produce one report identifying and describing available fishery data sources on shark species in Ecuador, Mexico and Peru (Report on Existing Data Sources – Metadata). These data sources should include but not be limited to existing fishery sampling programs, trade records, research conducted at fishery institutes and universities, as well as anecdotal information.<br>**2024:** Expand the mapping tools developed for Central America to include new data for Ecuador, Mexico and Peru. These tools identify and map all sites where shark catches |

| | are potentially landed along each country's EPO coastline**.** |
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| | For selected landing sites, conduct in situ visits to sites, collect data on site characteristics and the level of fishing activity, and catch composition.<br>**2025-2026:** Conduct a feasibility study to develop a sampling program for updating of morphometric relationships and for collecting biological samples for prioritized shark species. Develop proposals and test sampling designs for data collection of shark fishery information (catch, effort and composition data).<br>Initiate research to investigate the feasibility and development of sampling designs for Close Kin Mark Recapture (CKMR) analyses for prioritized shark species. |
| **External collaborators** | Fisheries authorities in Ecuador, Mexico and Peru. |
| **Deliverables** | Report on Existing data source on shark species in Ecuador, Mexico and Peru (Metadata report)<br>Sampling designs and logistical plans for estimating the species and size composition of shark catches in Mexico, Ecuador and Peru.<br>Report of the feasibility and sampling designs for Close Kin Mark Recapture analyses<br>Report on final sampling design, methodology and costs. |


| **PROJECT C.4.c: Improving the monitoring and assessment of shark stocks in the Eastern Pacific Ocean: expansion to Ecuador, Mexico and Peru** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>July 2023: the Local Coordinators (LCs) from Ecuador, Mexico and Peru conducted initial meetings with fishing authorities (SRP-Ecuador,PRODUCE-Peru, CONAPESCA-Mexico) and scientific entities (INAPESCA-Mexico, IPIAP-Ecuador, IMARPE-Peru) in their respective countries. Additionally, they began identifying and requesting data sources from other entities such as universities and NGOs.<br>August 2023: A Microsoft Access database was established for information storage. Moreover, the first internal workshop was held with the LCs to plan the remaining activities for 2023 and 2024.<br>September 2023: Coordination and planning for visits to regional offices of relevant fishing authorities (Ecuador) and scientific entities (Mexico and Peru) were undertaken by the LCs, and the fishing authorities' capacity to support the monitoring of shark landings was discussed.<br>September-November 2023: Fishing authorities provided historic and current shark catch statistics available in Ecuador, Mexico and Peru, along with the data collection forms and manuals used.<br>July-December 2023: Over 1,100 documents, including peer-reviewed scientific papers, grey literature and undergraduate, master, and doctoral theses, were gathered and processed from Ecuador (24%), Mexico (49%), and Peru (27%).<br>December 2023: Metadata analysis started and report produced. January-February 2024: Develop the first report of data source available (METADATA) and hire support technicians for Ecuador, Mexico and Peru.<br>February 2024: begin analysis of the unloading sites to determine landing sites for shark catches (e.g., SAC-14-INF-M), using remote sensing information (Google Earth) and the information collected in the Metadata phase.<br>March 2024: harmonization of data collection forms for the characterization of shark landing sites and fishing activity levels |

| April 2024: Development of a database for the characterization of shark landing sites and fishing activity levels. Preparation of the second progress activity report , including creating a map that highlights all identified shark landing sites using remote sensing information (i.e., Google Earth). <br> May 2024: Capacity building workshop for Local Coordinators and supporting technicians on the use of the database for the characterization of shark landing sites and fishing activity levels. |
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| **Challenges and key lessons learnt** <br> The team faced different challenges on data collection matters. In the case of Mexico, the lack of a unified and standardized system for the collection of fishery and sharks statistics across the country is a challenge. Efforts to establish a unified monitoring system are hindered by different views and preferences among professionals responsible for assessing and monitoring these species across different states. Our task will be to attempt to unify criteria, harmonize, and support the development of a national program for the collection of fishery and biological data for sharks. This absence of a unified shark sampling program in Mexico provides the opportunity to build a comprehensive data collection system, although this may require a reorientation of financial resources available. <br> On the other hand, a shark fishery sampling program exists in both Ecuador and Peru. However, these are usually affected by the lack of human resources and accessibility to some key shark landing sites, and there is the possibility of facing strong resistance by the authorities for modifications in their data collection systems considering that investments have already been made in developing data recording systems (i.e., apps and statistical software). |
| **Reports/publications/presentations** <br> A metadata report containing information about shark fishery data sources available in Ecuador, Mexico, and Peru has been prepared and shared with FAO. Document SAC-15-10 includes details on the metadata report, as well as other details about the current and future plans of the IATTC shark sampling program |
| **Comments:** |

| **PROJECT D.1.a: Exploring technologies for remote identification of FADs** |
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**THEME:** Data collection
**GOAL:** Investigate the use of new technologies to improve data quality
**TARGET:** Evaluate the functionality of electronic data collection and reporting systems
**EXECUTION**: Ecosystem and Bycatch Program

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| **Objectives** | Evaluate the suitability of different technologies to remotely and electronically identify FADs |
| **Background** | FADs may cause significant impacts species and ecosystems.<br>Assessing impacts require efficient collection methods for high-quality data, including correct tracking and monitoring of individual FADs throughout their lifetime.<br>Currently, FADs are identified using satellite-buoy identifiers, and appropriately obtaining buoys' alphanumeric serial numbers has traditionally been difficult for observers, and not possible with current EMS capabilities.<br>However, this information is key to merge and connect different IATTC databases.<br>EMS can generate certain data on FADs (e.g. deployments, removals) but only those types of data that can be collected with cameras.<br>An electronic system to automatically detect and identify FADs would improve the value and utility of all types of data, but particularly of data collected by EMS.<br>Several technologies for remote identification of objects are currently on the market. These technologies should be tested under controlled conditions to better understand their advantages and disadvantages. |
| **Relevance for management** | Technologies to remotely identify FADs would improve data collection and analyses and the development of comprehensive management recommendations for target and non-target species in the EPO |
| **Duration** | 12 months, starting in March 2022 (delayed one year due to COVID-19) |
| **Work plan and status** | [M 1-3] Preliminary assessment of candidate technologies and providers; purchase equipment.<br>[M 4-9] Test technologies under controlled conditions in the Achotines lab, Panama, gradually increasing distance between the FAD and the device used for detection and the potential severity of environmental conditions: tanks, coast, bay and open sea.<br>[M 10-12] Report writing. |
| **External collaborators** | Satlink and Digital Observer Services (DOS) |
| **Deliverables** | May 2023: reports for the FAD working group and SAC meetings with the summary of pros and cons of all the technologies considered, with specific proposals on preferred technologies for remote FAD identification and a future action plan. |

| **PROJECT D.1.a: Exploring technologies for remote identification of FADs** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>A series of meetings were conducted with project partners.<br>The feasibility of testing different technologies and their pros and cons were discussed.<br>Final decisions were made on the technologies to be tested, and material purchased.<br>Fieldwork in tropical environments was planned and executed in spring 2024 in Achotines, Panama. Before that, the technology was tested in Galicia, Spain, in December 2023 and January 2024, with promising results, and the technology was recalibrated and reconfigured as necessary. |
| **Challenges and key lessons learnt**<br>The electronic shortage and logistical issues due to COVID impacted the availability of many of these technologies, as well as the delivery times and custom clearance processes.<br>Engineering arrangements are being made to incorporate these technologies into experimental satellite buoys, so that fieldwork is efficiently conducted.<br>The at sea trials are promising although current prototypes require connection to the internet to successfully function and communciate to each other. This caveat could be overcome by developing a software interface that could make devices connect without requiring internet connection. |
| **Reports/publications/presentations**<br>A presentation will be made at the 8th *ad hoc* FAD WG meeting and the report of the project will be submitted to the EU at the due time |
| **Comments:**<br>A project extension was requested and granted due to complications related to COVID (e.g. electronic shortage, travel restrictions, customs delays). |

| LIFE-HISTORY STUDIES FOR SCIENTIFIC SUPPORT OF MANAGEMENT |
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| **PROJECT E.2.a: Investigate spatiotemporal variability in the age, growth, maturity, and fecundity of yellowfin tuna in the EPO** | |
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| **THEME:** Life-history studies for scientific support of management<br>**GOAL:** E. Life history, behavior, and stock structure of tropical tunas<br>**TARGET:** E.2. Reproductive biology of tropical tunas<br>**EXECUTION**: Biology Program | |
| **Objectives** | Estimate age, growth, maturity, and fecundity of yellowfin from four distinct areas of the eastern Pacific for use in spatially-structured stock assessment models |
| **Background** | Current estimates of age, growth, maturity, and fecundity of yellowfin are based on otolith and ovarian tissue samples collected over 30 years ago.<br>During 2009-2016 observers collected otolith and ovarian tissues samples at sea throughout the EPO<br>Tagging and morphometrics data indicate there are multiple stocks of yellowfin in the EPO, probably with different life history characteristics<br>Heavily-exploited fish stocks often show trends towards earlier maturation |
| **Relevance for management** | Spatially-structured stock assessments based on geographically-explicit life history parameters will provide a more accurate basis for the staff's management advice |
| **Duration** | 5 years; initiated in 2017 |
| **Work plan and status** | 2017-2022: Preparation and reading of otolith samples for age estimates<br>2018-2021: Preparation and reading of ovarian tissue samples for maturity and fecundity estimates<br>2019-2024: Analyses of age and growth and reproductive biology data, and preparation of manuscripts |
| **External collaborators** | |
| **Deliverables** | Updated, geographically-explicit life-history parameters for use in spatially-structured stock assessments<br>Manuscripts for publication in scientific journals |

| PROJECT E.2.a: Investigate spatiotemporal variability in the age, growth, maturity, and fecundity of yellowfin tuna in the EPO |
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| **Updated**: May 2022 |
| **Progress summary for the reporting period**<br>    Daily increment counts for 279 otoliths have been completed, 134 from the central offshore region, 130 from the central nearshore region, and 15 from the northern area.<br>    A general additive model was used to investigate whether differences in growth exists between the central nearshore and offshore regions.<br>        Microscopic slides of ovarian tissues from 1,756 fish from the four distinct areas have been evaluated and histological classifications of reproductive status completed.<br>        Fecundity estimates from 146 female yellowfin tuna have been completed. |
| **Challenges and key lessons learnt** |
| **Reports/publications/presentations**<br>        Fuller, D. and K. Schaefer. Abstract *in* Proceedings of the 69th annual tuna conference, 21-24 May 2018, Lake Arrowhead, USA<br>        Fuller, D. and K. Schaefer. Abstract *in* Report of the workshop on age and growth of bigeye and yellowfin tunas in the Pacific Ocean, 23-25 January 2019, La Jolla, USA<br>        Schaefer, K. M., and Fuller, D. W. 2022. Spatiotemporal variability in the reproductive biology of yellowfin tuna (*Thunnus albacares*) in the eastern Pacific Ocean. *Fisheries Research*, *248*, 106225. |
| **Comments:** Due to the continuation of the COVID-19 pandemic access to the SWFSC has slowed progress on preparation and reading of otoliths. Otolith preparation and reading was further slowed by the hiring and subsequent training of new staff members. |

| PROJECT E.3.a. Investigate geographic variation in the movements, behavior, and habitat utilization of yellowfin tuna in the EPO ||
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| **THEME:** Life-history studies for scientific support of management<br>**GOAL:** E. Life history, behavior, and stock structure of tropical tunas<br>**TARGET:** E.3. Analyze historical tagging data to improve spatially-structured tropical tuna assessments<br>**EXECUTION**: Biology Program ||
| **Objectives** | Evaluate geographic variation in movements, behavior, and habitat utilization of yellowfin tuna via analyses of existing archival tag data sets from several discrete areas of the EPO |
| **Background** | Yellowfin exhibit restricted movements; tagged fish are normally recovered within about 1000 nm of point of release<br>Future stock assessments of yellowfin should be spatially structured, because there are probably at least three stocks in the EPO<br>Understanding movements, dispersion, and mixing between stocks, as well as behavior and habitat utilization, is essential for understanding population dynamics, estimating exploitation rates within stocks, and preventing localized depletions |
| **Relevance for management** | Spatially-structured stock assessments based on geographically-explicit life history parameters will provide a more accurate basis for the staff's management advice |
| **Duration** | 2020-2021 |
| **Work plan and status** | Several existing archival tag data sets from discrete areas of the EPO will be analyzed and compared to describe geographic variation in movements, behavior, and habitat utilization<br>Historical conventional tag data sets for yellowfin from the EPO will also be included in the evaluations of movements and dispersion |
| **External collaborators** | |
| **Deliverables** | Manuscript for publication in a scientific journal |

| PROJECT E.3.a: Investigate geographic variation in the movements, behavior, and habitat utilization of yellowfin tuna in the EPO |
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| **Updated**: March 2021 |
| **Progress summary for the reporting period**<br>• A manuscript has been completed. |
| **Reports/publications/presentations**<br>Schaefer, K.M. and Fuller, D.W., 2022. Horizontal movements, utilization distributions, and mixing rates of yellowfin tuna (*Thunnus albacares*) tagged and released with archival tags in six discrete areas of the eastern and central Pacific Ocean. Fisheries Oceanography, 31(1), pp.84-107. |

| PROJECT E.4.a: IATTC Regional Tuna Tagging Program (RTTP) - EPO | |
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| **THEME:** Life-history studies for scientific support of management | |
| **GOAL:** E. Life history, behavior, and stock structure of tropical tunas | |
| **TARGET:** E.4. Initiate a multi-year tagging program for tropical tunas | |
| **EXECUTION**: Biology Program | |
| **Objectives** | Obtain data that will contribute to, and reduce uncertainty in, EPO tuna stock assessments, particularly for skipjack tuna; Obtain information on the rates of movement, dispersion, and mixing of skipjack, yellowfin, and bigeye tunas in the EPO, and between this region and other adjacent regions of the Pacific basin; and Obtain estimates of sex-specific growth, mortality, abundance, selectivity, and exploitation rates for those species of tuna in the EPO |
| | This project is described in detail in Appendix 2 of Document CAF-05-04, prepared for the meeting of the Committee on Administration and Finance in July 2017 |
| **Duration** | 5 years (2019-2023) |

| PROJECT E.4.a: IATTC Regional Tuna Tagging Program (RTTP) - EPO |
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| **Updated**: February 2023 |
| **Progress summary for the reporting period** |
| The initial Phase 1 85-day tagging cruise (6 March to 30 May 2019), aboard a chartered live-bait pole-and-line vessel operating off Central America and northern South America, was unsuccessful. No concentrations of skipjack, bigeye, or yellowfin tunas were found in unassociated or associated schools within the areas for which permits were obtained. A total of only 1,455 tunas were tagged: 220 skipjack (43 with archival tags (ATs)), 189 bigeye (46 with ATs), and 1,046 yellowfin (242 with ATs). The first Phase 2 89-day tagging cruise (1 February to 30 April 2020), aboard a chartered live-bait pole-and-line vessel operating off Central America and northern South America, including around the Galapagos Islands, was successful. A total of only 6,328 tunas were tagged: 6039 skipjack (185 with (ATs)), 274 yellowfin (9 with ATs), 8 bigeye (0 with ATs), and 7 fish not identified at the time of release. The second phase 2 tagging cruise and 3rd of the series executed under the RTTP was (1 March to May 2022) conducted aboard US flagged pole-and-line fishing vessel and operated across a wide area of the eastern Pacific Ocean, including the gulf of Panama for capturing and loading bait. Efforts were largely unsuccessful tagging a total of 1,115 tunas, 161 skipjack (26 with (ATs)), 829 yellowfin (221 with ATs), 125 bigeye (11 with ATs). |
| **Work Plan and Status** |
| <ul><li>Phase 2 of the IATTC RTTP - EPO will consist of two tagging cruises conducted during 2020 and 2022 of approximately 90 days each.</li><li>A pole-and-line live-bait tuna fishing vessel was chartered to conduct a tuna tagging cruise during the period of February through April of 2020.</li><li>Permits obtained from the Government of Ecuador and the Galapagos National Park, as well as the Government of Panama, and the Government of Mexico and the Revillagigedo Islands National Park for catching bait and fishing/tagging tunas during the 2020 tagging cruise period.</li><li>The 2020 cruise plan included going directly from the vessel's homeport of San Diego to the Galapagos Islands to begin fishing/tagging operations, focusing on SKJ.</li></ul> |

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| • The 2022 cruise plan was modified from 2020 as it was deemed catching bait within the Galapagos National Park wasn't possible in sufficient quantities to justify returning. |
| • For the 2022 cruise, while exhaustive efforts were taken by IATTC staff and government officials in Mexico, permits for the Revillagigedo islands were not granted, hampering the tagging efforts. |
| **Reports/publications/presentations** |
| Presentation at the May 2023 IATTC SAC Meeting |
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| **Comments:** |

| **PROJECT E.5.a: Evaluate the Pacific-wide population structure of bigeye and skipjack tunas, using genetic analyses** | |
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| **THEME:** Life-history studies for scientific support of management | |
| **GOAL:** E. Life history, behavior, and stock structure of tropical tunas | |
| **TARGET:** E.5. Genetic studies on stock structure | |
| **EXECUTION**: Biology Program | |
| **Objectives** | Determine whether bigeye and skipjack tuna from discrete areas of the Pacific Ocean show significant genetic heterogeneity |
| **Background** | Genetic studies can be used to evaluate and validate the results of tagging experiments<br>Modern genetic analyses can be used to assess genetic heterogeneity between tropical tuna stocks<br>Data from tagging experiments and genetic studies can inform spatially-structured stock assessments |
| **Relevance for management** | Spatially-structured stock assessments based on geographically-explicit life history parameters will provide a more accurate basis for the staff's management advice |
| **Duration** | 5 years (2017-2021) |
| **Work plan and status** | 2017-2019: Tissue samples from the Pacific and other oceans processed at CSIRO using genotyping and sequencing techniques<br>2018-2021: Analyses of genetic data at CSIRO with software specifically designed for uncovering and evaluating genetic heterogeneity in population structure<br>2022: Some sample cross contamination identified during analyses and resampling efforts began during Q4:2022<br>2022: Manuscript in preparation on assessment of skipjack population structure from samples from Indian Ocean, western and eastern Pacific.<br>2024: Manuscript in preparation on assessment of bigeye population structure from samples from western, central, and eastern Pacific |
| **External collaborators** | CSIRO, Hobart, Australia |
| **Deliverables** | Relevant information on population structure of bigeye and skipjack tunas in the Pacific for informing future stock assessments<br>Manuscripts for publication in scientific journals |

| PROJECT E.5.a: Evaluate the Pacific-wide population structure of bigeye and skipjack tunas, using genetic analyses |
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| **Updated**: December 2022 |
| **Progress summary for the reporting period** |
| • CSIRO processed additional tissue samples from the Pacific Ocean<br>• CSIRO conducted updated analyses of genetic data sets, including additional tissue samples Interpretation of results is being finalized<br>• CSIRO identified deficiencies in some EPO samples and resampling efforts have begun |
| **Challenges and key lessons learnt** |
| • Collections, processing, and analyses of suitable numbers of tissue samples for assessing population structure of tunas takes considerable time and effort.<br>• Preparations of manuscripts describing population structure of bigeye and skipjack tunas takes considerably longer than anticipated<br>• Samplers need to be cautious to avoid issues with sample contamination. |
| **Reports/publications/presentations:** |
| • Manuscripts in preparation on Pacific-wide population structure of bigeye and skipjack tuna |
| **Comments:** |
| **-** |

| PROJECT E.5.b: Investigate the spawning ecology of captive yellowfin tuna, using genetic analyses | |
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| **THEME:** Life-history studies for scientific support of management<br>**GOAL:** E. Life history, behavior, and stock structure of tropical tunas<br>**TARGET:** E.5. Genetic studies on stock structure<br>**EXECUTION**: Biology Program | |
| **Objectives** | Assess the spawning ecology of captive yellowfin tuna at the Achotines Laboratory, by estimating the number of females that contribute to single spawning events, and their spawning periodicity and frequency |
| **Background** | Determining spawning patterns and maternal lines of inheritance using genetic techniques contributes to understanding of the stock structure of tropical tunas<br>Captive spawning populations are useful for identifying genetic markers for female spawning patterns and matching parental markers to those found in progeny<br>During 2011-2014, spawning female yellowfin at the Achotines Laboratory were sampled to develop mitochondrial DNA markers, and these markers are being analyzed in the eggs and larvae to estimate spawning periodicity and frequency of females |
| **Relevance for management** | Better understanding of reproductive processes contributes to understanding of recruitment and population structure of yellowfin, essential for stock assessment |
| **Duration** | 12 months (June 2018-June 2019) |
| **Work plan and status** | June-December 2018: Complete laboratory analysis of genetic markers from spawning adults, eggs and larvae sampled in 2014<br>January 2019-December 2021: Preparation of final study results and submission of manuscript |
| **External collaborators** | Kindai University, Japan |
| **Deliverables** | SAC-09-14 Review of research at the Achotines Laboratory<br>SAC-10-18 Review of research at the Achotines Laboratory<br>Publication of results in a scientific journal |

| PROJECT E.5.b: Investigate the spawning ecology of captive yellowfin tuna, using genetic analyses |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>Laboratory analysis of genetic markers from spawning adults, eggs and larvae sampled in 2014 completed.<br>Analysis of DNA markers to estimate spawning periodicity and frequency of females during 2011-2014 completed;<br>Results for 2011-2013 presented at 69th Tuna Conference.<br>A new aspect of these studies is being developed during 2024-2025 in collaboration with Kindai University; Kindai colleagues are providing training to the ELH Group to use DNA to determine sex of yellowfin tuna held in captivity at the Achotines Laboratory. |
| **Challenges and key lessons learnt**<br>The genetic analyses for this study are time-consuming and require specialized analytical equipment, available to the group only at Kindai University. This delayed completion of the analysis. |
| **Reports/publications/presentations**<br>Results of genetic analysis presented at the 69th Tuna Conference, May 2018, the 71st Tuna Conference, May 2021, the World Aquaculture Society Annual Meeting, March 2019, and the 43rd Larval Fish Conference, May 2019<br>SAC-12-15 Review of research at the Achotines Laboratory<br> Cusatti, Susana, Daniel Margulies, Vernon Scholey, Yoshifumi Sawada and Yasuo Agawa. 2022. Spawning ecology of captive yellowfin tuna broodstock inferred by the use of mitochondrial DNA sequencing analysis. Aquaculture Science, Vol. 70, No. 4, December 2022. |
| **Comments:**<br>The genetic study was completed in 2022. A new aspect of these studies is being developed during 2024-2025 using DNA to determine sex of yellowfin held in captivity. |

| PROJECT F.2.a: Investigate the movements, behavior, and habitat utilization of silky sharks in the EPO | |
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| THEME: Life-history studies for scientific support of management<br>GOAL: F. Life-history studies for species at risk<br>TARGET: F.2. Life history of sharks<br>EXECUTION: Biology and Ecosystem Program | |
| Objectives | Evaluate movements, behavior, and habitat utilization of silky sharks in the equatorial and tropical EPO from in-depth analyses of existing data obtained from archival tags |
| Background | Understanding population structure and movements is essential for stock assessments, particularly for sharks<br>The information available about movements, behavior, and habitat utilization of silky sharks in the EPO is limited<br>Understanding behavior and habitat utilization is important for effective conservation measures and for ecological risk assessment analyses |
| Relevance for management | Improve management advice on silky sharks based on spatially-structured stock assessments; habitat utilization information is useful for mitigation and spatial management |
| Duration | 24 months (2020-2021) |
| Work plan and status | The archival tag data for silky sharks collected for previous IATTC projects funded through the EU will be analyzed in depth and compared for describing geographic variation in movements, behavior and habitat utilization in a manuscript to be submitted to a scientific journal.<br><br>A manuscript describing Silky Shark movements released in two discrete areas of the EPO is nearly complete using 79 datasets from miniPAT (pop-off archival tags) and will be submitted during the 2nd quarter of 2024. |
| External collaborators | INCOPESCA Costa Rica; WWF Ecuador; and INAPESCA Mexico |
| Deliverables | Manuscript for publication in a scientific journal |

| PROJECT F.2.a: Investigate the movements, behavior, and habitat utilization of silky sharks in the EPO |
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| Updated: February 2024 |
| **Progress summary for the reporting period**<br>        This project started in 2020 |

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| **PROJECT F3.a**: Feasibility study to develop a sampling program for updating morphometric relationships and collecting biological samples for priority species in EPO tuna fisheries: Phase 1 | |
| **THEME:** Life-history studies for scientific support of management <br> **GOAL:** F. Obtain key life history information for assessment and mitigation of ecological impacts on prioritized species <br> **TARGET:** F.3. Conduct life-history studies of prioritized species <br> **EXECUTION**: Biology and Ecosystem and Bycatch Program | |
| **Objectives** | To obtain morphometric relationships for priority species (e.g., tunas, billfishes, elasmobranchs, other large fishes) and to opportunistically collect biological samples |
| **Background** | Length-weight (L-W) relationships can vary markedly in space and time and can greatly influence stock and risk assessment models outcomes. L-W relationships for tunas are outdated (e.g., yellowfin: 1986, bigeye: 1966 and skipjack: 1959) or inadequate for many priority species (see SAC-13-11, SAC-09-12). <br> Catch estimations are also affected by imprecise and/or outdated L-W relationships used to convert catch in numbers to weights and vice versa. <br> Basic life history data for assessment models are absent or inadequate for most bycatch species <br> Size composition of fish and fishing grounds differ significantly between longline (LL) and purse-seine (PS) fisheries (e.g. see IATTC-98-01); this study would initially focus on a subset of longline and PS vessels to develop sampling protocols. Simultaneously, discussions between IATTC and CPCs on improving data provision (see SAC-12-09, SAC-12-16) would occur for possible expansion to other vessels and areas in coordination with the other data collection programs in the EPO (e.g. SAC-13-12). |
| **Relevance for management** | Evidence of structure in EPO stocks of tuna species has been shown from extensive tagging studies, meristic and morphometric analyses, and genetic work, and future assessment will be executed accounting for putative stock structure. Changes in catch estimations can initiate a response in management rendering improvements to conversion factors an essential component for providing better catch estimations. Collection of morphometric and biological samples (e.g. otoliths, tissues, stomachs), will provide information to refine key life history information and to develop improved models for tunas and other prioritized species, thereby advancing scientific advice for decision making. |
| **Duration** | 24 months |
| **Work plan and status** | Jun-Dec 2022: Internal staff discussions to identify target species and tasks, review and identify sampling opportunities across EPO fisheries. Reach out to CPCs and relevant stakeholders to identify collaborative sampling opportunities. As needed, collaborate with the industry to gain support, develop sampling design, data forms and databases, purchase equipment, initiate/refine protocols for LL, revise and complete protocol for PS vessels, develop a storage protocol for IATTC regional offices and imports/exports following strict international protocols, engage in conversations during workshops to improve data collection processes and identify other potential fisheries observers' program where sampling will be executed. Develop a research proposal for implementing a feasibility study in the EPO for prioritized species (Phase 2). |
| **External collaborators** | Fishing industry and CPCs, CITES offices in corresponding countries |
| **Deliverables** | Report to SAC-14 in 2023, including a potential research proposal |

| **PROJECT F3.a**: Feasibility study to develop a sampling program for updating morphometric relationships and collecting biological samples for priority species in EPO tuna fisheries: Phase 1 |
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| **Updated**: May 2024 |

**Progress summary for the reporting period**

A report summarizing the staff's internal discussions in 2022 on cross collaborations needed to address data gaps identified by the Stock Assessment, Biology and Ecosystem and Bycatch Programs was drafted (SAC-14 INF-J). The document provides background information, data gaps, potential opportunities and considerations for implementing a proposed hierarchical sampling approach for collecting morphometric data and complementary opportunistic biological sampling (e.g., tissues, stomachs, vertebral centra, gonads, and otoliths), for tropical tunas, billfishes and principal non-target species. A proposed research proposal of potential opportunities and associated budget are provided in Tables 1 and 2 (SAC-14 INF-J) and SAC-14-02b.

A staff recommendation was provided to the Commission, "In collaboration with CPCs and relevant stakeholders, develop a feasibility study (Project F.3.a)—which may be upscaled using a hierarchical phase-based approach (see SAC-14 INF-J)—for a fishery-dependent sampling program to collect morphometric measurements and biological samples from prioritized species". Although the SAC generally endorsed the recommendations on tunas in SAC-14-14, this morphometric proposal for a pilot project was not specifically mentioned (IATTC-101-03) and the project did not receive funds from the Commission.

Recommendations from the 1st External review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean, hosted in La Jolla, CA from October 2-6, 2023, further indicated the necessity for funding and implementation of Project F.3.a. The consensus of the external reviewers was that length-weight and weight-weight relationships currently used in the tuna stock assessments were "very outdated". The formal recommendation was for IATTC to "Update estimates of morphometric relationships using datasets that are sufficiently large to identify sources of variation (e.g., spatial / annual / seasonal / fishery / sampling method)."

**Challenges and key lessons learnt**

Despite the outdated nature of tuna length-weight relationships, by several decades, being used in stock assessments and the increasing interest in improving data collection for sharks and other species (e.g., dorado), biological sampling projects have yet to receive dedicated attention from the Commission.

**Reports/publications/presentations**

SAC-14 INF-J Improving data collection for morphometric relationships and biological sampling

See SAC-14-14 and IATTC-101-03 for SAC recommendations to the Commission on the need to support this type of projects

**Comments:**

The success of the project will be dependent on endorsement and funding by the SAC and Commission as well as extensive collaborations with stakeholders.

| **PROJECT G.1.a: Studies of pre-recruit survival and growth of yellowfin tuna, including expanding studies of early-juvenile life stages** | |
|---|---|
| **THEME:** Life-history studies for scientific support of management<br>**GOAL:** G. Investigate early life-history of tunas<br>**TARGET:** G.1. Investigation of the factors affecting pre-recruit survival of yellowfin<br>**EXECUTION**: Biology Program | |
| **Objectives** | Investigate the effects of key biological and physical factors on the survival and growth of pre-recruit life stages of yellowfin, with a new emphasis on studies of early-juvenile life stages |
| **Background** | Research on the early life history of yellowfin is designed to develop a more complete understanding of pre-recruit mortality and the influence of key environmental and biological factors on mortality<br>Ongoing research has examined the effects of physical (turbulence, light, water temperature, dissolved oxygen) and biological (food concentration) factors on growth and survival of larval stages of yellowfin<br>Recent rearing success now allows experimental studies of the growth and survival dynamics of early-juvenile yellowfin (1-6 months of age), a life stage rarely studied worldwide |
| **Relevance for management** | The ability to estimate the effects of key biological and physical factors on survival and growth of pre-recruit (0-6 months) life stages of yellowfin provides potentially key information on recruitment processes in yellowfin |
| **Duration** | 4 years |
| **Work plan and status** | January 2018-December 2023: Continued experimental studies of pre-recruit life stages at the Achotines Laboratory with a focus on early-juvenile life stages |
| **External collaborators** | Kindai University |
| **Deliverables** | Presentations for SAC-09, SAC-10,  SAC-11 and SAC-12<br>Publication of results in one or more scientific journals |

| PROJECT G.1.a: Studies of pre-recruit survival and growth of yellowfin tuna, including expanding studies of early-juvenile life stages |
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>　　Analysis of survival and growth patterns of larval and early-juvenile yellowfin continued through 2019, were delayed due to COVID-19 during 2020-2021 and were renewed in 2022. Current analyses focus on the early-juvenile (1-6 months) stages of yellowfin, which have been reared in land-based tanks and a sea cage since 2015. A retrospective analysis of early-juvenile growth patterns in captivity over the past 24 years is ongoing. |
| **Challenges and key lessons learnt**<br>- |
| **Reports/publications/presentations**<br>Presentations:<br>　　SAC-09 (May 2018), SAC-10 (May 2019), SAC-11 (May 2020),  SAC-12 (May 2021) and SAC-13<br>　　69th Tuna Conference (May 2018), the 70th Tuna Conference (May 2019) and the 71st Tuna Conference (May 2021)<br>　　42nd Larval Fish Conference (June 2018) and 43rd Larval Fish Conference (May 2019)<br>Two publications on this topic are being developed<br>SAC-12-15 Review of research at the Achotines Laboratory |
| **Comments:**<br> The juvenile studies continue to be supported by the regular IATTC budget with periodic collaboration with Kindai University.  Continuing studies of early-juvenile growth were delayed in 2020-2021 due to travel restrictions related to COVID-19, but were re-initiated  during 2022 and continued during 2023 and are planned for mid-2024. Research focus is now on density-dependent growth and scope for growth in early-juvenile stages from 1-6 months of age. |

| **PROJECT G.2.a: Develop comparative models of pre-recruit survival and reproductive patterns of Pacific tunas** | |
|---|---|
| **THEME:** Life-history studies for scientific support of management | |
| **GOAL:** G. Investigate early life-history of tunas | |
| **TARGET:** G.2. Comparative studies of early life histories of yellowfin and Pacific bluefin | |
| **EXECUTION:** Biology Program | |
| **Objectives** | Investigate important comparative aspects of the reproductive biology, genetics and early life histories of yellowfin and Pacific bluefin tuna |
| **Background** | Pre-recruit life stages of tunas are potentially key to understanding variations in abundance and reproductive patterns of tuna populations Ongoing since 2011, this project has investigated the comparative growth, nutrition and survival of larval yellowfin and Pacific bluefin tuna Experimental results are being used to comparatively model mortality processes occurring during the pre-recruit life stages of both species |
| **Relevance for management** | Comparative models of pre-recruit mortality processes are promising for assessing recruitment patterns of both species |
| **Duration** | 30 months |
| **Work plan and status** | June 2018-June 2020: Continue experimental studies of comparative larval growth and finalize data analyses June-December 2023: Complete manuscript and submit to scientific journal |
| **External collaborators** | Kindai University, Fisheries Laboratory University of Texas |
| **Deliverables** | Presentations for SAC-09, SAC-10 and SAC-11 Publication of results in a scientific journal |

| PROJECT G.2.a: Develop comparative models of pre-recruit survival and reproductive patterns of Pacific tunas |
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br><br>Comparative experimental studies of pre-recruit life stages of yellowfin and Pacific bluefin continued during 2018 and 2019. Experimental investigations of the growth and feeding patterns of Pacific bluefin larvae were carried out at the Aquaculture Institute of Kindai University in July 2018 and July 2019. Further studies were delayed in 2020-2021 due to travel restrictions of COVID-19, but experiments were continued during 2022.<br><br>A comparative analysis of the larval traits (survival, growth, starvation rates) of yellowfin and Pacific bluefin is being developed to gain insights into differences in spawning patterns and nursery habitats of the two species in the Pacific Ocean.<br><br>Experimental results are being incorporated into models of the pre-recruit mortality processes for both species.<br><br>A new study was initiated in mid-2019 in collaboration with Dr. Lee Fuiman of the University of Texas to investigate the relationship between diet and daily ration of captive spawning yellowfin and the fatty acid composition of their eggs. Sampling was completed in mid-2022 and samples of yellowfin eggs and adult food items are being analyzed for fatty acid composition at University of Texas. |
| **Challenges and key lessons learnt:**<br><br>- |
| **Reports/publications/presentations**<br>Presentations:<br><br>SAC-09 (May 2018), SAC-10 (May 2019), SAC-11 (May 2020), SAC-12 (May 2021) and SAC-13<br>69th Tuna Conference (May 2018) and 70th Tuna Conference (May 2019)<br>42nd Larval Fish Conference (June 2018) and 43rd Larval Fish Conference (May 2019).<br>World Aquaculture Conference (February 2020) and Aquaculture America 2024 (February 2024)<br><br>SAC-12-1 5 Review of research at the Achotines Laboratory<br><br>Two publications on this topic are being developed, and a third study was published:<br><br>Tanaka, Tenji, Tomoki Honryo, Yoshifumi Sawada, Daniel Margulies, Vernon Scholey, Jeanne Wexler, Maria Stein, Amal Biswas, and Kenji Takii. 2022. Biochemical changes occurring in yellowfin tuna eggs during embryonic development. Fishes Vol. 7, 62. |
| **Comments:**<br><br>Regular program funds are supporting the ongoing studies with Kindai University and the fatty acid study of yellowfin eggs conducted in collaboration with University of Texas. Experimental sampling in 2020-2021 was delayed due to travel restrictions related to COVID-19, but experimental work was re-initiated in 2022, continued during 2023 and is planned for mid-2024. |

| **PROJECT G.3.a: Develop a larval growth index to forecast yellowfin recruitment** | |
|---|---|
| **THEME:** Life-history studies for scientific support of management | |
| **GOAL:** G. Investigate early life-history of tunas | |
| **TARGET:** G.3. Tools to forecast recruitment | |
| **EXECUTION**: Biology Program | |
| **Objectives** | To develop a larval or early-juvenile growth index for yellowfin tuna in the Panama Bight which might prove useful as an index of recruitment strength of yellowfin in the EPO |
| **Background** | Growth rate variability in the larval and juvenile stages of pelagic marine fishes is substantial, and has strong potential to influence mortality patterns during pre-recruit life stages<br>Previous research by the Early Life History group has identified some local correspondence in the Panama Bight between high growth rates/density-dependence in growth of yellowfin larvae and recruitment estimates for yellowfin<br>Quarterly or seasonal nightlight surveys of early-juveniles in the Panama Bight are recommended at the Achotines Laboratory, with aging analysis conducted for growth rate estimation and comparison to quarterly recruitment estimates for yellowfin |
| **Relevance for management** | The development of a larval or early-juvenile growth index is promising as a forecasting tool for assessing yellowfin recruitment patterns |
| **Duration** | 4 years |
| **Work plan and status** | June 2023-December 2024: Conduct quarterly or seasonal nightlight surveys of yellowfin at the Achotines Laboratory<br>January 2023-June 2024: Conduct otolith aging analysis on field-caught fish<br>Analyze and compare growth data and recruitment estimates for yellowfin, and complete manuscript and submit to scientific journal |
| **External collaborators** | |
| **Deliverables** | Presentations for SAC-09, SAC-10, SAC-11 and SAC-12<br>Publication of results in a scientific journal |

| PROJECT G.3.a: Develop a larval growth index to forecast yellowfin recruitment |
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>　　　Analysis of *in situ* growth of yellowfin larvae and early-juveniles in relation to ocean temperature, availability of forage, larval density and availability of potential predators in nursery grounds in the Panama Bight, determined from past at-sea surveys at the Achotines Laboratory, is continuing during 2023. |
| **Challenges and key lessons learnt**<br>　　　Funding has not yet been secured for the at-sea surveys and subsequent analyses necessary for the completion of the growth index analysis, but expansion of analysis of past *in situ* growth sampling is continuing in 2024. |
| **Reports/publications/presentations**<br>Presentations:<br>　　　SAC-09 (May 2018)<br>　　　42nd Larval Fish Conference (June 2018) and 43rd Larval Fish Conference (May 2019)<br>SAC-12-15  Review of research at the Achotines Laboratory |
| **Comments:**<br>- |

| | SUSTAINABLE FISHERIES |
|---|---|

| **PROJECT H.1.b phase 2: Improve the yellowfin tuna stock assessment:** Explore alternative hypotheses of stock structure and life-history for YFT in exploratory stock assessment models ||
|---|---|
| **THEME+:** Sustainable fisheries<br>**GOAL:** H. Research and development of stock assessment models and their assumptions<br>**TARGET:** H.1. Improve routine tropical tuna assessments<br>**EXECUTION**: Stock Assessment Program ||
| **Objectives** | Improve the yellowfin tuna stock assessment by exploring alternative hypotheses of stock structure and life-history |
| **Background** | A benchmark assessment was conducted in 2020 with 48 models representing several hypotheses for the stock. The main overarching hypotheses, stock structure, was not possible to address extensively |
| **Relevance for management** | The stock assessment is used to provide management advice<br>The duration of recommended seasonal closures is based on risk analyses of bigeye and yellowfin that use the assessment results.<br>Improvements in the yellowfin assessment will make the staff's management advice more accurate and precise |
| **Duration** | 2021-2025 |
| **Work plan and status** | 2021: Re-evaluate the natural mortality assumptions<br>2022-23: Explore different hypotheses on stock structure<br>2022: Workshops to finalize improvements to the longline CPUE and length-composition data (Projects H.1.e – ext and H.1.f)<br>2023: Re-evaluate the model assumptions and implement exploratory models<br>2024: Exploratory assessment<br>2025: Benchmark assessment |
| **External collaborators** | |
| **Deliverables** | Report(s) to SAC in 2022, 2023 and 2024 |

| **PROJECT H.1.b phase 2: Improve the yellowfin tuna stock assessment:** Explore alternative hypotheses of stock structure and life-history for YFT in exploratory stock assessment models ||
|---|---|
| **Updated**: August 2024 ||
| **Progress summary for the reporting period**<br>The conceptual model (CM) for yellowfin tuna in the EPO was updated based on extensive literature review. The CM relies strongly on environmental forcing. The work focused on exploratory analyses. Tree analysis on length composition data using environmental gradients as explanatory variables were done. External reviews for data and modelling aspects of the tropical tuna stock assessments took place in 2023. The staff completed a benchmark assessment for yellowfin tuna in 2020 and another was planned for 2024. However, due to unresolved issues with the assessment, a benchmark was not completed in 2024 and an exploratory assessment was developed. A benchmark assessment is planned for 2025. Improvements in the yellowfin assessment were made to natural mortality, growth, and how fisheries are modelled. However, uncertainty remained in the stock structure. In 2024, an exploratory stock assessment was developed using these improvements that focus on data from the core area of the dolphin (DEL) fishery. Sensitivity to the assumption about the stock structure and the presence of large fish were also carried out. Stock status indicators based on purse-seine fishery associated with dolphins and longline CPUE and mean length were evaluated for five ||

areas to investigate the possibility of local depletion. Further research and data collection, particularly about stock and spatial structure, are needed to produce reliable assessments and management advice in the future. The project is extended for one more year to address the stock structure uncertainties.

In addition, in 2023-2024 an index of abundance for yellowfin tuna based on the operational-level logbook data from the Japanese longline fleet were obtained in collaboration with a visiting scientist from Japan. That indices cover mostly the area in the southwest of the EPO, which may comprise a different stock. The index presented high uncertainty in recent years due to the small sample size related to de decrease of effort of the Japanese fleet. .

**Challenges and key lessons learnt**

The main challenge is the modelling of the spatial structure for yellowfin tuna, as there is not enough tagging data to inform it.   The workshop on longline CPUE and length-composition data did not take place for lack of funding, and the work continues through collaborations with some CPCs

**Reports/publications/presentations**

SAC-14-06 YFT exploratory analysis

RVMTT-01-REP External review of modelling aspects for stock assessments of tropical tuna in the eastern Pacific Ocean (Nov 06-10, 2023)

RVDTT-01-REP External review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean (Oct-02-06, 2023)

SAC-15-INF-F Stock status indicators (SSI) for tropical tunas in the EPO

SAC-15-03 Exploratory analysis and stock status indicators for yellowfin tuna in the EPO

**Comments:**

| **PROJECT H.1.d(ext): Improve indices of abundance and length composition based on longline data** | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.1. Improve routine tropical tuna assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Improve the yellowfin and bigeye indices of relative abundance from longline data |
| | Determine methods to identify targeting in longline fisheries |
| | Develop spatio-temporal models for creating indices of relative abundance from longline data |
| | Develop appropriate longline length-composition data for the index of abundance and for the catch |
| | Continue the ongoing collaborative work |
| **Background** | Indices of relative abundance derived from longline CPUE data are the most important piece of information in the bigeye and yellowfin stock assessments |
| | Only the Japanese data are currently used to create these indices |
| | The characteristics, tactics, and spatial distribution of the fishery have changed over time |
| | The same length-composition data are used for the index and for the catch, but these could differ |
| | Collaborative research and a workshop in 2019 have substantially progressed the work towards achieving the objectives. |
| | New methods, such as spatio-temporal modelling, have been developed and are used in the creation of the indices |
| | Additional research is needed to address changes in target species and factors that may change catchability so better indices of abundance by size class can be estimated |
| | Access to operational-level data for longer time periods is essential for advancing the research. Several CPCs have granted such access to the staff under bilateral MoUs renewable. |
| | The staff is recommending changes in the data submission to facilitate the research on longline data |
| | Research conducted to resolve issues in using the longline CPUE and composition data needs to be presented and discussed with scientists of the relevant CPCs |
| **Relevance for management** | The indices have a direct impact on the stock assessment, and any improvements in the indices will directly improve the management advice for bigeye and yellowfin |
| **Duration** | 2020-2025 |
| **Work plan and status** | 2020-2022: work with CPC scientists to progress longline research |
| | Winter 2022: workshop preparation. |
| | Spring/Summer 2022: one-week workshop to discuss the results of the research conducted to resolve issues in using the longline CPUE data, write workplan to finish the work. |
| | Summer/Fall 2022: write workshop report, manuscript on longline indices of abundance |
| | 2023-2025: continue improving the indices based on longline data. |
| | If funding is obtained, organize a workshop |
| **External collaborators** | CPCs involved in the longline fishery, mainly China, Japan, Korea, Chinese Taipei |
| | Invited speakers |

| Deliverables | Workshop report |  |
|---|---|---|
|  | Indices of relative abundance |  |
|  | Length compositions |  |
|  | Project report to SAC-14, 2023 |  |
| **Budget (US$)** | Workshop and research expenses and invited participant travel costs | 50,000 |

| **PROJECT H.1.d(ext): Improve indices of abundance and length composition based on longline data** |
|---|
| **Updated**: August 2024 |
| **Progress summary for the reporting period** In 2022, through collaboration with Japan and Korea, indices for South EPO swordfish using spatiotemporal models were obtained which was used in the stock assessment stock assessment. In 2021-2022, research on spatiotemporal models was conducted using aggregated data shared by Japan through MOU. In 2023, A visiting scientist from Japan spent two months in La Jolla working on improving the indices of abundance for bigeye and yellowfin tuna using operational level data. A second visit took place in March 2024 which allowed for the estimation of indices of abundance for bigeye and yellowfin tuna using spatiotemporal models fit to operational level data from the Japanese fleet. The indices were used as indicators for both species. For bigeye tuna, the index was also used as the main piece of information in the benchmark assessment. |
| **Challenges and key lessons learnt** |
| The project was not funded, the workshop did not take place. However, discussion with CPCs, mainly Japan and Spain, took place, facilitated by visits of one staff member to the Centro Español de Oceanografía (Madrid) and National Far-Sea lab (Yokohama) while on trips for other meetings. Collaborative work was agreed, and a new MOU with Japan was discussed. Discussions with other scientists took place in several venues, and the need for a wider discussion on use of longline data for indices of abundance is widespread across RFMOs. The same fleets fish in different oceans and for different species. The need for guidelines on good practices on how to use longline data and how to standardized it to represent the stocks is urgent. Several recent assessments were almost jeopardized due to longline indices of abundance issues. The IATTC staff would like to initiate a dialog across scientists and scientific providers working on different RFMOs on this topic. |
| The staff also organized a workshop focused on industrial longline to discuss the recommendations to change the data reporting resolution, with the aim of improving the data reporting of longline logbooks (WSDAT-01) and proposed modifications in the submission of operational level data (SAC-14-INF-Q) |
| The continuation of the work depends on scientific staff access to the data from the CPCs. |
| **Reports/publications/presentations** |
| SAC-13-INF-M Comparisons of indices of abundance for the swordfish |
| SAC-13-INF-N Japanese logbook analysis for southern eastern swordfish |
| SAC-14-05 Exploratory analysis for the bigeye assessment |
| SAC-14-15 South EPO swordfish assessment: final report |
| WSDAT-01 Report |
| SAC-14-INF-Q  1st workshop on improvements in data collection and provision (LL fishery) - updated recommendationsSAC-15-03 |
| SAC-15-02 Bigeye tuna benchmark assessment 2024 |
| SAC-15-INF-F Stock status indicators (SSI) for tropical tunas in the EPO |
| SAC-15-INF-U Analysis of Japanese longline fishery data for skipjack in the eastern Pacific Ocean |
|  |
| **Comments:** |
| The staff is requesting for funding again this year. The objectives would be broader to encompasses tuna, billfish and sharks and focus on discussing good practices when constructing indices of abundance using longline data. |
| The staff will continue collaborating with the CPCs to improve the indices. |

| PROJECT H.1.g: Improve the purse-seine index of abundance for yellowfin tuna based on CPUE of purse-seine sets on dolphins | |
|---|---|
| THEME+: Sustainable fisheries<br>GOAL: H. Research and development of stock assessment models and their assumptions<br>TARGET: H.1. Improve routine tropical tuna assessments<br>EXECUTION: Stock Assessment Program | |
| Objectives | Improve the yellowfin tuna stock assessment main index of abundance by understanding factors related to catch rates and length composition |
| Background | Since the 2020 benchmark assessment for yellowfin tuna, the main index of abundance is obtained from the CPUE of purse-seine sets on dolphin standardized using spatiotemporal models.  The fisheries, however, have evolved over time, and changes in catchability may have occurred. Discussions with the fishing industry revealed that substantial changes in technology have occurred in the last 5 years. In addition, there is evidence that the length composition of tunas may differ according to the species of dolphin they are associated with. Finally, the external review panel indicated that the was no clear evidence that the index was an index of abundance of yellowfin rather than an index of the yellowfin-dolphin interaction. |
| Relevance for management | The yellowfin tuna stock assessment main piece of information is the index derived from the purse-seine fisheries with sets associated with dolphins. Improvements in the index will reflect in the yellowfin assessment, which will make the staff's scientific advice more accurate and precise. |
| Duration | 2024-2027 |
| Work plan and status | List potential variables that can change catchability including code groups and changes in technology.<br>Exploratory data analysis<br>Modelling |
| External collaborators | Purse-seine fishing industry that operates with purse-seine sets on dolphins |
| Deliverables | Report(s) to SAC in 2026, 2027 |
| Budget (US$) | Travel money for meetings with the industry | |
| | | |

| PROJECT H.3.a: Analysis of recent skipjack tagging data | | |
|---|---|---|
| **THEME:** Sustainable fisheries | | |
| **GOAL:** H. Improve and implement stock assessments, based on the best available science | | |
| **TARGET:** H.3. Develop a benchmark stock assessment for skipjack tuna (conditional on implementation of tagging program | | |
| **EXECUTION**: Stock Assessment Program | | |
| **Objectives** | Estimate abundance and fishing mortality rate of skipjack tuna from recent tagging data while accounting for mixing rates | |
| **Background** | Currently, no assessment is available for skipjack tuna in the EPO<br>Tagging data has been collected in several recent tagging cruises<br>Practicalities of tagging skipjack limit the spatial distribution of tag releases<br>The short-lived nature of skipjack tuna necessitate the modelling of mixing rates<br>Spatio-temporal models of abundance are combined with advection-diffusion of tags to model the tagging data and estimate absolute abundance and fishing mortality | |
| **Relevance for management** | Provides estimates of abundance and fishing mortality that can be used in stock assessments or compared with proxy reference points | |
| **Duration** | 2021-2024 | |
| **Work plan and status** | Contract analyst<br>Develop model<br>Apply model to updated data<br>Present methods and results at SAC<br>Publish paper | |
| **External collaborators** | To be determined | |
| **Deliverables** | Report presented at SAC 2024<br>Published paper | |
| **Budget (US$)** | From EU tagging project funding | $150,000 |

| PROJECT H.3.a: Analysis of recent skipjack tagging data |
|---|
| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Analysis of tagging data conducted |
| **Challenges and key lessons learnt**<br>The analysis is computationally demanding, but switching methodologies solved this issue<br>Future work needs to include the fishing mortality<br>Possible applicable to yellowfin and bigeye |
| **Reports/publications/presentations**<br>SAC-13-08, SAC-14 INF-E, SAC-15 INF-G |
| **Comments:**<br>Funding was secured from the EU for 2024 |

| PROJECT H.3.b: Skipjack Stock assessment | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL: H**. Improve and implement stock assessments, based on the best available science | |
| **TARGET:** H.3. Develop a benchmark stock assessment for skipjack tuna | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | To develop as stock assessment, including the use of tagging data, to provide stock status and management advice |
| **Background** | The PSA rationale is no longer appropriate for skipjack tuna due to the implementation of the IVLs for bigeye tuna<br>A stock assessment is needed for skipjack tuna to provide management advice<br>Analysis of tagging data can provide estimates of biomass and fishing mortality<br>An interim assessment was developed in 2022 and was considered reliable enough for management advice<br>Several aspects of the assessment could be improved |
| **Relevance for management** | Provides management advice for skipjack tuna |
| **Duration** | 2024 |
| **Work plan and status** | Develop model<br>Apply model to updated data<br>Present methods and results at SAC |
| **External collaborators** | DTU |
| **Deliverables** | Report presented at SAC 2024 |
| **Budget (US$)** | IATTC staff | |

| PROJECT H.3.b: Skipjack Stock assessment | |
|---|---|
| **Updated**: May 2024 | |
| **Progress summary for the reporting period** | |
| The skipjack benchmark assessment was completed | |
| **Challenges and key lessons learnt** | |
| **Reports/publications/presentations** | |
| SAC-15-04 | |
| **Comments:** | |

| PROJECT H.3.c: Estimate skipjack growth rates from recent tagging data | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** H. Improve and implement stock assessments, based on the best available science<br>**TARGET:** H.3. Develop a benchmark stock assessment for skipjack tuna (conditional on implementation of tagging program<br>**EXECUTION**: Stock Assessment Program | |
| **Objectives** | To estimate growth from data collected in the recent tagging cruses |
| **Background** | Estimates of growth are needed for YPR analysis and stock assessments<br>Otolith data is unreliable for estimating growth of skipjack tuna<br>Data is available from several recent tagging cruises<br>Tag growth increment data can be used to estimate length-specific growth rates |
| **Relevance for management** | The estimates of growth will be used in YPR and/or stock assessment models to provide management advice |
| **Duration** | 2023-2024 |
| **Work plan and status** | Develop model<br>Apply model to updated data<br>Present methods and results at SAC<br>Publish paper |
| **External collaborators** | None |
| **Deliverables** | Report presented at SAC 2024<br>Published paper |
| **Budget (US$)** | IATTC Staff | |

| PROJECT H.3.c: Estimate skipjack growth rates from recent tagging data | |
|---|---|
| **Updated**: May 2022 | |
| **Progress summary for the reporting period**<br>Growth analysis conducted | |
| **Challenges and key lessons learnt**<br>    No tagging data is available for large skipjack<br>    No aging data is available | |
| **Reports/publications/presentations** | |
| **Comments:**<br>-The absolute age and asymptotic length could not be estimated from the tagging data | |

| PROJECT H.4.a: Conduct routine stock assessments of tropical tunas | |
|---|---|
| THEME: Sustainable fisheries | |
| GOAL: H. Research and development of stock assessment models and their assumptions | |
| TARGET: H.4. IATTC tropical tuna assessments | |
| EXECUTION: Stock Assessment Program | |
| **Objectives** | Update the assessments of bigeye, yellowfin, and skipjack tunas |
| **Background** | Assessments or indicators of bigeye, yellowfin, and skipjack are conducted every year |
| | Bigeye and yellowfin assessments use the Stock Synthesis modeling platform |
| | Skipjack assessment is based on stock status indicators |
| | Assessments or indicators are updated annually, using the most recent data |
| | Major improvements to the assessments (methods and assumptions) are implemented periodically |
| **Relevance for management** | The staff's management advice for tunas is based on its stock assessments |
| | The duration of the seasonal closures recommended by the staff for bigeye and yellowfin are based on the fishing mortality estimated in the assessments |
| **Duration** | Every year (March-May) |
| **Work plan and status** | 15 March: data for previous year available; assessments initiated |
| | Three weeks before SAC meeting: Assessment reports posted on IATTC website |
| | Mid-May: Present assessments at SAC meeting |
| **External collaborators** | |
| **Deliverables** | Stock assessment reports for the SAC and the IATTC; presentations at SAC and IATTC meetings |

| PROJECT H.4.a: Conduct routine stock assessments of tropical tunas | 
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period** |
| Benchmark assessment conducted for bigeye 2020 |
| Benchmark assessment conducted for yellowfin 2020 |
| Interim assessment conducted for skipjack 2022 |
| Indicators constructed for the three species 2023 |
| External review of modelling aspects for stock assessments of tropical tuna in the eastern Pacific Ocean (Nov 06-10, 2023) RVMTT-01 |
| External review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean (Oct-02-06, 2023) RVDTT-01 |
| Benchmark assessment for bigeye 2024 |
| Benchmark assessment for yellowfin tuna 2024 |
| Benchmark assessment for skipjack tuna 2024 |
| **Challenges and key lessons learnt** |
| The results of the bigeye and yellowfin assessments were considered unreliable, and they were improved for the 2020 benchmark assessments (Projects H.1.a and H.1.b). The models were further improved to address the uncertainty about the stock structure of yellowfin tuna and the bimodal pattern in the results of the risk analysis for bigeye tuna. The external review panels suggested several scenarios to include in the risk analyses for both species. |

**Reports/publications/presentations**

[SAC-11-06](#) Bigeye tuna: benchmark assessment

[SAC-11-07](#) Yellowfin tuna: benchmark assessment

[SAC-12-06](#) Assessment methods for skipjack in the EPO: a proposal relying on recent data from the IATTC regional tuna tagging program (2019-2022)

[SAC-13-07](#) Skipjack tuna: interim assessmentSAC-14-04 Stock status indicators (SSIs) for tropical tunas in the eastern Pacific Ocean

[RVMTT-01](#)-REP External review of modelling aspects for stock assessments of tropical tuna in the eastern Pacific Ocean (Nov 06-10, 2023)

[RVDTT-01](#)-REP External review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean (Oct-02-06, 2023)

[SAC-15 INF-F](#) - Stock status indicators (SSIs) for tropical tunas in the eastern Pacific Ocean

**Comments:** A new scientist was hired to join the stock assessment team who will lead the skipjack stock assessment.

| PROJECT H.6.a: Participate in assessments of shared species by the International Scientific Committee (ISC) | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.6. ISC stock assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Staff participation in development and improvement of assessments for North Pacific-wide species of interest to the IATTC, especially Pacific bluefin and albacore tunas, but also billfishes and sharks |
| | Understand the assessment results, and communicate them to the Commission |
| **Background** | The ISC and its various working groups assess stocks in the north Pacific that are covered by both the IATTC and WCPFC |
| | The IATTC staff provides data and advice for the assessments |
| | Assessments are periodic, and the stocks assessed differ each year. |
| **Relevance for management** | The IATTC uses the results of the ISC assessments to provide management advice |
| **Duration** | Ongoing; ISC meets annually, usually in July |
| **Workplan and status** | See ISC website for details (http://isc.fra.go.jp/) |
| **External collaborators** | ISC |
| **Deliverables** | Report to SAC meetings |

| PROJECT H.6.a: Participate in assessments of shared species by the International Scientific Committee (ISC) |
|---|
| **Updated**: May 2024 |
| **Progress summary for the reporting period** |

February 2020: submitted a working paper for the Billfish working group
March 2020: Attended the virtual Pacific bluefin working group workshop. New benchmark assessment developed.
September 2020: Attended the virtual Albacore working group workshop about the progress on Management Strategy Evaluation
December 2020: Attended the virtual Albacore working group workshop about the progress on Management Strategy Evaluation
November 2020: Attended the virtual billfish working group biological workshop to assess histological and ageing methods for north Pacific billfishes.
November 2020: Attended the virtual billfish working group data preparation workshop to prepare data inputs for the 2021 blue marlin stock assessment.
February 2021: Started a Basecamp North Pacific Albacore MSE – ISC albacore working group discussions for managers and other stakeholder
March 2021: Attended the 5th North Pacific Albacore MSE workshop; the objectives were: (i) help managers and stakeholders understand MSE results, (ii) get feedback to ALBWG on the presentation of MSE results.
March 2021: Made a presentation to the Billfish working group on the "1th technical workshop on S EPO swordfish, Stock structure of swordfish in the Pacific Ocean".
April 2021: Participated in the north Pacific bluefin working group meeting.
December 2021: Attended the virtual billfish working group data preparation workshop to prepare

data inputs for the 2022 striped marlin stock assessment.
May 2022: Attended the [webinar of the North Pacific Albacore Working Group](#). Collaborated on a working paper.
November 2022: participated in the shortfin mako working group meeting on biological assumptions. Assisted with the development of the shortfin mako conceptual model with provision of habitat use and post release survival data.
November 2022: Attended the virtual billfish working group data preparation workshop to prepare fishery and biological data inputs for the 2023 North Pacific swordfish stock assessment.
December 2022: Attended the virtual billfish working group biological data workshop on billfish ageing.
December 2022: Made a presentation on the use of conceptual models to improve stock assessment models at the [Shark Working group meeting](#) (Shimizu, Japan).
December 2022: Attended the North Pacific Albacore Working Group [data preparatory meeting](#). The goal of the meeting was to review the inputs to the 2024 stock assessment (Yokohama, Japan).
February 2023: Attended the ISC SHARKWG North Pacific shortfin mako pre-assessment workshop held in La Jolla, CA, USA.
March 2023: Attended the Bluefin Tuna Working Group meeting. The goals of the meeting were to evaluate the data for the next benchmark assessment and discuss MSE
March 2023: Attended the North Pacific Albacore Working Group meeting. The goal of the meeting was to conduct the stock assessment (La Jolla, USA).
April 2023: Attended the Billfish Working Group meeting. The goals of the meeting were to revise the conservation information for striped marlin and to conduct the stock assessment of the north Pacific swordfish (Honolulu, USA).
May 2023: Attended the ISC SHARKWG North Pacific shortfin mako (SMA) conceptual model development workshop (remote participation)
June 2023: Attended the ISC SHARKWG SMA conceptual model review workshop (remote participation)
November 2023: Remotely participated in the data preparatory meeting (hybrid-meeting) for stock assessment of North Pacific shortfin mako held in Yokohama Japan.
January 2024: Attended the ISC BILLWG meeting (discussion on rebuilding plan for MLS and external review for MLS) (remote participation)
January 2024: Attended the ISC SHARKWG SMA Model development meetings in La Jolla, CA.
March 2024: Attended the ISC North Pacific Albacore Working Group meeting (Victoria, Canada).

**Challenges and key lessons learnt**
The main challenge has been to conciliate tasks the scientific staff need to lead with the participation in the ISC working groups.

**Reports/publications/presentations**
See working group reports on the ISC [website](#)

**Comments:**
- Future funding for staff to travel to these meetings should be allocated.

| **PROJECT H.7.c: Participate in south Pacific albacore assessment** | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.7. Other assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Staff participation in development and improvement of the south Pacific albacore assessment |
| | Understand the assessment results, and communicate them to the Commission |
| **Background** | The assessment is for albacore in the south Pacific that are covered by both the IATTC and WCPFC |
| | The IATTC staff provides data and advice for the assessment |
| **Relevance for management** | The IATTC uses the results of the assessment to provide management advice |
| **Duration** | Ongoing; SPC to deliver assessment results in the 2021 SC |
| **Workplan and status** | See [SPC website](#) for details |
| **External collaborators** | SPC |
| **Deliverables** | Report to SAC meetings |

| **PROJECT H.7.c: Participate in south Pacific albacore assessment** |
|---|
| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| January 2021: Attend the SPC stock assessment meetings for south Pacific albacore |
| March 2021: Made a presentation in the SPC pre-assessment workshop (PAW) on the fishery stratification for albacore in the southern EPO |
| August 2021: Presented the assessment results in SPC's 17th regular session of the scientific committee |
| May 2022: Present the assessment results in SAC-13 |
| April 2024: participate in a South Pacific Albacore assessment with emphasis on climate change |
| Challenges and key lessons learnt |
| Movement scenario is the largest axis of uncertainty in the south Pacific albacore assessment |
| The south Pacific albacore stock is healthy and the recent fishing mortality was much lower than the fishing mortality corresponding to MSY |
| Spawning biomass decreased fast in recent years due likely to high longline catch |
| The stock should be monitored in the future through for example stock status indicators and conduct another benchmark assessment in 3 or 4 years |
| **Reports/publications/presentations** |
| The stock assessment report can be found at https://meetings.wcpfc.int/node/12551 |
| **Comments:** |
| - |

| PROJECT H.7.d: Participate in south EPO blue shark assessment | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.7. Other assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Staff participation in development of the south Pacific blue shark assessment<br>Understand the assessment results, and communicate them to the Commission |
| **Background** | The assessment is for blue shark in the south Pacific covered by both the IATTC and the CPPS<br>The IATTC staff provides data and advice for the assessment |
| **Relevance for management** | The IATTC uses the results of the assessment to provide management advice |
| **Duration** | 5 years: 2022 – 2026 |
| **Workplan and status** | A Memorandum of Understanding was signed between the IATTC and the CPPS for the mutual goal of doing a stock assessment for the blue shark in the south EPO, the following activities are planned, they will be implemented by CPPS with assistance from the IATTC staff:<br>2022 – Coordination meeting (September 2022)<br>2023 – Workshop about the fisheries for blue shark<br>2024 – Workshop on the conceptual model for blue shark and data<br>2025 – Workshop on stock assessment of blue shark<br>2026 – Workshop on management strategy evaluation |
| **External collaborators** | *Comisión Permanente del Pacífico Sur* (CPPS), the focal point is Dr. Patricio Barría (IFOP-Chile), chair of the *Comité Científico y Técnico PAR-Tiburón* |
| **Deliverables** | Report to SAC meetings |

| PROJECT H.7.d: Participate in south EPO blue shark assessment |
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>A workshop for building a conceptual model for the stock is planned for the second semester of 2024 |
| **Challenges and key lessons learnt**<br>The main challenge is the time availability for the staff to dedicate to the work |
| **Reports/publications/presentations** |
| **Comments:** |

| PROJECT H.7.e: South EPO swordfish monitoring and research | |
|---|---|
| THEME: Sustainable fisheries | |
| GOAL: H. Research and development of stock assessment models and their assumptions | |
| TARGET: H.7. Other assessments | |
| EXECUTION: Stock Assessment Program | |
| Objectives | Monitor the South EPO swordfish using indicators<br>Continue the research for improving the assessments |
| Background | The South EPO swordfish stock benchmark assessment was finalized in 2023.<br>The stock needs to be monitored due to the increase in catches and indices.<br>Several hypotheses may explain this pattern, it is not clear which one is more likely.<br>Collaborative research with CPCs should be continued to improve the understanding about this stock and its fisheries |
| Relevance for management | The stock assessment is needed to provide management advice |
| Duration | 2023-2025 |
| Workplan and status | Exploratory data analysis for the Ecuadorian fleet<br>Improvement on indices of abundance<br>Report to SAC |
| External collaborators | Scientists from Chile, European Union, Peru, Japan, Korea, Chinese Taipei, China and the Pacific Community (SPC) |
| Deliverables | Documents for SAC-15 and SAC-16 |

| PROJECT H.7.e: South EPO swordfish monitoring and research |
|---|
| Updated: March 2024 |
| **Progress summary for the reporting period**<br>The Ecuadorian longline observers database was incorporated to the IATTC databases |
| **Challenges and key lessons learnt**<br>The main challenge is the availability of time for the stock assessment staff to dedicate to the project giving the benchmark assessments for the tropical tunas. |
| **Reports/publications/presentations** |
| **Comments:** |

| PROJECT H.8.b: Second trial dolphin survey in the eastern tropical Pacific Ocean (ETP) |
|---|
| **THEME:** Sustainable Fisheries |
| **GOAL:** H. Improve and implement stock assessments, based on the best available science |
| **TARGET:** H.8. Assess status of dolphin stocks in the eastern tropical Pacific |
| **EXECUTION**: Stock Assessment Program, Ecosystem and Bycatch Program |

| | |
|---|---|
| **Objectives** | Fully field-test the drone protocol to be used in a main dolphin survey, as outlined by Oedekoven et al. (2021) |
| **Background** | Population dynamics modelling has been the preferred approach for evaluating the stock status of ETP dolphins, and those models have relied on estimates of abundance from fishery-independent surveys that were conducted by the National Marine Fisheries Service (NMFS). |
| | As a result of a hiatus in the NMFS surveys since 2006, there are currently no reliable indicators with which to monitor the status of ETP dolphin populations. This lack of information poses obvious problems for management. For example, the Antigua Convention of the Inter-American Tropical Tuna Commission (IATTC) requires that the status of all species potentially impacted by the tuna fisheries in the eastern Pacific Ocean be monitored. |
| | In addition, abundance estimates are needed to ensure that incidental dolphin mortalities are both sustainable and insignificant because the stock mortality limits are based on estimates of abundance. |
| | These needs provide impetus for a new ship-based line-transect survey to obtain new estimates of absolute abundance so that population trends can be updated. In preparation for a new dolphin survey, trial survey was conducted in November 2019 (Oedekoven et al. 2021) to field-test the ship and drone survey protocols that would be used in the new survey. |
| | During this trial survey it was not possible to fully test the drone protocol because the drone camera systems and data acquisition systems, and drone personnel, provided to the project were not according to the specified protocol, and thus a second trial survey is necessary. |
| **Relevance for management** | Improve the management of dolphin stocks in the ETP. |
| **Duration** | November 2022 – May 2024 |
| **Work plan and status** | November 2022 – March 2023: preparation of a detailed trial survey work plan and budget. |
| | April 2023 – October 2023: preparation for second trial survey. |
| | November 2023: conduct second trial survey. |
| | December 2023 – May 2024: data analysis, prepare report. |
| **External collaborators** | University of St Andrews (and contractors hired by the University of St Andrews) |
| | Pacific Alliance for Sustainable Tuna |
| | Government of Mexico |
| **Deliverables** | Presentation at SAC-14 (May 2023) on trial survey plan; report on the results presented at SAC-15 (May 2024). |
| **Comments** | In as much as funding for this project has not yet been secured, the timeline shown above is preliminary. |

| **PROJECT H.8.c: Cow-calf separation study** | |
|---|---|
| **THEME:** Sustainable Fisheries | |
| **GOAL:** H. Improve and implement stock assessments, based on the best available science | |
| **TARGET:** H.8. Assess status of dolphin stocks in the eastern tropical Pacific | |
| **EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Evaluate whether permanent separation of dolphin mothers and their calves occurs during purse-seine fishing operations on dolphin-associated tuna. |
| **Background** | With the drastic decrease in dolphin mortality due to entanglement in tuna purse-seine nets during the 1990s, more attention was paid to other possible sources of mortality.<br>Some studies have shown that in the 1980s and 1990s there were cases of orphaned nursing calves due to maternal mortality.<br>Based on analysis of biological samples collected by fisheries observers, it has also been suggested that mothers and calves may be separated during chases leading to purse-seine sets.<br> However, it remains an open question whether current fishing operations lead to permanent separation of cows and calves.<br>The objective of this study is to resolve this question by determining, through direct observation, whether dolphin mothers and calves are indeed separated during chase and/or backdown. |
| **Relevance for management** | Improve the management of dolphin stocks in the ETP. |
| **Duration** | 1 year |
| **Work plan and status** | May 2022: obtain commitment from one or more purse-seiners to participate in the study.<br>June – August 2022: hold workshop on development of a detailed field protocol; consultation with drone team on project details; hire graduate students and an observer to assist with project.<br>September – November 2022: preparation for study.<br>December 2022 – January 2023: Conduct field study.<br>January – May 2023: data analysis; report preparation. |
| **External collaborators** | Michael Scott;<br>Workshop participants: Drs. Karin Forney and Eric Archer (NMFS); Drs. Lisa Balance and John Durban (Oregon State University).<br>Drone company; several graduate students, one or more purse-seine vessels.<br>Pacific Alliance for Sustainable Tuna |
| **Deliverables** | Presentation of results at SAC-14 and SAC-15 (May 2023-2024). |
| **Comments** | As much as full funding for this project has not yet been secured, the timeline shown above is preliminary. |

| PROJECT I.1.a: Conduct a Management Strategy Evaluation (MSE) for tropical tunas in the EPO | |
|---|---|
| THEME: Sustainable fisheries | |
| GOAL: I. Test harvest strategies using management strategy evaluation (MSE) | |
| TARGET: I.1. Conduct a comprehensive MSE for bigeye tuna and plan MSEs for the other tropical tuna species, including the multi-species fishery for tropical tunas | |
| EXECUTION: Stock Assessment Program | |
| Objectives | Continue technical development of MSE for tropical tunas.<br>Provide training and enhance dialogue / communication among scientists, industry, managers and other stakeholders regarding the MSE process for tropical tunas through the facilitation of a series of workshops.<br>Elicit alternative candidate reference points, harvest control rules, performance metrics from stakeholders to be tested in addition to the interim ones. |
| Background | The Performance Review of the IATTC, the proposed Strategic Science Plan, and the SAC all recommended improving knowledge sharing, human-institutional capacity building and communication of scientific advice.<br>MSE is a major objective at IATTC and other organizations. Part of the MSE process is highly technical and done by scientists. Another part (defining objectives, performance metrics, candidate management strategies), requires input and participation of managers and other stakeholders. These parts evolve in synergy. Stakeholder participation throughout the MSE process is central to its success and will be facilitated by understanding the MSE process, its components and by strengthening communication among scientists, managers and other stakeholders. Initial introductory workshops on MSE in 2015, 2018, restricted to Latin-American developing countries. Further MSE training workshops for the tuna Industry were held in 2019. Three IATTC MSE Workshop were held (2019, 2021, 2022). |
| Relevance for management | Key elements of IATTC's current management strategy, such as its control rule and reference points, along with alternatives, are currently being evaluated via MSE. The technical support will allow for better model development and directly influence the relevance of the MSE results.<br>Workshops will improve scientists, managers and other stakeholder communication and important input for the technical work.<br>Results will facilitate adopting a permanent tropical tuna HCR as per Res. C-16-02 |
| Duration | MSE Workplan for BET extended to 2024, funds secured for a permanent harvest strategy staff position starting January 2024. |
| Work plan and status | Continue technical development of MSE and support of IATTC Staff.<br>Development/tailoring of MSE Workshop materials and online resources to EPO tropical tuna fisheries including presentations and hands-on working sessions. Conduct annual Workshops with managers, industry and other stakeholders to improve understanding of the MSE process, elicit objectives, performance metrics, alternative control rules, and risk, as well as to show initial results/gather feedback |
| Collaborators | Work carried out by external contractor and IATTC staff. |
| Deliverables | Reporting to SAC of MSE development, progress, and results. Series of Workshops, Workshop reports and associated training and online materials. |

| PROJECT I.1.a: Conduct a Management Strategy Evaluation (MSE) for tropical tunas in the EPO |
|---|
| **Updated**:  February 2024 |
| **Progress summary for the reporting period**<br>Modified MSE demonstration tool (https://valeromaspez.shinyapps.io/TunaMSE_EPO_ENG/)<br>Customized computer code for MSE simulation work.<br>2nd and 3rd IATTC MSE workshops were conducted during May 2021 and December 2022. |
| **Challenges and key lessons learnt**<br>Pandemic altered the timeline and format of the 2nd and 3rd WS, funding has been  secured for continuation of MSE work by establishing a new harvest strategy staff position. |
| **Reports/publications/presentations (selected)**<br>**Presentations**:<br>May 2021: 2nd IATTC MSE Workshop Presentations<br>December 2022: 3rd IATTC MSE Workshop Presentations<br><br>**Reports**:<br>Valero, J. L. 2023. Management strategy evaluation (MSE) for tropical tuna fisheries in the EPO: progress report. Document SAC-14-INF-F. Inter-Amer. Trop. Tuna Comm.<br>Valero, J. L., and A. Aires-da-Silva. 2023. 3rd IATTC Workshop on Management Strategy Evaluation (MSE) for tropical tunas: management objectives and performance metrics. IATTC Meeting Report.<br>Maunder, M. N., Aires-da-Silva, A., Minte-Vera, C., Valero J. 2023. Interim limit and target reference points for tuna, billfish and other highly productive fishes in the Eastern Pacific Ocean. Document SAC-14-INF-O. Inter-Amer. Trop. Tuna Comm., 14th Scient. Adv. Com. Meeting.<br>Valero, J. L., and A. Aires-da-Silva. 2022. 2nd IATTC Workshop on Management Strategy Evaluation (MSE) for tropical tunas: management objectives and performance metrics. IATTC Meeting Report.<br>IATTC. 2021. Development, Communication And Evaluation Of Management Strategies (MSE) For Tropical Tuna Fisheries In The EPO Involving Managers, Industry, Scientists And Other Stakeholders. Document IATTC-98-INF-I. Inter-Amer. Trop. Tuna Comm., 98th Annual Meeting. |

| **PROJECT J.1.a:** Temporal trends and variability in the spatial distribution of tropical tuna purse-seine fishing | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** J. Relationship between purse-seine fishing strategies and fishing mortality<br>**TARGET:** J.1. Identify and monitor changes in technology and fishing strategies<br>**EXECUTION**: Ecosystem and Bycatch Program and Stock Assessment Program | |
| **Objectives** | Evaluate the reliability of the data obtained on identification of FADs.<br>Develop spatial-temporal indices and statistics of tropical tuna purse-seine fishery distribution in the EPO.<br>Understand the dynamics of the purse-seine fishing operations and fishing behavior in the eastern Pacific Ocean. |
| **Background** | Catch per unit effort (CPUE) standardization and model-based stock assessments are the standard for assessing the abundance and stock status of exploited species.<br>However, these approaches are complex and it can be difficult to identify all covariates for estimating stock size while controlling for changes in fishing efficiency.<br>If these approaches are not properly implemented, they can lead to hyperstability, wherein CPUE values remain constant despite stock decline.<br>Therefore, it is useful to complement more sophisticated stock assessment models with simpler approaches based on catch and effort data to maximize the probability of detecting overexploitation and hyperstability as early as possible.<br>Time series of spatial indices of fisheries can help identify temporal patterns with a focus on long-term trends that might be indicative of declining stock status for both tuna and bycatch species or hyperstability. |
| **Relevance for management** | This project will contribute to advance our understanding of tropical tuna purse-seine fisheries spatial-temporal dynamics and their relationship to both target and non-target species catch and propose, as needed, conservation and management measures for the IATTC fisheries, as necessary.<br>This project is also expected to receive feedback and support of well-established working groups in other t-RFMOs, such as the tropical tuna, FAD or Bycatch and Ecosystem working groups of IOTC and ICCAT. |
| **Duration** | 24 months |
| **Work plan and status** | Develop a series of annual spatial indices for the catch of the three major species of tropical tunas and the most important bycatch species, as a function of ocean and fishing mode.<br>Examine the time series of these indices to identify trends and/or unique events with a particular eye towards any long-term trends that might be indicative of declining stock status and hyperstability.<br>Analyses will be conducted adapting the methodologies developed for the Atlantic and Indian Oceans and described in SCRS/2021/148. |
| **External collaborators** | Institut de Recherche pour le Développement (IRD), Instituto Español de Oceanografía (IEO), Secretariat of the Pacific Community (SPC) |
| **Deliverables** | A report for the SAC, Bycatch Working Group and the FAD Working Group in 2023, as well as peer-reviewed publications |

| **PROJECT J.1.a:** Temporal trends and variability in the spatial distribution of tropical tuna purse-seine fishing |
|---|
| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>A first version of the code has been prepared and is ready to be run on IATTC data.<br>Coordination with other t-RFMOs on data availability and formatting has been achieved so results are region-specific but also comparable. |
| **Challenges and key lessons learnt**<br>The code needs to be refined to accommodate ocean-specific data needs and the differences in the fishing dynamics.<br>The timeframe of the lead scientist has changed, and the project timeline has been revised to accommodate these needs. |
| **Reports/publications/presentations (selected)** |
| **Comments:**<br>Due to logistical and scheduling issues with the main author of the study, the project has been extended for another year. Results will be presented in 2025. |

| **PROJECT J.1.b:** Changes in catches and fishing strategies related to the Individual Vessel Threshold (IVT) program ||
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** J. Relationship between purse-seine fishing strategies and fishing mortality<br>**TARGET:** J.1. Identify and monitor changes in technology and fishing strategies<br>**EXECUTION**: Ecosystem and Bycatch Program and Stock Assessment Program ||
| **Objectives** | Evaluate impacts of the IVT program on catches of tropical tunas<br>Evaluate changes in fishing strategies potentially relating to the IVT program |
| **Background** | Resolution C-21-04 established an Individual Vessel Threshold (IVT) program which imposes additional days of closure to fishing vessels as a function of the extent to which individual vessels exceed specified thresholds of bigeye tuna catch. The purpose of this project is to examine what effects the IVT program has had on the dynamics of the fishing fleet, specifically the volume and relative proportion of catch of the tropical tuna species and the employed fishing strategies. |
| **Relevance for management** | This project will contribute to our overall understanding of the fleet dynamics of the tropical tuna fisheries. In particular, it will advance our understanding of the effects of the implemented management measures and the mechanisms behind recent changes in the volume of catch of the tropical tuna species, and the extent to which responses to the IVT program may or may not explain shifts in the species composition of the purse seine fleet catches. |
| **Duration** | 12 months |
| **Work plan and status** | Examine evidence for changes in total catch of tropical tunas related to the IVT program.<br>Examine evidence for changes in probability of capture of bigeye related to the IVT program.<br>Examine whether there is evidence of vessels switching from bigeye to yellowfin tuna catches in response to the IVT.<br>Examine whether there is evidence in a reduction in the concentration of bigeye tuna catches within a subset of fishing vessels in response to the IVT.<br>Examine whether there has been evidence of shifts in broader fishing strategies (set types, location, timing, etc.) in potential relation to the IVT. |
| **External collaborators** |  |
| **Deliverables** | A report for the SAC in 2024 (SAC-15 INF-K) |

| **PROJECT J.1.c:** Evaluation of empirical and potential impacts of "El Corralito" | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** J. Relationship between purse-seine fishing strategies and fishing mortality<br>**TARGET:** J.1. Identify and monitor changes in technology and fishing strategies<br>**EXECUTION**: Ecosystem and Bycatch Program and Stock Assessment Program | |
| **Objectives** | Examine empirical and theoretical evidence for the potential effects of the "El Corralito" closure on target and key bycatch species. |
| **Background** | The IATTC has utilized various versions of a spatial closure for tropical tuna by purse-seine vessels within the area of 96º and 110ºW and between 4°N and 3°S and lasting roughly a month since 2009, known broadly as "El Corralito". The purpose of this project is to examine, through both empirical and theoretical methods, evidence for the impacts of El Corralito on various aspects of catches and populations of target and key non-target species throughout the convention area. Where possible simulation modeling will be used to link empirical findings to broader population dynamics outcomes not directly observable. |
| **Relevance for management** | This project will provide guidance as to the observed and potential effects of El Corralito within the convention area, based on evidence from historical data as well as simulation modeling. This will help the Commission to determine what role El Corralito will play in future management. |
| **Duration** | 18 months |
| **Work plan and status** | Analyze deviations in seasonal catch trends of tropical tunas during periods in which El Corralito was active.<br>Analyze deviations in catch levels of tropical tunas along distance gradients from El Corralito borders during periods in which El Corralito was active.<br>Explore companion analyses for certain key bycatch species.<br>Develop simulation modeling to advice on the potential broader impacts of El Corralito and, likely, alternative spatial management measures. |
| **External collaborators** | |
| **Deliverables** | A report for the SAC in 2024 (SAC-15 INF-M) |

| PROJECT J.2.a: Quantify the relationship between vessel operational characteristics and fishing mortality | |
|---|---|
| THEME: Sustainable fisheries<br>GOAL: J. Relationship between purse-seine fishing strategies and fishing mortality<br>TARGET: J.2. Relationship between vessel operational characteristics and fishing mortality<br>EXECUTION: Stock Assessment Program | |
| **Objectives** | Evaluate the reliability of the data obtained on identification of FADs.<br>Investigate methods to determine purse-seine set type from various sources of data (i.e. Observers, vessel logbooks, canneries, etc.).<br>Evaluate the relationship between catch and number of FAD deployments.<br>Investigate more precise measures of fishing capacity that take into consideration days fished, set type, and vessel characteristics.<br>Investigate the relationship between fishing mortality and fleet capacity.<br>Evaluate alternative management measures such as closed areas, individual vessel limits, and gear restrictions. |
| **Background** | The constantly increasing capacity of the purse-seine fleet in the EPO requires more stringent management measures.<br>Several management measures have been investigated as an alternative to increasing the seasonal closure.<br>However, the measure of fishing capacity used to determine the days of closure is somewhat simplistic, and a more precise measure of capacity, and the relationship between capacity and fishing mortality, needs to be investigated.<br>Also, the relationship between the number of FADs deployed and catches needs to be better understood.<br>Although the staff has conducted some initial analyses, further studies need to be carried out to provide alternative management measures. |
| **Relevance for management** | The results of the project will enable the staff to refine current measures and develop alternative recommendations for managing tropical tunas in the EPO, and provide the Commission with additional tools when developing management measures. |
| **Duration** | 24 months |
| **Work plan and status** | 2018 – Initial analyses of the data that will lead to new insights<br>2019 – Further analyses to improve the staff's management advice<br>2020 – Apply the lessons learnt from the project and provide recommendations on both alternative management measures and additional data collection. |
| **External collaborators** | |
| **Deliverables** | Multiple reports for the meetings of the SAC and the Commission, including recommendations on tuna conservation and possibly on improvements to data collection.<br>Software will be created that can be used to update the analyses with new data and/or alternative assumptions and new methods. |

| PROJECT J.2.a: Quantify the relationship between vessel operational characteristics and fishing mortality |
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| **Updated**: May 2023 |
| **Progress summary for the reporting period** |

**Progress summary for the reporting period**

**Task 1** (*Evaluate the reliability of the data obtained on identification of FADs*): an extensive review of FAD data reporting under Resolutions C-16-01 and C-17-02 led to:

i. modifications of Resolution C-16-01 to require only vessels without an observers onboard to fill FAD form 9/2018;

ii. multiple agreements to provide high-resolution buoy data, including biomass, in a voluntary basis for a pilot project (J.3.a, FAD-05-INF-E, FAD-06-03, FAD-07-03);

iii. continuous update of a database on buoys reported under Resolution C-17-02 and the creation of a preliminary database on buoys with biomass information;

iv. a new pilot project on remotely and electronically identifying FADs (Project D.1.a); and

v. creation of a new high-resolution buoy database submitted to the secretariat under C-21-04.

**Task 2** (*Investigate methods to determine purse-seine set type*): following promising tests of a preliminary set type classification algorithm, a new version is being developed, incorporating additional information to reduce the error rates. The tool has been proved to be useful and was published in a peer-reviewed journal in 2023 (Lennert-Cody et al. 2023).

**Task 3** (*Evaluate the relationship between catch and number of FAD deployments*): see Lennert-Cody et al. 2018, SAC-10-INF-K, FAD-04-01, FAD-05-INF-A, FAD-05-INF-C, FAD-06-01, IATTC-98-INF-J. Further analysis may be required once FAD tracking data are available for the entire fleet.

**Task 4, 5** (*Investigate more precise measures of fishing capacity/the relationship between fishing mortality and fleet capacity*): the staff expects to incorporate the results of its preliminary research in in-depth analyses during year 4-5 of the project. In addition, a collaboration pilot project on developing alternative abundance indices using echo-sounder buoy data is underway (J.3.a) (see FAD-05 presentation and FAD-05-INF-E, FAD-06-03, FAD-07-03). Preliminary indices were, and will be, presented in 2021, 2022 and 2023 FAD WG and SAC meetings. The buoy index developed in 2022 was used in the interim skipjack assessment (SAC-13-07). Similarly, the relationship between bigeye fishing mortality estimated by the benchmark stock assessment models and the number of OBJ sets have been investigated (FAD-05-INF-D). The document is currently being prepared to be submitted to a peer-reviewed journal.

**Task 6** (*Evaluate alternative management measures*): the staff is pursuing various alternatives, including a multi-species dynamic management approach and reducing the number of active buoys allowed per vessel (see FAD-04-01, SAC-11-INF-M, SAC-12-08 and IATTC-98-INF-J).

**Challenges and key lessons learnt**

Current limits on the number of active buoys per vessel may be too high to be effective.

The dynamic management approach looks promising for developing alternative conservation and management measures for juvenile bigeye and yellowfin in a multi-species fisheries context, as well as for sensitive bycatch species and groups.

Despite the new forms and training workshops, FAD data reporting is still imperfect. Training of managers, fishers and observers should continue.

High-resolution buoy data, which will be available for the staff in 2022 (see Res. C-21-04), are needed to link IATTC databases (*i.e.* observers, FAD logbooks, buoy data). A single reporting format for all CPCs is desirable and thus, the staff prepared format templates and letters to effectively receive this data directly from buoy manufacturers. Similarly, the IATTC staff prepared a buoy deactivation/reactivation reporting format to comply with C-21-04, which can be found at the IATTC website.

High-resolution buoy data, including biomass, is key to develop fisheries-independent abundance

indices and test alternative hypothesis for fishing mortality. The buoy index was proven to be useful and was included in the skipjack interim assessment of 2022 (SAC-13-07, FAD-07-03).

Because active FADs, not FAD deployments, are subject to limits, analyses using this data were performed in [FAD-04-01](#), FAD-05-INF-A, FAD-05-INF-C, FAD-06-01 and considered in SAC-11-INF-M, SAC-12-08 and IATTC-98-INF-J but may need to be repeated with high-resolution FAD tracking data in the future, including simulations using agent based models or other available tools.

The relationship between bigeye fishing mortality and the number of OBJ sets is positive for all but one area in the EPO, including the predominant offshore equatorial OBJ fishing area where the majority of bigeye catch occurs (FAD-05-INF-D). This work is currently being prepared for submission to a peer-reviewed journal.

**Reports/publications/presentations**
**Presentations:**
September 2019: American Fisheries Society 2019 annual conference
**Reports**:
FAD-04-01 Active FAD limits
FAD-05 INF-A Floating object fishery indicators: a 2019 report
FAD-05-INF-C Floating object fishery indicators: a 2020 report
FAD-05-INF-D Relationship between floating-object effort and fishing mortality
FAD-05-INF-E Tropical tuna biomass indicators from echosounder buoys in the EPO
FAD-06-01 - Floating object fishery indicators: a 2021 report
FAD-06-03 - Updated biomass indicators from echosounder buoys
FAD-07-01 - Floating object fishery indicators: a 2022 report
FAD-07-03 - Updated biomass indicators from echosounder buoys
FAD-08-01 - Floating object fishery indicators: a 2023 report
FAD-08-02 - Updated biomass indicators from echosounder buoys
[SAC-11-INF-M](#) [FAD management measures](#)
[SAC-12-08 FAD management options](#)
SAC-13-07 Skipjack tuna in the eastern Pacific Ocean, 2021: interim assessment
IATTC-98-INF-J - Active FAD limits for the purse seine fishery: staff's considerations
SAC-14-08 - SKJ exploratory analysis
**Publications:**
Lennert-Cody, C. E., J. Lopez and M. N. Maunder (2023). "An automatic purse-seine set type classification algorithm to inform tropical tuna management." Fisheries Research 262.

**Comments:**
Because the lead researcher of the project is now permanent staff, additional research will be conducted for some of the tasks in 2020-2024

| **PROJECT J.2.b:** Identifying operational characteristics associated with mobulid bycatch in the eastern Pacific Ocean | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** J. Relationship between purse-seine fishing strategies and fishing mortality<br>**TARGET:** J.2. Relationship between vessel operational characteristics and fishing mortality<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Understand the nature of mobulid bycatch in the purse seine fishery, and in particular, the effect of different operational characteristics on mobulid bycatch rates.<br>Build on and inform ongoing research to host workshops with purse seine skippers and crew to identify feasible onboard gear, handling and release modifications to reduce mobulid mortality.<br>Tailor bycatch mitigation options for variability in vessel and gear type, as well as the operational details of the vessel. |
| **Background** | Manta and devil rays (i.e. mobulids) range overlaps with that of the world's tuna fleets, leading to the potential for interactions with fisheries.<br>Recent interest in mobulid conservation has focused on reducing post-release mortality. However, the operational characteristics of vessels that might determine bycatch rates for mobulids are not well understood yet.<br>Understanding operational characteristics that are related to variability in mobulids bycatch rates will help target specific segments of the fleet for bycatch mitigation and improve discussions with stakeholders and fishers. |
| **Relevance for management** | The results of this work will help prioritize vessels with relatively high bycatch and help to identify vessels with feasible mitigation options to reduce mobulid mortality. Similarly, the results of the project will enable the staff to better understand the effect of operational characteristics of purse seiners and mobulids bycatch and propose both additional experiments and conservation and management measures for mobulids in the EPO, as necessary. |
| **Duration** | 24 months |
| **Work plan and status** | 2023, 2024 – analyze observer data and build models for sets with reported bycatch of mobulids as well as for sets without mobulids as a function of several operational characteristics. The analysis will focus on areas and months previously identified as bycatch "hotspots" (Lezama-Ochoa et al. 2019). The potential effect of environmental variables (e.g. SST, temperature at depth, MLD, chlorophyll) on catch rates will also be tested, and, if possible, modelled to obtain a clearer signal between vessels operational characteristics and the bycatch rates.<br>2025 – production of dissemination materials and reports for the SAC and the Bycatch Working group |
| **External collaborators** | University of California Santa Cruz<br>Duke University |
| **Deliverables** | A report for the Bycatch Working Group and the SAC in 2025<br>Dissemination material for skippers' workshops and the tuna conference 2025 |

| **PROJECT J.2.b:** Identifying operational characteristics associated with mobulid bycatch in the eastern Pacific Ocean |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Coordination and discussions with the main author on data availability and formatting.<br>Survey conducted with the fleet on the use of different elements for bycatch avoidance (e.g. use of aerial surveys, helicopters).<br>Preparation of a peer-reviewed publication describing the use of helicopters for bycatch mitigation. |
| **Challenges and key lessons learnt** |
| **Reports/publications/presentations (selected)**<br>Waldo et al. – Exploring helicopter vessel communication for Mobulid bycatch avoidance (EBWG-01)<br>Waldo et al. 2024 – Bycatch mitigation from the sky: using helicopter communication for Mobulid conservation in tropical tuna fisheries, *Frontiers in Marine Science* |
| **Comments:**<br>Due to scheduling issues with the main author of the study, the project has been extended for another year. Results are expected to be presented in 2025. |

| PROJECT J.3.a: Developing alternative buoy-derived tuna biomass indexes | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** J. Relationship between purse-seine fishing strategies and fishing mortality<br>**TARGET:** J.3. Study the impact of FAD operations on fishing mortality to improve management advice<br>**EXECUTION**: Bycatch Mitigation and Gear Technology Group and Stock Assessment Program | |
| **Objectives** | Determine the feasibility of echo-sounder buoy data to be used for developing alternative abundance indices for tropical tuna.<br>Develop preliminary catch-independent abundance indices for tropical tunas.<br>Evaluate the usefulness of these indices to inform and complement traditional stock assessment and other projects of interest for the Commission (e.g. MSE, habitat models).<br>Explore the future availability of echo-sounder buoy data in the region for scientific purposes.<br>Develop strategies and plans to improve the robustness of results and help interpretation.<br>Recommend new feasible technological developments to buoy manufacturers. |
| **Background** | Fishing efficiency of the tropical tuna purse seines are rapidly evolving due to technology and effort creep and obtaining reliable CPUE is challenging task.<br>New technologies also provide new opportunities for science. Echo-sounder buoys have the potential to daily sample thousands of FADs in a systematic and non-invasive manner.<br>This information could be used to develop alternative abundance indices for tunas using catch-independent data.<br>Other t-RFMOs (e.g. ICCAT) have explored the use of buoy derived abundance indices in their recent stock assessments. Those indices were developed by AZTI.<br>The good relationship with AZTI, OPAGAC and Cape Fisheries granted access to historical satellite-linked echosounder buoy data used by the fleet in the Pacific Ocean. |
| **Relevance for management** | This project will advance our understanding of tropical tuna species population dynamics and stock status. Project activities will support several objectives for increasing the sustainability of exploited resources described in the SSP as well as will advance on the use of new technologies and data sources to improve decision-making. |
| **Duration** | 12 months, extended to 48 due to COVID-19 |
| **Work plan and status** | 2020 – data extraction and preparation. Run standard procedures and methodologies to obtain preliminary indices. Start discussing and exploring new approaches and uses of the data.<br>2021 – an AZTI researcher will visit the IATTC headquarters and preliminary indices will be updated. Preparation of dissemination materials and recommendations. |
| **External collaborators** | AZTI Foundation, OPAGAC, Cape Fisheries, ISSF |
| **Deliverables** | A series of alternative abundance indices for the three species of tropical tuna using catch-independent information.<br>Dissemination material, including documents and presentations for the Scientific Advisory Committee and the workshop on developing alternative abundance indices for tropical tuna that ISSF is organizing, likely, in 2021. |

| PROJECT J.3.a: Developing alternative buoy-derived tuna biomass indexes |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| Several online meetings have been conducted with collaborators in 2020-2022. A research stay of 3 months has been conducted by an AZTI researcher in 2023. The research stay helped streamline the work and the methodology and trained some new IATTC staff members on the process and the data. In addition, the feasibility of echo-sounder buoy data to be used for developing alternative abundance indices for tropical tuna has been determined. |
| A series of preliminary catch-independent abundance indices for tropical tunas have been produced. |
| A list with research ideas, approaches and plans to improve the robustness of results and help interpretation has been produced and updated every year, and the team will work on them in the future. The buoy derived abundance index for skipjack has been used in the interim assessment conducted in 2022 and will be tentatively explored for 2023 and 2024 yellowfin, bigeye and skipjack assessments. Two additional BREP proposals have been prepared to improve data use and interpretation of both historic and future data. |
| Access to historic data is being negotiated with several industry partners. |
| **Challenges and key lessons learnt** |
| Several additional tasks have been identified to improve the model output. A list of the ideas to be explored in 2021-2024 are described in FAD-05-INF-E, FAD-06-03, FAD-07-03 and FAD-08-02. |
| Access to high-resolution historic buoy data, including biomass information, is key to advance the scientific advice but has also been identified as problematic and confidential by some fleet owners. The staff does not require real time data and guarantees that all the IATTC confidentiality and privacy rules are followed, if access to historic data is granted. The present project, where data has been provided by OPAGAC and Cape Fisheries in a voluntary basis, is a good example of success. Other voluntary agreements are currently being explored by the IATTC staff, while officially recommending the reporting of historic high-resolution buoy data. |
| The buoy derived abundance index was proven to be useful to improve skipjack assessment in 2022 and its use will be explored for the 2024 yellowfin and bigeye tuna assessments. |
| **Reports/publications/presentations** |
| **Presentations:** |
| FAD-05-Pres |
| FAD-06-03 |
| **Reports**: |
| FAD-05-INF-E Tropical tuna biomass indicators from echosounder buoys in the EPO |
| FAD-06-03 Tropical tuna biomass indicators from echosounder buoys in the EPO |
| FAD-07-03 Updated biomass indicators from echosounder buoys |
| FAD-08-02 Updated biomass indicators from echosounder buoys |
| SAC-13-07 Interim skipjack assessment |
| **Other products** |
| A series of preliminary buoy-derived abundance indices for tropical tuna species for internal discussion and use in the skipjack interim assessment in 2022, as well as preliminary indices for the 2024 yellowfin, skipjack and bigeye assessments. |
| **Comments:** |
| Because of the pandemic, the research stay of the main-researcher in La Jolla was postponed to 2023. The research stay was successful and help the IATTC staff better understand the process to derive the buoy index. |
| A workshop on echo-sounder buoy data is expected to be organized by ISSF in 2023/2024, where the results and methods of this project will be presented and discussed. |

| PROJECT K.1.a: POSEIDON project progress report | |
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| **THEME:** Sustainable fisheries<br>**GOAL:** K. Improve our understanding the socio-economic aspects of sustainable tropical tuna fisheries<br>**TARGET:** K.1. Collaborate in socio-economic studies by other organizations<br>**EXECUTION:** Stock Assessment Program | |
| **Objectives** | Build and evaluate an agent-based, adaptive fishing fleet model as an analytic tool to support management |
| **Background** | POSEIDON is a coupled human-ecological model that combines an agent-based, adaptive fishing fleet model with existing fishery models or simple biological data, to simulate vessel behavior and fishery outcomes based on policies, market influences, and environmental factors.<br>POSEIDON provides a powerful platform for policy evaluation and decision support, with a strong focus on the spatial and human dimensions of fisheries management.<br>POSEIDON was originally developed by a multidisciplinary team from the University of Oxford, Ocean Conservancy, George Mason University, the University of California, Santa Barbara, and Arizona State University, as part of an effort to advance innovation in fisheries management.<br>The model has been calibrated and validated to the U.S. West Coast groundfish fishery. It is now being adapted to explore MSC certification for Indonesia's deep-water snapper fishery (in partnership with The Nature Conservancy, Indonesia). |
| **Relevance for management** | The model will be used to explore timely research questions, including FAD management, understanding the spatial dynamics of the fishery, as well as some of the social and economic issues which effect management. |
| **Duration** | 3 years (end year 2024) |
| **Work plan and status** | A researcher will be based at the IATTC's office in La Jolla, and will be charged with 1) scoping model application and designing a use cases that are supportive of IATTC policy evaluation processes, 2) understanding and accessing relevant datasets from IATTC, and 3) conducting statistical analyses of data to support model development.<br>This researcher will work closely with the modeling team based at the University of Oxford and Ocean Conservancy to drive model design, calibration and validation of the tool and its outputs, as well as evaluation of model results. |
| **External collaborators** | University of Oxford, Ocean Conservancy |
| **Deliverables** | A computer algorithm with which to run simulations to explore management options.<br>A project report and publications in peer-reviewed journals. |

| PROJECT K.1.a: POSEIDON project progress report |
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| **Updated**: May 2023 |

**Progress summary for the reporting period**

Following the developing of an initial version of the POSEIDON operating model, the POSEIDON team developed a joint research plan in 2021 to continue developing the simulation tool in support of IATTC priorities. Following that plan, the POSEIDON team has recently completed a series of model development milestones. The POSEIDON model was expanded to include several feature expansions and updates, as follows. To represent a complete picture of the purse seine fishery, the POSEIDON team revised the fleet behavioral model to incorporate dolphin-setting vessels and improving the realism of unassociated sets in the simulation. They also augmented the model with an age-structured population dynamics model for Yellowfin, Bigeye and Skipjack tuna. In consultation with key international FAD researchers, changes were implemented to improve FAD aggregation dynamics. Further, an additional module was added to the model to represent value chain dynamics, such that the model can support evaluation of economic impacts of changes in the fishery. A joint diagnostics plan was developed to outline the standards that the tool must meet to match the IATTC's standard of accuracy and scientific rigor. Thus, a model selection process was performed to identify the best performing model across a set of different FAD dynamic and trip planning algorithms.

The revised model was used to perform a full calibration on 2017 observer and other supporting data. The results were compared to a series of diagnostics, co-developed by IATTC staff and the POSEIDON team, to measure the performance and skill of the model to capture important elements of the fishery including spatial and non-spatial catch, actions, and other trip planning indicators such as trip length.

Overall, the POSEIDON model was able to reproduce catch, effort, and overall trip dynamics with low error. The spatial results were more error prone but overall were able to capture large scale patterns in fishing effort as well as the heterogeneity of actions from class 6 fishing vessels.

The POSEIDON team is currently working to address comments and clarifications requested by IATTC to better understand the elements of the calibration process as well as suggestions made to improve the spatial "fit" of the calibrated model.

Last, the model dynamics and infrastructure are being tailored to the management needs requested by IATTC staff by 1) improving the usability of the model by developing and R interface and 2) refining the spatial model validation process to be more flexible so that IATTC staff can better understand model skill for a range of spatial resolutions.

**Challenges and key lessons learnt**

The greatest challenge has been identifying a proper set of diagnostics to evaluate the model performance as agent-based models are not typically used in a fisheries management capacity. The co-development of these diagnostics with POSEIDON and IATTC staff was a significant undertaking but resulted in a tangible and novel set of diagnostics to judge the model. We expect these metrics to evolve over time as both teams learn more about the management needs and model capabilities and constraints.

Another challenge was to identify the secondary drivers of the spatial fit in the southern region of the eastern Pacific Ocean.

Reports/publications/presentations

**Presentations**:

-EPO POSEIDON model diagnostics. IATTC staff. Jan 2023

-Development of an Agent-Based Bio-Economic Model for Tropical Tunas (POSEIDON). ICCAT SCRS. 2023

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| - Benefits of an Agent-Based Bio-Economic Model for the Indian ocean Tropical Tunas. 3rd IOTC Ad Hoc Working Group on Fads. 2023<br>- Modeling fish aggregating device drift in the Eastern Pacific Ocean using estimated ocean currents. 5th IATTC Ad Hoc Working Group on Fads. 2021<br>- POSEIDON Model of Eastern Pacific Tropical Tunas can inform management issues. 5th IATTC Ad Hoc Working Group on Fads. 2021<br>- Exploring FAD Management in the Eastern Pacific Ocean using an Agent-Based Bio-Economic Model: POSEIDON. World Fisheries Congress. 2021 |
| **Comments:**<br>Given the positive outcomes of the initial model diagnostics there has been some interest in applying the POSEIDON EPO-tuna model to other tropical tuna fisheries.  The POSEIDON team is currently performing a data gap analysis to implement a similar model in the Atlantic Ocean with the goal of developing a joint project with several research institutions. |

| ECOLOGICAL IMPACTS OF FISHERIES: ASSESSMENT AND MITIGATION |
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| **PROJECT L.1.a: Develop habitat models for bycatch species caught in the EPO to support ecological risk assessments (ERAs)** | |
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation **GOAL:** L. Evaluating ecological impacts **TARGET:** L.1. Develop analytical tools to identify and prioritize species at risk for data collection, research and management **EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | To use presence-only catch data to develop habitat models for key bycatch species caught in EPO tuna fisheries to facilitate mapping of their geographic range. To make distribution maps available in a format suitable for use as base maps for ecological risk assessment models (e.g., PSA, EASI-Fish) |
| **Background** | Many bycatch species caught in EPO tuna fisheries lack sufficient biological and catch data to undertake traditional stock assessment to determine their vulnerability to fishing. Data-limited Ecological Risk Assessment (ERA) methods are now increasingly used to determine the most vulnerable species to fishing, which have a strong reliance on estimating impacts using the overlap of fishing effort with a species' distribution. Given the success of using the EASI-Fish approach for assessing the vulnerability of data-poor bycatch species in the EPO (e.g. sharks, devil rays, leatherback turtles), further development of SDMs for other species is required. |
| **Relevance for management** | Developing habitat models for bycatch species will improve the fishing mortality estimates using ERAs, from which their status can be determined and guide managers. |
| **Duration** | 24 months |
| **Work plan and status** | Jun-Dec 18: model development Jan-Feb 19: apply habitat model to bycatch species to be included in ERAs Mar-April 19: Finalize habitat maps for bycatch species May 19: present final model and assessment results at SAC-10. Jun 21-Sept 22: use Pacific-wide datasets to explore the use of a range of alternative SDMs in isolation or as ensembles for shark species caught in EPO pelagic fisheries |
| **External collaborators** | CPCs, SPC |
| **Deliverables** | Presentations at SAC-10, SAC-13 and at WCPFC, if required. Procedure, if successful, to be used annually within ERA models to assess the vulnerability of bycatch species in the EPO. |

| PROJECT L.1.a: Develop habitat models for bycatch species caught in the EPO to support ecological risk assessments (ERAs) |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Initial models were developed using Integrated Nested Laplace Approximation (INLA) and Generalized Additive Models (GAMs) for one species of mobulid, and machine learning algorithms for the leatherback turtle, which formed the basis of EASI-Fish assessments for these species.<br>Subsequent explorations of SDMs were undertaken in 2021-2022 for 32 shark species caught in the EPO, in collaboration with SPC staff.<br>In 2022, IATTC staff collaborated with SPC staff and combined all available Pacific-wide datasets to develop SDMs from an ensemble of four models for 32 shark species caught in EPO pelagic fisheries. The SDMs were then used in a vulnerability assessment for all impacted sharks in the EPO using the EASI-Fish approach and in a subsequent EASI-Fish assessment that focused on the potential efficacy of various CMMs for the most vulnerable species, silky and hammerhead sharks.<br>Similarly, a machine learning species distribution model was recently developed for the EP leatherback turtle by the IATTC staff. |
| **Challenges and key lessons learnt**<br>Even highly sophisticated models in data-rich settings can predict habitat poorly, depending on the environmental data used for the prediction.<br>It is likely that many more presence points occur within the EEZ of coastal nations in the EPO, however, obtaining high resolution data from domestic fisheries is a major challenge.<br>Although the collaboration with SPC utilized data from across the entire Pacific, the SDMs predicted relatively low probability of occurrence for several very common species in the EPO. This was thought to be due to relative differences in relationships between presence and some environmental variables across a vast environmental gradient of the Pacific Ocean. It was found that predicting presence at the RFMO scale produced significantly more realistic distribution maps and that a ensemble approach to SDMs may be required in future for large scale SDMs, such as the basin scale. Because of potential differences in methods, SPC-IATTC are currently considering putting together a working group to discuss best practices in SDMs for tunas, sharks and other prioritized species. |
| **Reports/publications/presentations**<br>Seven manuscripts that use the habitat models have been published in scientific journals or given as IATTC presentations:<br>Lopez, J, Griffiths, S.P, et al. (2024). A machine learning species distribution model for the critically endangered East Pacific leatherback turtle Dermochelys coriacea. *Endangered Species Research*<br>Griffiths, S.P., Siu, S., Hutchinson, M., Lopez, J., Aires-da-Silva, A. 2023. Vulnerability assessment and simulation of potential conservation and management measures for silky and hammerhead sharks caught in eastern Pacific Ocean pelagic fisheries. *14th Meeting of the Scientific Advisory Committee of the IATTC, 15-19 May 2023, La Jolla, California, USA. Document SAC-14-12*.<br>Griffiths, S.P., Lezama-Ochoa, N., 2021. A 40-year chronology of spinetail devil ray (*Mobula mobular*) vulnerability to eastern Pacific tuna fisheries and options for future conservation and management. *Aquatic Conservation: Marine and Freshwater Ecosystems* 31, 2910–2925.<br>Griffiths, S.P., Lezama-Ochoa, N., Román, M.H., 2019. Moving towards quantitative ecological risk assessment for data-limited tuna fishery bycatch: application of "EASI-Fish" to the spinetail devil ray (*Mobula mobular*) in the eastern Pacific Ocean. *9th Meeting of the IATTC Working Group on Bycatch, 11 May 2019, San Diego, California, USA. Document BYC-09-01*.<br>Griffiths, S.P., Kesner-Reyes, K., Garilao, C., Duffy, L.M., Román, M.H., 2019. Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish): a flexible vulnerability assessment approach to quantify the cumulative impacts of fishing in data-limited settings. *Marine Ecology Progress Series* |

625, 89-113.

Griffiths, S.P., Wallace, B., Swimmer, Y., Alfaro-Shigueto, J., Mangel, J.C., Oliveros-Ramos, R., 2020. Vulnerability status and efficacy of potential conservation measures for the east Pacific leatherback turtle (*Dermochelys coriacea*) stock using the EASI-Fish approach. *10th Meeting of the IATTC Working Group on Bycatch, 10 September 2020, La Jolla, California, USA. Document BYC-10-01*.

Griffiths, S.P., Fuller, L.M., Potts, J., Nicol, S., 2022. Vulnerability assessment of sharks caught in eastern Pacific Ocean pelagic fisheries using the EASI-Fish approach. *13th Meeting of the Scientific Advisory Committee of the IATTC, 16-20 May 2022, La Jolla, California, USA. Document SAC-13-11, 80*.

**Comments:**

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| PROJECT L.2.c: Assessing the efficacy of potential management options on highly vulnerable shark species in the EPO | |
|---|---|
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** L. Evaluating ecological impacts<br>**TARGET:** L.2. Develop analytical tools to identify and prioritize species at risk for data collection, research and management<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | To use the EASI-Fish ERA approach to assess the efficacy of potential conservation and management measures for reducing fishing impacts on shark species identified in project L.2.b as being highly vulnerable in the EPO |
| **Background** | IATTC is committed, through the Antigua Convention, to ensure the long-term sustainability of all non-target species impacted by EPO tuna fisheries.<br>IATTC Project L.2.b used the EASI-Fish (Ecological Assessment for the Sustainable Impacts of Fisheries) approach to identify the most vulnerable elasmobranch species caught as bycatch in EPO tuna fisheries.<br>EASI-Fish has been used by the IATTC as an alternative approach to traditional population models to assess the efficacy of management measures on data-limited bycatch species including the critically endangered leatherback turtle and the spinetail devil ray.<br>The staff has been tasked to conduct conventional stock assessments for priority shark species, but the quality of the available fishery data remains prohibitive for this purpose (see section 4 on shark workplan). As an interim data-limited alternative to conventional stock assessments, EASI-Fish will be used to assess shark species identified as being highly vulnerable. |
| **Relevance for management** | EASI-Fish assessments can transparently identify vulnerable elasmobranch species in the EPO. However, vulnerability may be reduced differently for each species. Therefore, by undertaking separate EASI-Fish assessments for each vulnerable species, management measures that may be most efficient and cost-effective may be identified for each species, and for all species in concert. This will ultimately simplify the development of fewer management measures (if required) and minimize the losses of target species catch as a result. |
| **Duration** | 12 months |
| **Work plan and status** | Jun-Dec 22: develop species-specific EASI-Fish assessments for the most vulnerable species identified and pose potential management strategies to reduce vulnerability<br>Jan-Apr 23: Finalize EASI-Fish assessments<br>May 23: present final species-specific EASI-Fish assessment results at SAC-14. |
| **External collaborators** | CPCs, SPC. |
| **Deliverables** | Paper and oral presentation at SAC-14<br>Scientific journal publication |

| PROJECT L.2.c: Assessing the efficacy of potential management options on highly vulnerable shark species in the EPO |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br><br>Apr 2022: Initial EASI-Fish assessment completed for 32 shark species caught in EPO tuna fisheries (Document SAC-13-13)<br><br>Apr-May 2022: 20 species identified from EASI-Fish as "most vulnerable" and require further consideration and/or more detailed assessment.<br><br>May 2022: SAC to determine which (and how many) species are the highest priority to include in this project.<br><br>Aug 2022: The IATTC Scientific Coordinator gained support from the Members to use EASI-Fish to undertake a vulnerability assessment for silky and hammerhead sharks, which were the most vulnerable shark species identified in project L.2.b. Coincidentally, these species were scheduled for conventional stock assessment under Resolution C-16-05, but insufficient catch and effort data thwarted efforts to undertake these assessments.<br><br>Oct 2022-Mar 2023: IATTC staff reviewed and analyzed existing and newly acquired catch and effort data from the ABNJ project to use in the EASI-Fish assessments.<br><br>Mar-Apr 2023: EASI-Fish models run for four species (silky and three hammerhead sharks) and a range of hypothetical management measures simulated.<br><br>Apr 2023: Final report submitted and presented at SAC 14 (SAC-14-12).<br><br>Apr 2024: Since presenting the assessment at SAC 14, the IATTC scientific staff received feedback from its Members regarding EASI-Fish model assumptions. During 2024, the staff undertook an extensive internal review of the EASI-Fish methodology, especially regarding the sensitivity of results to catchability/gear efficiency parameters, and further model development has been undertaken. |
| **Challenges and key lessons learnt**<br><br>The challenges and key lessons learned primarily related to the lack of data for the majority of species and fisheries included in the assessment. Even rudimentary morphometric relationships (e.g. length-weight) and basic biological parameters (e.g. length at first maturity) we lacking for the EPO region (and often across the entire Pacific Ocean) for many species, even those commonly caught commercially, such as thresher sharks. As a result, information for several species was derived from different ocean basins, and in the cases of some small requiem and hammerhead sharks, from other species. Although high quality spatially-explicit fishing effort data were available for the purse-seine fleet of large vessels (I.e. Class 6), data were only available at low resolution for the important industrial longline fleet, or completely lacking for some artisanal gillnet and longline fleets. This severely compromised the estimates of overlap between these fisheries and the assessed species, and in most cases results in an underestimate of fishery impact. The key lesson arising from the work is that basic biological information on sharks, and fishing effort and catch information is severely lacking in the EPO. Recommendations from the work included regional studies on the basic biology of shark species in the EPO, and improved monitoring of catch and effort in commercial (purse seine Class 1-5 and industrial longline) and artisanal fleets. The impact of the artisanal fisheries should not be ignored and so concerted efforts are required to better understand the extend of catches for near-term EASI-Fish assessments and also longer term conventional stock assessments. This required work expands significant spatial and temporal scales and is therefore costly to undertake, so close collaboration and coordination with coastal CPCs was recommended.<br><br>The EASI-Fish model was designed to be used in data-poor settings, which required the use of conservative assumptions. An important assumption is that one or more units of fishing effort occurring in a grid cell where a species is deemed "present" by the species distribution model can catch all fish in that cell where all susceptibility parameters are fully realized. This catchability/gear |

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| efficiency assumption was queried by some IATTC Members and subsequent sensitivity analyses showed the results of EASI-Fish models to be sensitive to this assumption. Staff now refined how this parameter is estimated (e.g., using gear efficiency models such as 'the domain of potential interaction') but highlighted the need for improved spatially explicit fishing effort data. |
| **Reports/publications/presentations** |
| Griffiths, S.P., Siu, S., Hutchinson, M., Lopez, J., Aires-da-Silva, A. 2023. Vulnerability assessment and simulation of potential conservation and management measures for silky and hammerhead sharks caught in eastern Pacific Ocean pelagic fisheries. *14th Meeting of the Scientific Advisory Committee of the IATTC, 15-19 May 2023, La Jolla, California, USA. Document SAC-14-12* |
| **Comments:** |
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| **PROJECT L.2.d: Pacific-wide vulnerability assessment of pelagic shark species caught as bycatch in tuna fisheries** | |
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** L. Evaluating ecological impacts<br>**TARGET:** L.2. Develop analytical tools to identify and prioritize species at risk for data collection, research and management<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | In collaboration with SPC, use the EASI-Fish ERA approach to undertake a Pacific-wide vulnerability assessment of shark species caught as bycatch in tuna fisheries managed by the IATTC and WCPFC<br>To identify the most vulnerable species using traditional biological reference points |
| **Background** | In 2021, SPC developed species distribution models for all shark bycatch species caught in WCPFC tuna fisheries with the intent to undertake a vulnerability assessment using the EASI-Fish approach.<br>Many of the species examined by SPC have a Pacific-wide distribution and therefore cross the jurisdictional boundary between the IATTC and WCPFC.<br>In 2022, SPC will conduct the first shark assessment using EASI-Fish. Therefore, in order to better model the true extent of fishery impacts on cross jurisdictional stocks, the SPC and IATTC staff will collaborate in the assessment. |
| **Relevance for management** | EASI-Fish assessments can transparently identify vulnerable species by using well established biological reference points, thus minimizing the chances of incurring false positives that may require improper and costly management actions to be taken. Many ERAs have previously been undertaken on individual fisheries or jurisdictions, thus underestimating true fishery impacts on shared stocks. By undertaking a Pacific-wide EASI-Fish assessment for shared stocks both the IATTC and WCPFC will better understand the true extent of fishery impacts on assessed stocks, and be able to identify species of high vulnerability in order to subject to further assessment or management as required. |
| **Duration** | 12 months |
| **Work plan and status** | Sep 2021-June 2022: complete Pacific-wide EASI-Fish assessment in collaboration with SPC and identify vulnerable species.<br>Aug 2022: present assessment results at WCPFC SC in 2022.<br>May 2023: present assessment results at SAC-14 in 2023, if required. |
| **External collaborators** | SPC |
| **Deliverables** | Paper and oral presentation at SAC-14 and WCPFC SC, if required.<br>A scientific journal publication. |

| PROJECT L.2.d: Pacific-wide vulnerability assessment of pelagic shark species caught as bycatch in tuna fisheries |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>July-Sept 2021: Collated available effort and shark interaction data for 8 fisheries in the EPO from IATTC databases, 5 fisheries in the WCPO from SPC databases, and publicly available publications<br>Sept 2021-Mar 2022: Collated available biological information for ~50 shark bycatch species shared with the WCPO area from IATTC and SPC databases.<br>Jan-Feb 2022: SPC developed SDMs for ~50 species using an ensemble approach from 4 SDM algorithms using all data from the Pacific Ocean.<br>June 2022: Species to be selected for assessment in EASI-Fish with consultation with IATTC and WCPFC stakeholders.<br>Aug 2022: Discussions between SPC and IATTC staff revealed a technical issue in SDM development that posed a problem for undertaking a Pacific-wide assessment for shark species. The issue pertains to habitat preferences being modelled for the entire Pacific, but relative regional differences in the relationship strength between presence and environmental variables resulted in the EPO probability of occurrence being underestimated for several species. Staff are currently discussing how to resolve this issue by potentially creating an ensemble of subregions to develop a basin-wide SDM. Similarly, SPC-IATTC are in conversations to put together a working group on best practices for SDMs.<br>Sept 2023: Collaboration with SPC colleagues was interrupted by their need to direct resources into internal assessments and the hiring of a dedicated ERA staff member, who would also be responsible for SDM development. The person was hired in early December 2023 and so it is hoped collaboration of this project will resume in 2024. |
| **Challenges and key lessons learnt** |
| **Reports/publications/presentations** |
| **Comments:**<br>- |

| PROJECT L.2.f: Development of a draft list of shark species under the purview of the IATTC | |
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| THEME: Ecological impacts of fisheries: assessment and mitigation<br>GOAL: L. Evaluating ecological impacts<br>TARGET: L.2. Develop analytical tools to identify and prioritize species at risk for data collection, research and management<br>EXECUTION: Ecosystem and Bycatch Program | |
| Objectives | To develop a draft list of shark species known to be impacted by tuna fisheries in the EPO to be considered under the purview of the IATTC. |
| Background | At its 101st meeting, the Inter-American Tropical Tuna Commission adopted Resolution C-23-07 "*Conservation measures for the protection and sustainable management of sharks*" with the aim to consolidate existing measures that pertain to sharks in IATTC Resolutions C-05-03, C-16-04, C-16-05, and to strengthen shark conservation and management measures in the eastern Pacific Ocean. In addition, the resolution sets forth various recommendations and mandates regarding research and data collection pertaining to sharks in order for the IATTC to comply with the measures of Resolution C-23-07, other relevant IATTC resolutions, and relevant items under the Antigua Convention. To define the scope of this research and data collection, Article 13 of the resolution requires "…*the IATTC scientific staff, in consultation with the IATTC SAC and EBWG, shall develop a draft list of shark species under the purview of the Commission in the Convention Area for its consideration*".<br><br>IATTC Project L.2.b used the EASI-Fish (Ecological Assessment for the Sustainable Impacts of Fisheries) approach to identify the most vulnerable elasmobranch species caught as bycatch in EPO tuna fisheries. In this project, a complete list of species that have been recorded to interact with EPO tuna fisheries was developed, but questions remained as to what extent tuna fisheries pose a bona fide threat to the sustainability of these species, and which species are under the purview of the IATTC given their occupancy of habitats that exist beyond the typical fishing grounds of the tuna fishing fleets. |
| Relevance for management | Having a definitive list of species for which the IATTC is responsible for ensuring the long-term sustainability of their populations is the critical first step for determining the level of resource investment towards the management of a species. Given that IATTC fisheries interact with over 100 species of animals caught incidentally during fishing operations, much consideration is required as to the level of resources required to monitor, assess and manage impacted species, or how these species may be handled by other organizations should the IATTC not have sole responsibility. |
| Duration | 12 months |
| Work plan and status | Oct-Dec 23: extract data from Project L.2.b and IATTC databases to develop a list of shark species known to be impacted by EPO fisheries<br>Jan-Apr 24: Develop a draft list of shark species under the purview of the IATTC by considering their geographic distributions, extent of interaction with IATTC fisheries, and results of the quantitative vulnerability assessment in Project L.2.b, as well as IATTC's political instruments and framework.<br>May 24: present draft list of species at SAC-15 and EBWG-02. |
| External collaborators | CPCs |
| Deliverables | Document SAC-15-09 and oral presentation at SAC-15 |

| PROJECT L.2.f: Development of a draft list of shark species under the purview of the IATTC |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Oct-Dec 23: Data extracted from Project L.2.b and IATTC databases to develop a list of shark species known to be impacted by EPO fisheries<br>Jan-Apr 24: Draft list of shark species under the purview of the IATTC developed by considering their geographic distributions, extent of interaction with IATTC fisheries, and results of the quantitative vulnerability assessment in Project L.2.b, as well as IATTC's political instruments and framework. |
| **Challenges and key lessons learnt** |
| **Reports/publications/presentations**<br>SAC-15-09 |
| **Comments:**<br>- |

| PROJECT M.1.a: Evaluate the effect of the depth of non-entangling FADs on catches of tunas and bycatches of other species in the purse-seine fishery | |
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| THEME: Ecological impacts of fisheries: assessment and mitigation | |
| GOAL: M. Mitigating ecological impacts | |
| TARGET: M.1. Investigate gear technology to reduce bycatch and bycatch mortality | |
| EXECUTION: Life-history and Behavior | |
| **Objectives** | Evaluate the performance of shallow non-entangling versus normal depth FADs in the EPO purse-seine fishery, with an emphasis on the tuna and non-tuna species catch composition; seeking a practical solution to reduce fishing mortality on small undesirable sizes of bigeye |
| **Background** | The fishing mortality of small bigeye caught in sets on FADs should be reduced, to increase the maximum sustainable yield from the bigeye fisheries in the EPO<br>Bigeye tuna associated with FADs in the EPO exhibit deeper depth distributions than skipjack or yellowfin tunas<br>The presence of bigeye in the EPO purse seine catch was reported to be more likely with deeper floating objects |
| **Relevance for management** | A potential solution for reducing fishing mortality on small undesirable sizes of bigeye and/or reducing fishing mortality on bycatch species associated with FADs, including sharks and turtles |
| **Duration** | 2015-2018 |
| **Work plan and status** | 2015-2017: ISSF arranged for experiments to be undertaken at sea in collaboration with NIRSA, a seafood company located in Posorja, Ecuador, with a fleet of 11 purse-seine tuna vessels.<br>The first experiment began in June-July 2015 with deployments of 50 shallow and 50 normal depth FADs and concluded on 31 October 2016. The second experiment began in March-May 2017 with deployments of 100 shallow and 100 normal depth FADs and concluded on 31 December 2017.<br>2018: The catch data collected by observers aboard NIRSA vessels from sets on the experimental FADs from the two experiments is being examined to confirm FAD types<br>2018: A statistical evaluation of the performance of the shallow non-entangling versus normal depth FADs, including the tuna and non-tuna species catch compositions, will be conducted |
| **External collaborators** | ISSF, NIRSA |
| **Deliverables** | Relevant information on performance of shallow non-entangling FADs versus normal FADs based on field experiments<br>Full resolution FAD data was provided to the data team working on the POSEIDON model project<br>Manuscript for peer review and publication in a scientific journal |

| **PROJECT M.1.a: Evaluate the effect of the depth of non-entangling FADs on catches of tunas and bycatches of other species in the purse-seine fishery** |
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| **Updated**: June 2019 |
| **Progress summary for the reporting period**<br><br>    Analyses of the catch-per-set data for tunas and non-tuna species, coupled with corresponding effort and environmental data, were completed.<br><br>Manuscript in final stages of preparation for submission to a peer-reviewed scientific journal in 2019'. Analyses complete and manuscript accepted for publication. |
| **Challenges and key lessons learnt**<br><br>    There is no significant difference in the catch by tuna species, or the catch of total tunas between shallow (5m depth) non-entangling dFADs and a traditional dFAD design (40m depth) in the EPO.<br><br>    Drift speeds between shallow (5m depth) non-entangling dFADs and a traditional dFAD design (40m depth) were not significantly different.<br><br>    Satellite buoy echo-sounder data was compared to total tuna catch to evaluate whether echo-sounder biomass estimates were accurate. Results from the evaluation of 67 sets indicated that there is no correlation between biomass reported under the buoy and what the vessel captured. Eighty-five percent of the buoy estimates over estimated biomass by a considerable margin. |
| **Reports/publications/presentations**<br><br>Schaefer, K.M., Fuller, D.W. and Chaloupka, M., 2021. Performance evaluation of a shallow prototype versus a standard depth traditional design drifting fish-aggregating device in the equatorial eastern Pacific tuna purse-seine fishery. *Fisheries Research*, *233*, p.105763. |
| **Comments:**<br><br>- |

| PROJECT M.1.b: Test sorting grids | |
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| THEME: Ecological impacts of fisheries: assessment and mitigation<br>GOAL: M. Mitigating ecological impacts<br>TARGET: M.1. Investigate gear technology to reduce bycatch and bycatch mortality<br>EXECUTION: Ecosystem and Bycatch Program | |
| Objectives | Reduce bycatches of small fishes (tunas and others) in purse-seine sets. |
| Background | Small individuals of any species (target or non-target) of no market value should be released to reduce the impacts of fishing operations and improve the sustainability of the fishery.<br>Many seiners have sorting grids, different types of panels to allow the escape of fish of a size determined by the dimensions of the grid used, but their use has not been well documented because captains can lift them out of the water, and they do so not to lose any potential catches.<br>Previous experiments have quantified unwanted species passing through the grid. It is necessary to test their survival after escaping, since they may have been injured while going through the grid.<br>Experiments to verify survival should follow the tests of the grid to release unwanted individuals. |
| Relevance for management | Reduce the impacts of fishing and improve the sustainability of the fishery |
| Work plan and status | Convene a workshop with fishing captains and gear experts to decide on the standard design for all tests, using previous experience from the region.<br>Build the design in 2 seiners, with a commitment to cooperate by leaving the grid fully underwater in all sets.<br>Monitor with a camera the utilization of the grid in all sets.<br>Deploy a speedboat with a researcher to film escape through the grid.<br>This initial pilot program will attempt to measure the quantity and characteristics of escaped fish, not their survival<br>Evaluate the significance of the releases, assuming survival.<br>If significant, design a project to measure survival in a floating pen.<br>Discuss with captains ways to improve their operation if needed. |
| Duration | 18 months |
| External collaborators | |
| Deliverables | May 2019: progress report for SAC-10 |

| PROJECT M.1.b: Test sorting grids |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br><br>Upon presenting the report of the 1st Workshop of Sorting Grid (refer to the WSSG-01 Meeting Report) during the 9th Meeting of the Bycatch Working Group, the SAC, in its 14th Meeting (see document SAC-14-16), recommended to the Commission to continue conducting methodological improvement workshops involving scientific personnel, CPC, industry, captains, and experts to build upon the results of the WSSG-01. Additionally, it was suggested that observer programs record the usage (or not) of fish excluder grids by tuna purse seine vessels, along with any relevant complementary information. This data should be made accessible to the scientific staff and the SAC for their analysis and consideration. In response to this |

request, the staff conducted a survey of 43% of the Class 2-6 EPO purse-seine fleet (n=118) as an initial step. Among the surveyed vessels, 37% had the sorting grid installed. Regarding the immersion levels at which the sorting grid typically operates, observers have provided information from 26 trips. In 42% of trips (n=11) the sorting grid operated at 76-100% submerged, in 19% of trips (n=5) it operated at 51-75% submerged, in 31% (n=8) it operated at 26-50% submerged, and in 8% (n=2) it operated at 1-25% submerged.

| **PROJECT M.1.c.** | **Acoustic discrimination to avoid purse seine catches of undersized yellowfin tuna** |
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation |

**PROJECT M.1.c. Acoustic discrimination to avoid purse seine catches of undersized yellowfin tuna**

**THEME:** Ecological impacts of fisheries: assessment and mitigation
**GOAL:** M. Mitigating ecological impacts
**TARGET:** M.1. Investigate gear technology to reduce bycatch and bycatch mortality
**EXECUTION**: Biology Program

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| **Objectives** | Reduce bycatches of small yellowfin in purse-seine sets. |
| **Background** | The International Seafood Sustainability Foundation (ISSF) has been supporting investigations of acoustic methods for discrimination among tuna species caught in purse-seine sets<br>Acoustic technologies could provide the ability to discriminate and avoid undersized yellowfin tuna by the purse-seine fishery to reduce the impacts of fishing operations and improve the sustainability of the fishery.<br>To discriminate yellowfin from skipjack and bigeye, it is necessary to know the acoustic properties of yellowfin, in particular, the target strength (TS) and TS-fish length relationship.<br>Acoustic studies will be conducted on juvenile yellowfin (1-yr-old) held in a previously deployed sea cage at the Achotines Laboratory<br>The fundamental acoustic information obtained for yellowfin will then be compared to information previously obtained for skipjack and bigeye, hopefully enabling fishers to discriminate species before fishing |
| **Relevance for management** | Reduce the impacts of fishing and improve the sustainability of the fishery |
| **Work plan and status** | Early 2020 purchase materials used to anchor and deploy sea cage<br>January-April 2022 install sea cage and collect juvenile yellowfin in waters adjacent to the Achotines Laboratory<br>June 2021-April 2022 staging of ISSF acoustic equipment at Achotines Laboratory<br>May-June 2022 acoustic trial was completed at Achotines Laboratory<br>Late 2022 draft report of study results completed by ISSF researchers:<br>Boyra, Guillermo, Bea Sobradillo, Udane Martinez, Iker Urtisberea, Jon Uranga, and Gala Moreno. Target strength of yellowfin tuna.<br>Late 2022 workshop organized to present the results and discuss them with scientists and buoy manufacturers |
| **Duration** | 36 months |
| **External collaborators** | International Seafood Sustainability Foundation (ISSF) researchers Drs. Gala Moreno and Guillermo Boyra |
| **Deliverables** | ● Study report developed by ISSF researchers and workshop organized by ISSF<br>● Publication of results by ISSF researchers in peer-reviewed journal – in preparation as of early 2024 |

| PROJECT M.1.d. Developing and testing bycatch release devices in tuna purse seiners | |
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.1. Investigate gear technology to reduce bycatch and bycatch mortality<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Develop and test bycatch release devices in tuna purse seiners to improve post release survival, handling and release of sensitive key bycatch species, with particular emphasis on sharks |
| **Background** | Bycatch of Endangered, Threatened and Protected (ETP) species, especially elasmobranchs, are a concern in tropical tuna purse seine fisheries<br>While the IATTC has resolutions promoting the application of best bycatch handling and releasing practices (e.g., for mobulids, sharks, turtles), there is a lack of clear guidelines for the fleet, and current release methods are quite rudimentary, often involving manual handling or basic self-made tools<br>As part of fisheries improvement projects, several fishing organizations have implemented voluntary programs to improve bycatch handling and releasing practices.<br>Associating and collaborating with experienced research institutions and fishing organizations would help explore, discuss and progress towards a reduction of bycatch mortality through the promotion of new tools that facilitate best handling and releasing practices |
| **Relevance for management** | Contributes to increase crew safety and survival of key sensitive bycatch species accidentally caught in tuna purse seiners |
| **Work plan and status** | Coordinate the testing of a number of novel technological devices to release bycatch species in large tuna purse seiners<br>These specific devices will be designed to achieve more efficient releases (e.g. faster, less handling stress, safer for the crew)<br>The benefits of these devices will be assessed in terms of species survival using satellite tags and other biological indicators (e.g. lactate levels, vitality indicators, etc.)<br>Collect device utilization data through IATTC observers and scientific cruises with embarkment of AZTI/IATTC/ISSF scientists<br>Use results of the project to inform conversations during skippers' workshops<br>Promote the utilization of the most efficient devices and methods in the region and, as appropriate, help shape recommendations |
| **Duration** | 24 months |
| **External collaborators** | AZTI Foundation, the International Seafood Sustainability Foundation (ISSF) and OPAGAC |
| **Deliverables** | A report showing results from novel alternative bycatch release devices tested at sea in large tuna purse seiners<br>Dissemination material, including documents and presentations for the IATTC Bycatch Working Group, the SAC and the tuna conference. |

| PROJECT M.1.d.  Developing and testing bycatch release devices in tuna purse seiners |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| Jun-Sept 21: Discuss, decide, and build specific tools for large purse-seine vessels. |

**PROJECT M.1.d.  Developing and testing bycatch release devices in tuna purse seiners**

**Updated**: May 2024

**Progress summary for the reporting period**
Jun-Sept 21: Discuss, decide, and build specific tools for large purse-seine vessels.
Sept 21-Jan 22: Develop data collection forms and protocols as well as discuss and agree the sampling design.
Jan 22-Apr 22: Finalize dedicated data collection forms and instructions and coordinate logistics for the first scientific cruise with a researcher from AZTI and an IATTC observer.
Apr 22: The first scientific cruise had to be postponed at the last minute due to issues related to COVID-19.
May 22: the first scientific cruise happened where 16 silky sharks were tagged.
Jun-Dec 22: information on shark handling and releasing practices was collected on two more trips.
May 23: a second scientific cruise was conducted where 8 sharks were tagged.
March 24: the third cruise on board the Aurora B took place to tag sharks, take blood samples and test bycatch release devices (BRD) to better understand the survival rates of the species under different landing and handling scenarios to test the efficacy of BRDs (Hoppers, grids, ramps).

**Challenges and key lessons learnt**
Some technological devices seem promising to improve both fishing crews' safety and sharks post-release survival. Sharks that are separated and released from the upper deck   have higher survival rates than sharks that are separated from the catch on the well deck. Hoppers with ramps are a safe and effective combination for returning sharks to the sea, although the use of stretchers are also advantageous.
New technologies (i.e., suction discs) are currently being explored as a potential technology to be used in purse seiners.
Blood samples are needed to better estimate post-release survival of the species and develop size and fishing-operation-specific survival curves.
Satellite tags failed

**Reports/publications/presentations**
A [presentation](#) at the BYC-10 meeting.
A presentation and information paper EB-01-INF-B was presented at the EBWG-01 meeting.

**Comments:**
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**PROJECT M.1.d.  Developing and testing bycatch release devices in tuna purse seiners**

**Updated**: May 2024

**Progress summary for the reporting period**
Jun-Sept 21: Discuss, decide, and build specific tools for large purse-seine vessels.
Sept 21-Jan 22: Develop data collection forms and protocols as well as discuss and agree the sampling design.
Jan 22-Apr 22: Finalize dedicated data collection forms and instructions and coordinate logistics for the first scientific cruise with a researcher from AZTI and an IATTC observer.
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**Challenges and key lessons learnt**
Some technological devices seem promising to improve both fishing crews' safety and sharks post-release survival. Sharks that are separated and released from the upper deck   have higher survival rates than sharks that are separated from the catch on the well deck. Hoppers with ramps are a safe and effective combination for returning sharks to the sea, although the use of stretchers are also advantageous.
New technologies (i.e., suction discs) are currently being explored as a potential technology to be used in purse seiners.
Blood samples are needed to better estimate post-release survival of the species and develop size and fishing-operation-specific survival curves.
Satellite tags failed

**Reports/publications/presentations**
A [presentation](#) at the BYC-10 meeting.
A presentation and information paper EB-01-INF-B was presented at the EBWG-01 meeting.

**Comments:**
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| PROJECT M.2.b: Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation | |
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| THEME: Ecological impacts of fisheries: assessment and mitigation<br>GOAL: M. Mitigating ecological impacts<br>TARGET: M.2. Develop best practices for release of bycatch species<br>EXECUTION: Life-history and Behavior Group | |
| Objectives | Estimate post-release survival of silky sharks captured by Mexican longline vessels in the eastern tropical Pacific, utilizing a best handling practice, and define boundaries encompassing the probable distribution silky shark pupping areas in the EPO |
| Background | Apparent severe decline in the population of silky sharks in the EPO, based on trends in standardized catch-per-unit-of-effort indices<br>Domestic longline fleets from Latin America conduct multi-species fisheries including retaining silky sharks<br>Defining the probable distribution of silky shark pupping areas would be useful for better understanding population structure and for consideration of conservation measures including spatiotemporal closures |
| Relevance for management | Resolution C-16-06 on conservation measures for silky sharks stipulates to improve handling practices for live sharks to maximize post-release survival, and identification of pupping areas of the silky shark |
| Duration | 2018-2020 |
| Work plan and status | 2018-2019: 69 silky sharks will be tagged with archival tags on Mexican longline vessels, using best handling practices<br>2019-2020: The data obtained will be analyzed for post-release survival and movements during 2019 and 2020.<br>2019-2020: Exploratory analyses of silky shark size at capture data, compiled from various fisheries in the EPO, will be conducted to determine the areas and times where silky shark pupping most likely occurs |
| External collaborators | INAPESCA, Mexico |
| Deliverables | Silky shark post-release survival rate captured by Mexican longline vessels, using best handling practices<br>Probable distribution of silky shark pupping areas |

| PROJECT M.2.b: Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation |
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| **Updated**: February 2022 |
| **Progress summary for the reporting period** |
| 57 silky sharks were tagged with archival tags on Mexican longline vessels, using best handling practices |
| The satellite data sets obtained have been compiled |
| A table of metadata has been compiled, including release and pop-up dates and locations for all tags reporting to date, along with the fate of each shark. |
| **Challenges and key lessons learnt:** |
| **Reports/publications/presentations** |
| Schaefer, K., Fuller, D., Castillo-Geniz, J.L., Godinez-Padilla, C.J., Dreyfus, M. and Aires-da-Silva, A., 2021. Post-release survival of silky sharks (*Carcharhinus falciformis*) following capture by Mexican flag longline fishing vessels in the northeastern Pacific Ocean. Fisheries Research, 234, p.105779. |
| **Comments:** |

| PROJECT M.2.c: Manta and devil ray post-release survival, movement ecology, and genetic population structure | |
|---|---|
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.2. Develop best practices for release of bycatch species<br>**EXECUTION**: Bycatch Mitigation and Gear Technology Group | |
| **Objectives** | Quantify baseline capture and survival probabilities of mobulid species and identify best practices for handling and release<br>Identify vertical and horizontal habitat use of the species to improve selectivity<br>Quantify the accuracy of onboard observer species identification<br>Characterize population genetic structure and effective population size across the Eastern Pacific for four mobulid species. |
| **Background** | Manta and devil ray populations are impacted globally by targeted fisheries and bycatch, including purse seine fisheries operating in the EPO<br>The IATTC forbids retention of mobulid rays and requires release without the use of gaffs, hooks, or damage to the body or gills.<br>Fishing crews have begun employing a variety of handling and release methods, from release by hand to the use of cargo nets. To date, there is no quantitative data to estimate the effect of these methods on the survivorship of the species |
| **Relevance for management** | Improve fishery sustainability, reduce interaction rates, improve post-release survival rates of sensitive bycatch species, and develop guidelines for best handling and release practices |
| **Duration** | 2021-2023 |
| **Work plan and status** | Train selected observers to deploy satellite tags and collect tissue samples<br>Develop specific complementary data collection forms and protocols for data collection and tagging<br>Analyze satellite tags to investigate animals' post release survival, ecology, and horizontal and vertical behavior<br>Analyze tissue samples using Restricted Site Associated Sequencing (RAD-Seq) techniques to infer population structure and size from genetic information, as well as assess the accuracy of onboard observer species identification abilities.<br>Conduct skippers' workshops to discuss potential improvements and help shape best handling and release practices<br>Develop bycatch mitigation and management measures based on scientific evidence |
| **External collaborators** | The Manta Trust, The Monterey Bay Aquarium, The Conservation Action Lab at University of California Santa Cruz |
| **Deliverables** | A peer-reviewed publication on the post-release survivorship of manta and devil rays released alive from tuna purse seine vessels<br>Empirically derived guidelines for the best handling and releasing practices<br>Peer-reviewed publications on the horizontal and vertical distribution of mobulid rays, and their environmental preferences<br>A peer-reviewed publication on the population genetic structure of four mobulid species<br>A peer-reviewed publication on the accuracy of species identification and the effort to improve species identification forms and training for observers<br>Dissemination material for the Ecosystem and Bycatch Working Group |

| PROJECT M.2.c: Manta and devil ray post-release survival, movement ecology, and genetic population structure |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| 2021: Develop data collection forms and protocols as well as discuss and agree the sampling design. |
| 2021-2022: distribute tagging kits to IATTC and TUNACONS observers for opportunistic tagging. Collect tissue samples at sea, on land, and from collaborators. Biological sampling kits also made available to central American shark sampling program technicians. |
| 398 usable tissue samples were collected and analyzed up to date, belonging to 4 species. About 350 more samples were analyzed in 2022. |
| A manuscript on mobulids genetic and population structure was prepared and submitted to a peer-reviewed journal. |
| 2023: Tagging completed, and data sets are aggregated from external mobula tagging studies for meta-analysis. |
| 2024: The factors affecting post release survival rates of mobula captured in global purse seine fisheries are analyzed and a manuscript was prepared and submitted for peer-review. |
| 88 tags were deployed on mobulids to date: 40 *M. mobular*, 12 *M. Thurstoni*, 32 *M. tarapacana*, 4 *M. birostris*. |
| **Challenges and key lessons learnt** |
| Analyses of tag data suggest species-specific post-release mortality rates and that survivorship declines drastically if mobula are not returned to the sea within three minutes. The predicted survival probability after 3 minutes on deck was 80.2% for M. birostris, 89.9% for M. mobular, 75.1 % for M. tarapacana, and 43% for M. thurstoni. This decreased to 42.3% for M. birostris, 62.5% for M. mobular, 35.1% for M. tarapacana, and 12% for M. thurstoni after 15 minutes on deck. |
| Preliminary genetic analyses suggest weak but significant population structure for all the species with good data – *M. birostris, M. thurstoni*, and *M. munkiana*. Strong evidence of connectivity exists, but local selection may also be occurring. |
| For *M. thurstoni* and *M. munkiana*, very low diversity and high inbreeding has been detected, suggesting potential genetic bottleneck or depletion. |
| There is clear distinction between Indian Ocean/W Pacific and eastern Pacific Oceans, suggesting EPO should likely be managed distinctly. Additionally, there are significant differences from northern and southern EPO, though this varies slightly by species. For some, subregions-subpopulations (north-south) may exist within the ETP. |
| Other regional mobulid mitigation initiatives exist, and active collaboration is being undertaken at the moment (i.e., mobulid bycatch mitigation tools in purse-seiners operating in both WCPO-EPO). |
| Several tags failed to report, and arrangements were made with the tag provider to replace them. |
| New tags will be deployed in 2024 as part of a 'phase 2' to test survival rates when bycatch reduction devices (e.g., grids) are used and release times are minimized across species. |
| **Reports/publications/presentations** |
| A [presentation](#) at the BYC-10 meeting. |
| Several presentations for the skippers' workshops in 2020, 2021 and 2022. |
| A peer-reviewed publication. |
| *Cronin et al. 2022, Harnessing Stakeholder Knowledge for the Collaborative Development of Mobulid Bycatch Mitigation Strategies in Tuna Fisheries, ICES Journal of Marine Science.* |
| The above paper was presented to the EB-01 Working Group. |
| A manuscript of the post release survival data was submitted to peer-review in early 2024 and will be presented to the EBWG-02: 'Get them off the deck: Straightforward interventions increase post-release survival rates of manta and devil rays in tuna purse seine fisheries' |
| **Comments:** |
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**PROJECT M.2.d: Evaluating knowledge and data gaps to the implementation of best handling and release practices for vulnerable species in IATTC fisheries**

THEME: Ecological Impacts of Fisheries: Assessment and Mitigation
GOAL: **M**. Mitigate the ecological impacts of tuna fisheries
TARGET: M.2. In collaboration with the industry, conduct scientific experiments to develop a best practices manual for the handling and release of prioritized bycatch species
EXECUTION: Ecosystem and Bycatch Program

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| **Objectives** | Conduct a review to identify knowledge and data gaps hindering the implementation of best handling and release guidelines for vulnerable species in IATTC fisheries |
| **Background** | Improving the post release fate of prioritized, vulnerable and/or no retention species is key to support sustainable fisheries.<br>Handling and release practices have been shown to have significant impacts on survival outcomes for discarded species.<br>Therefore, accurate guidance on handling and release practices that maximize the potential for survival post release for prioritized species is desirable across IATTC fisheries. |
| **Relevance for management** | Improved handling and release practices will reduce the impact of IATTC fisheries on vulnerable species and populations |
| **Duration** | 24 months |
| **Workplan and status** | Year 1: Collate and review available data on post release survival and current handling practices; write a review document for the EBWG; make recommendations to improve research and knowledge gaps and priorities.<br>Year 2: Start developing a live document with improved handling and release guidelines for vulnerable species across fishing sectors where possible, seek CPC input, explore options to improve communication with fishers, including developing illustrations to accompany guidelines or online resources. |
| **External collaborators** | CPCs, fishing organizations |
| **Deliverables** | Review document collating available information and identification of research and knowledge gaps to be addressed in future efforts (EBWG-01-01)<br>Identification of areas where vulnerable species resolutions can be improved, and make recommendations to the SAC and the Commission accordingly.<br>Dissemination material (e.g., illustrated guides, online resources) for the fleet, the Ecosystem and Bycatch Working Group, the SAC, and other meetings and organizations of interest. |

| **PROJECT M.2.d: Evaluating knowledge and data gaps to the implementation of best handling and release practices for vulnerable species in IATTC fisheries** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period:**<br>An exhaustive review of existing IATTC guidelines, and available post release survival data was conducted to identify gaps in current guidelines and available data that are useful in the development of meaningful Best Handling and Release Practices (BHRP) guidelines. The paper EB-01-01 was presented to the EBWG and SAC-14. A memo was sent to all CPCs and cooperating non-members requesting any data on post release survival data and any BHRP guidance and regulations. The next steps are to compile all information and develop a workplan for BHRP adoption for all vulnerable taxa across fisheries and this will be presented to the EBWG-02 and SAC-15 as document EB-02-03.<br>In 2024 Shark BHRP will be developed as requested by the Commission and presented to the EBWG and SAC-15 in paper SAC-15-11 (see project M.2.f). |
| **Challenges and key lessons learnt:**<br>Data validating post release fate using recommended practices is expensive and difficult to generate. Furthermore, fleet characteristic data will be necessary to generate recommendations for best practices across the region and collaboration across CPCs and other relative entities will be necessary in the development of BHRP for vulnerable species. |
| **Reports/publications/presentations**:<br>EB-01-01 on "Knowledge and research gaps to the implementation of best handling and release practices for vulnerable species" was posted and presented to the EBWG and SAC-14.<br>EB-02-03 "A workplan for BHRP adoption for all vulnerable taxa" will be presented at the EBWG. |
| **Comments:**<br>The SAC-14 acknowledged the importance of developing Best Handling and Release Practice guidelines for vulnerable species and made several recommendations to the Commission in section 9 of SAC-14-16. As such, the Commission adopted Resolution C-23-07 on sharks and tasked the staff to prepare Best Handling and Releasing guidelines for sharks in 2024 (SAC-15-11) |

| PROJECT M.2.e: Investigating post release survival of silky sharks captured in class 2-5 purse seine vessels | |
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| THEME: Ecological Impacts of Fisheries: Assessment and Mitigation<br>GOAL: M. Mitigate the ecological impacts of tuna fisheries<br>TARGET: M.2. In collaboration with the industry, conduct scientific experiments to develop a best practices manual for the handling and release of prioritized bycatch species<br>EXECUTION: Ecosystem and Bycatch Program | |
| Objectives | Conduct a post release survival study (PRS) of silky sharks captured in class 2-5 purse seine vessels to generate quantitative estimates of survival and to identify best handling and release methods |
| Background | Understanding and reducing the impacts of tuna fishing on associated species is a requirement of the Antigua Convention.<br>Improving the post release fate of prioritized, vulnerable and/or no retention species is a research priority to promote sustainable fisheries.<br>Vessel operational characteristics and handling and release practices have been shown to have significant impacts on survival outcomes for discarded species, including sharks.<br>PRS rates of incidental sharks in smaller size class purse seine vessels is an existing knowledge and data gap. Therefore, a satellite telemetry and blood chemistry study will be conducted in collaboration with TunaCons observers on class 2 – 5 vessels. |
| Relevance for management | Results will improve stock and vulnerability assessments assumptions and help design the best handling and release practices for this fleet segment |
| Duration | 36 months |
| Workplan and status | Year 1: Purchase tagging and blood chemistry material. Train observers in tagging and blood withdrawal techniques. Develop forms and data collection methods to record additional data on handling release methods used and condition of the animal.<br>Year 2: Only half of the funds are dispersed per year so year two will be focused on deploying the second batch of tags and continued blood sampling of shark bycatch<br>Year 3: Data analysis and write-up of results. |
| External collaborators | CPCs, Tuna Cons, MSC |
| Deliverables | Shark PRS estimates by landing stage and handling and release method for smaller size class purse seine vessels.<br>Improvements to best handling and release practice guidance for this sector as well as improved assumptions for parameters in the species assessments.<br>Reports and presentations for the EBWG and the SAC, including main results and recommendations of the project |

| **PROJECT M.2.e: Investigating post release survival of silky sharks captured in class 2-5 purse seine vessels** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period:** <br> In July 2023 IATTC staff travelled to Manta to train IATTC and TUNACONS observers to tag and to conduct blood withdrawals on incidentally captured sharks to generate survival estimates for silky sharks across sizes ranges captured in small purse seines (i.e., class 2-5). <br> During Year 1 of the study 5 trips were conducted, where 21 tags were deployed on sharks and blood lactate levels were measured for survival estimation, by landing stage, release condition and handling method. |
| **Challenges and key lessons learnt:** <br> There appears to be another bug in the tagware that is proving problematic in that some data is not transmitted and tags are shed early. Fate on tag shedding has been established however and may still prove useful. The training has proven effective, and the data being generated for this study is of very high quality for survival rate projections for this fleet. |
| **Reports/publications/presentations:** |
| **Comments:** <br> During year 2 an additional 16 tags are set to be deployed during 3-4 cruises. |

| **PROJECT M.2.f (new): Developing best handing and release practice (BHRP) guidelines for sharks in IATTC fisheries** | |
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| **THEME:** Ecological Impacts of Fisheries: Assessment and Mitigation<br>**GOAL: M**. Mitigate the ecological impacts of tuna fisheries<br>**TARGET:** M.2. In collaboration with the industry, conduct scientific experiments to develop a best practices manual for the handling and release of prioritized bycatch species.<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Develop best handling and release practice guidelines for sharks captured in IATTC fisheries |
| **Background** | The Commission during the 101$^{st}$ meeting adopted Resolution C-23-07 on the Protection and Sustainable Management of Sharks. Section 12 of the Resolution requires the staff in collaboration with the IATTC SAC and EBWG, to develop and recommend to the Commission a set of best handling guidelines for the safe release of sharks for inclusion in this measure in 2024.<br>Handling and release practices have been shown to have significant impacts on survival outcomes for discarded species. Therefore, accurate guidance on handling and release practices that maximize the potential for survival post release for prioritized species is desirable across IATTC fisheries. |
| **Relevance for management** | Improved handling and release practices will reduce the impact of IATTC fisheries on vulnerable species and populations |
| **Duration** | 12 months |
| **Workplan and status** | Because good data exists on handling impacts survival for sharks captured in longline and purse seine fisheries, a review of available data, literature, recommendations, and information and domestic guidelines provided by the CPCs to the staff has been compiled to derive evidence driven BHRP guidelines for IATTC fisheries, which are presented to the EBWG-02 and SAC-15 for review and refinement prior to provision to the 102$^{nd}$ Commission meeting for consideration for adoption and inclusion in C-23-07. |
| **External collaborators** | CPCs, fishing organizations, global experts |
| **Deliverables** | SAC-15-11: Best Handling and Release Practices guidelines for sharks captured across IATTC fisheries with tool requirements for consideration for adoption during the 102$^{nd}$ Commission meeting. |

| PROJECT M.5.b: Reducing losses, and fostering recovery of FADs in the purse-seine fishery in the EPO | |
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.5. Develop best practices to mitigate anthropogenic impacts on EPO habitats<br>**EXECUTION**: Data Collection and Database Program, Ecosystem and Bycatch Program | |
| **Objectives** | Evaluate the extent of stranded, abandoned or lost FADs (SAL-FADs) in the EPO. Evaluate the impact of SAL-FADs on coastal areas and islands of the EPO, with special emphasis on identification of deploying locations.<br>Identify or develop oceanographic models to forecast strandings of FADs.<br>Based on findings, develop mitigation and management measures and strategies to minimize SAL-FADs. Promote recovery of SAL-FADs and evaluate its effectiveness. |
| **Background** | SAL-FADs have an impact on coastal areas in the EPO, but the information available is mostly anecdotal.<br>Some FAD components lost at sea or not retrieved, particularly those made of plastics or other materials that are not readily degradable, can last many years in the environment as pollutants and threaten vulnerable ecosystems.<br>SAL-FADs can also be a danger to navigation.<br>SAL-FADs may produce 'ghost-fishing' in the EPO. |
| **Relevance for management** | Ecological impacts on vulnerable ecosystems are an important factor in FAD fishery management.<br>Results may be useful for CPCs in the development of best fishing practices and management measures for FADs |
| **Duration** | 28 months |
| **Work plan and status** | May 2022-March 2023: Survey stakeholders about areas and impacts of SAL-FADs. Previous versions of this document planned research on identifying or develop ocean circulation model to forecast FAD trajectories beyond fishing grounds. This plan has been combined with M.5.c<br>Based on models from project K.1.a [Poseidon] and the result of surveys, identify levels of sensitivity and categorize possible stranding areas.<br>As permitted by restrictions due to pandemic allow: Workshop with stakeholders and ISSF scientists to identify mitigation strategies for SAL-FADs, based on findings of survey and models<br>Based on results from above: Present a report of all findings and proposals for mitigation strategies at. |
| **External collaborators** | Poseidon team |
| **Deliverables** | At this point, due to restrictions due to pandemic, a schedule of timing is not possible. |

| PROJECT M.5.b: Reducing losses, and fostering recovery of FADs in the purse-seine fishery in the EPO |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Development and distribution of survey on impact of SAL-FADs. 20 responses to date: academic (1), consultant (1), industry (2), environmental NGOs (3), industry NGO (6), government (7).<br>Two staff members attended the ISSF-sponsored workshop on the reduction of the impact of FADs in September 2018.<br>Two staff members participated in a SPC-WCPFC sponsored workshop on the implementation of a framework for data collection on FAD stranding events. This WCPO initiative was presented at the 2023 FAD WG meeting. |
| **Challenges and key lessons learnt**<br>Despite repeated notices to encourage stakeholders to participate in the survey, the response has been poor.<br>Pandemic conditions have not allowed in-person meetings, which in the opinion of the staff is necessary to foster discussion. However, the staff will participate in a WWF-ISSF-TUNACONS organized workshop on designing effective FAD recovery programs, planned for May 2024. |
| **Reports/publications/presentations**<br>A presentation for the FADWG on the results of the workshop on designing effective FAD recovery programs, as well as an update on IATTC's efforts to gauge CPC interest in developing a regional data collection program on FAD strandings originating from EPO fisheries. |
| **Comments:**<br>The project was due to start date in early 2018, but was delayed. To date, only the first objective has been addressed and with minimum success. Additional tasks have been conducted in collaboration with external partners, including ISSF-WWF-TUNACONS and SPC-WCPFC on two important components (1) designing guidelines for effective FAD recovery programs and (2) determining CPC interest in participating in a regional data collection program on FAD strandings originating from EPO fisheries—following the system of data collection and dedicated data forms already established by the WCPFC and described in FAD-07 INF-A.<br>The modelling of FAD movements is being combined with other projects (K1.a and M.5.c). |

| **PROJECT M.5.c: Definition of guidelines to reduce the impact of lost and abandoned FADs on marine turtles** | |
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.5. Develop best practices to mitigate anthropogenic impacts on EPO habitats<br>**EXECUTION**: Bycatch Mitigation and Gear Technology Group | |
| **Objectives** | Minimize the impacts caused by lost and abandoned FADs on sea turtles, while also defining future guidelines to reduce the impact of FAD structures on sea turtles´ habitats |
| **Background** | It is estimated that around 20% of FADs are lost or abandoned every year in the Pacific Ocean<br>Recent scientific literature identified potential FAD accumulation areas in Papua New Guinea, Solomon Islands, French Polynesia, Hawaii, Perú and Galapagos, among others<br>Most of these areas are essential habitats for many sea turtles, including nesting areas for leatherback turtle<br>Despite most of the FADs in the region are low entanglement risk FADs, the exact magnitude of turtles that become entangled, partially or permanently, is unknown, as well as their effects on their habitats |
| **Relevance for management** | Reduce interaction of FADs with non-target species as well as decreasing stranding events in habitats of interest for sea turtles, with special emphasis on foraging and nesting areas |
| **Duration** | 20 months – December 2020 to July 2022, extended until the end of 2022 due to COVID-19 pandemic |
| **Work plan and status** | Evaluation of the starting point, through collecting information on current FAD loss and stranding events and FAD interactions with turtles<br>Modelling FAD trajectories arriving at essential habitats for turtles, with special focus on leatherback turtle and Hawaiian Islands<br>Evaluating options to reduce FAD impact and definition of guidelines for best practices, including outreach and conversations with stakeholders, fishing crew and managers<br>Several workshops will be organized during the project to promote discussion and acceptance of results |
| **External collaborators** | Hawaii Pacific University, ISSF, NOAA, SPC |
| **Deliverables** | Reports of the workshops organized during the workshop<br>A peer-reviewed publication on the results of the modelling of FAD drifts<br>A report with guidelines to reduce the impact of FAD structures on sea turtles and their habitat<br>Dissemination material for the Bycatch Working Group, likely in 2022 and 2023. |

| **PROJECT M.5.c: Definition of guidelines to reduce the impact of lost and abandoned FADs on marine turtles** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>A series of passive-drift Lagrangian simulation experiments were undertaken based on possible FAD drifting behavior.<br>Guidelines to reduce the impact of lost and abandoned drifting FADs on sea turtles have started to be drafted. The guidelines will identify means to reduce the interactions and mortalities associated with (i) entanglement in FADs structure, and (ii) FAD stranding events in turtle´s essential habitats.<br>Several workshops were held to discuss results with different fleets operating in the Pacific Ocean and define potential guidelines for FAD construction that may reduce impacts on sea turtles.<br>Three staff members attended an in-person workshop in Hawai'i in late 2022 to discuss projects results.<br>A series of documents and peer-reviewed manuscripts are currently being prepared (e.g. EBWG-01, FAD-07-04).<br>The project is officially completed but additional efforts are being conducted to assess and predict the effects of the different lifetimes of biodegradable FADs in the simulated FAD densities and connectivity between different regions across the Pacific. |
| **Challenges and key lessons learnt**<br>Corridors of connectivity between industrial FAD fishing grounds and zones of important habitats for sea turtles were identified.<br>For FADs deployed in the EPO, the main areas of concern appear to be the turtle habitats in the south-eastern Pacific Ocean, corresponding to oceanic leatherback (*Dermochelys coriacea*) migration and feeding grounds. Moderate accumulation of FADs was also detected in the equator, coastal and oceanic habitats and nesting sites around Mexico, Costa Rica and Panama.<br>A large equatorial area, south of Hawai'i, important leatherback foraging habitat, exhibited large numbers of FADs transiting when deployed in the equatorial zones north of the equator, from both the EPO and WCPO.<br>The detected connectivity patterns appear to be somewhat mitigated against by the current deployment distribution of FADs in the EPO. |
| **Reports/publications/presentations**<br>BYC-11-05 – Simulating FAD trajectories for key sea turtle habitats in the Pacific Ocean.<br>BYC-11-INF-A – Progress report on guidelines for to reduce the impact of lost FADs on sea turtles<br>Abstract submitted to the International Marine Debris Conference in Korea in 2022<br>FAD-07-04 - Guidelines for turtle friendly FAD construction<br>A series of peer-reviewed publications are either published, in preparation or under review, including a study on the effect of different biodegradable FAD lifetimes in FAD densities and connectivity between regions across the Pacific. |
| **Comments:** |

| **PROJECT M.5.d: Evaluation of new biodegradable materials in the tropical marine environment, for the construction of FADs** |||
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| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.5. Develop best practices to mitigate anthropogenic impacts on EPO habitats<br>**EXECUTION**: Ecosystem and Bycatch Program, Achotines Laboratory and Biology Program |||
| **Objectives** | A controlled experiment in tropical waters to assess the degradation of new BioFAD surface components that reduce ocean debris and pollution contributions by commercial tuna fishing. ||
| **Background** | Almost half of the global tropical tuna catch worldwide is currently fished by purse seiners using FADs.<br>FADs construction materials have evolved, aimed at higher resistance and durability. The utilization of synthetic materials has become prevalent due to their exceptional resilience, but these synthetic materials contribute to the increasing problem of marine litter and potential species entanglement.<br>Thus, the IATTC adopted Resolution C-23-04 that requires fleets to transition to fully biodegradable FADs by 2030. ||
| **Relevance for management** | Reducing ecosystem and ecological impacts on vulnerable ecosystems and species is key for FAD management purposes. The results derived from this assessment will support fleets transitions to biodegradable FADs and contribute towards developing best fishing practices and management measures by the Commission ||
| **Duration** | 13 months ||
| **Work plan and status** | Mo. 1: Analysis of the specifications of the trials, experimental design, assemblage and installation under controlled conditions in Achotines, Panamá.<br>Mo. 2-13: Periodic evaluations and monitoring of biodegradable materials, analysis of performance of materials under controlled conditions. ||
| **External collaborators** | AZTI ||
| **Deliverables** | Complete data collection sheet and audiovisual information of the evaluations<br>Dissemination material for the FAD Working Group, likely in 2024-2025. ||

| PROJECT M.5.d: Evaluation of new biodegradable materials in the tropical marine environment, for the construction of FADs |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>December 2023-January 2024: material acquisition and shipping to Achotines, Panama.<br>February – April 2024: The specifications of the trials, experimental design and samples assemblage and installation were made. The collection of data on physical characteristics of biodegradable materials started. |
| **Challenges and key lessons learnt**<br>Rough ocean and weather conditions in the Achotines Lab may affect the condition of the BioFAD materials. To prevent material losses, the BioFADs were tethered in an offshore tuna cage, and evenly distributed within the sea cage ring |
| **Reports/publications/presentations** |
| **Comments:** |

| INTERACTIONS AMONG THE ENVIRONMENT, THE ECOSYSTEM, AND FISHERIES |
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**PROJECT N.1 Investigate the effects of wind-induced microturbulence on yellowfin larval survival**

**THEME:** Interactions among the environment, the ecosystem. and fisheries
**GOAL:** N. Understanding the interactions among environmental drivers, climate, and fisheries
**TARGET:** N.1. Understanding the effects of short-term environmental fluctuations
**EXECUTION**: Early Life-history Group

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| Background | Studies have shown that feeding success and survival of marine fish larvae can be influenced by the levels of wind-induced microturbulence in the larval feeding environment |
| | Multiple experiments were conducted over 4 years to examine microturbulence effects on yellowfin larval survival, and optimal turbulence estimates for larval survival were converted to optimal wind speeds |
| | Estimated optimal wind speeds for larval survival have been examined for correlations with yellowfin recruitment during 1987-2007 |
| Relevance for management | The wind speed-recruitment analysis is promising for assessing yellowfin recruitment patterns in relation to larval survival |
| Duration | 36 months |
| Work plan and status | June-December 2019: Refine analyses of survival and feeding data and finalize wind speed-recruitment analysis |
| | January-December 2023: Complete manuscript and submit to scientific journal |
| External collaborators | University of Tokyo |
| Deliverables | Presentations for SAC-09, SAC-10 and SAC-11 |
| | Publication of results in a scientific journal |

| **PROJECT N.1.b: Investigate the effects of wind-induced microturbulence on yellowfin larval survival** |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>Analysis of experimental survival and feeding data in response to microturbulence completed.<br>Feeding parameters examined in relation to microturbulence included average prey and biomass consumption and size of prey captured.<br>A meeting with Dr. Shingo Kimura at University of Tokyo in August 2019 included adjustments and improvements to the final modeling of the experimental turbulence results.<br>During 2022 and 2023 the experimental analysis of larval feeding responses to microturbulence was expanded<br>A manuscript summarizing experimental estimates of optimal microturbulence and a wind speed-recruitment analysis of select areas of the EPO is nearing completion |
| **Challenges and key lessons learnt**<br>Measuring microturbulence in experimental tanks is difficult on a scale that is relevant to the foraging environment of larval yellowfin. This was addressed by using a microacoustic doppler velocimeter (ADV) to measure turbulent dissipation rates in the tanks at microscale (5 mm x 5 mm) precision; they were also estimated using a small-scale ($m^3$) model developed by a colleague at the University of Tokyo. |
| **Reports/publications/presentations**<br>Presentation at SAC-10 and SAC-11<br>Presentation at 45th Larval Fish Conference, August 2022 |
| **Comments:**<br>This project will be completed with the submission of a manuscript by late 2024. |

| PROJECT N.1.c: Developing dynamic species distributions models to inform conservation and management of non-target species and communities in the eastern Pacific Ocean | |
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| **THEME:** Interactions among the environment, the ecosystem, and fisheries<br>**GOAL:** N. Understanding the interactions among environmental drivers, climate, and fisheries<br>**TARGET:** N.1. Understanding the effects of short-term environmental fluctuations<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Contribute to the development of high-resolution dynamic habitat models for key non-target species and ecological functional groups impacted by tuna fisheries to better understand the dynamics of target-bycatch-environment co-occurrence and assess the vulnerability of the species under existing and projected effort and environmental regimes using EASI-Fish. |
| **Background** | Managing the diverse range of co-occurring species is a significant challenge owing to the dynamic biophysical environment of the EPO at different scales<br>Understanding the likelihood of species-fishery interactions requires knowledge of each species' spatio-temporal distribution relative to that of the fishing effort under specific environmental conditions<br>Besides, dynamic models can assist in the assessment of the potential vulnerability of species and ecological functional groups (e.g. hammerhead sharks) to existing or predicted levels of fishing effort using EASI-Fish<br>The IATTC has done significant progress on dynamic models of distribution for the main tropical tuna species (e.g. SAC-10-INF-D) but models for some of the most important key bycatch species are missing<br>The project will produce models for a total of 8 species, selected based on IATTC's current conservation and management priorities and data availability |
| **Relevance for management** | Advancing our understanding of the relationship between environment, biological community structure and vulnerable bycatch species to guide the development of alternative and/or complementary bycatch mitigation measures |
| **Duration** | 48 months, starting in March 2021 |
| **Workplan and status** | Mar-Apr 2021: Conduct exploratory data analysis and extraction of environmental covariates<br>Apr-Dec 2021: Develop models and evaluations for 8 key bycatch species<br>Dec 2021-Apr 2022: Run model predictions<br>Dec 2021-Aug 2022: Preparation of written reports and peer-reviewed manuscripts<br>Apr 2022-Aug 2022: Development of a beta online portal for decision makers<br>Aug 2021-Aug 2022: Continuous engagement with IATTC CPCs, fishers, and other key EPO resource stakeholders<br>**2023-2026:** Continue developing or updating models for key bycatch species |
| **External collaborators** | Stockholm Resilience Center at the University of Stockholm |
| **Deliverables** | A compendium of spatially-explicit dynamic species distribution models for key non-target bycatch species<br>A beta-version user-friendly online platform to visualize main results and promote engagement and conversations with decision-makers<br>Dissemination of material, including peer review publications, documents and presentations for the IATTC SAC and working groups on Bycatch and FADs, capacity building workshops with stakeholders, and other national and international scientific forums |

| **PROJECT N.1.c: Developing dynamic species distributions models to inform conservation and management of non-target species and communities in the eastern Pacific Ocean** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>Long-term empirical data was analyzed to assess the effectiveness of static vs dynamic management options for two vulnerable shark species.<br>Machine-learning species distribution models were run for key bycatch species, including certain species of sharks and the critically endangered leatherback turtle.<br>A set of predictions for those key sensitive bycatch species are being run to help improve EASI-Fish models. |
| **Challenges and key lessons learnt**<br>Closing areas of high fishing inefficiency, and reallocating effort proportionally to reflect historical patterns, yearly tuna catch may have increased while the bycatch of certain sharks could have decreased significantly.<br>Static closures seem less effective than dynamic and adaptive measures, which should be considered to more efficiently fulfill conservation and sustainability objectives in the EPO.<br>Machine-learning algorithms are powerful tools to deal with data-limited species and can produce accurate and reliable species distribution models for sensitive species.<br>Data confidentiality issues were experienced by participants, which delayed the project significantly. However, a solution was found, and analyses are being run preserving all confidentiality aspects of the data. The project has now been taken over by the permanent IATTC scientific staff.<br>Predictions for sharks are underway, beginning with silky shark. |
| **Reports/publications/presentations**<br>Presentation at BYC-10<br>Presentations and documents at BYC-11 (BYC-11-01, BYC-11-04)<br>2 manuscripts have been accepted in peer-reviewed journals. |
| **Comments:**<br>The COVID-19 pandemic and issues with data sharing and confidentiality delayed the project. The number of SDMs to de delivered will be revised to meet conservation priorities and deadlines.<br>The postdoctoral position of the main collaborator is over, and this work will be revised and taken over by the new members of the Ecosystem and Bycatch Program. |

| PROJECT N.1.d: Evaluate link between increased YFT catches environmental change | |
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| **THEME:** Interactions among the environment, the ecosystem and fisheries<br>**GOAL:** N. Understanding the interactions among environmental drivers, climate, and fisheries<br>**TARGET:** N.1. Understanding the effects of short-term environmental fluctuations<br>**EXECUTION**: Ecosystem and Bycatch Program & Stock Assessment Program | |
| Objectives | Evaluate whether changes in the environment may have contributed to the increases in YFT catches by the purse seine fleet. Specifically, investigate the occurrence of trends/shifts in YFT suitable habitat and corresponding effects in catch rates and length composition, that may explain recent increases in catch. |
| Background | In 2022 and 2023 YFT catches far exceeded previous years' catches. It was hypothesized that this may be the result of changing fishing behavior due to the implementation of the new management measures (Resolution C-21-04) intended to address conservation concerns related to bigeye tuna (BET). The measures included the establishment of annual BET catch thresholds on individual purse-seine vessel, which may have been an incentive to avoid BET and target YFT instead. Preliminary analyses do not support the switching in target (SAC-15-INF-K), and other factors, such as oceanographic conditions, may have played a role. The productivity of the EPO YFT tuna stock shows large annual variability, likely related to environmental conditions. Availability of YFT may also change in different oceanographic regimes. Concomitant to management changes, recent years have also experienced strong ENSO regime fluctuations, including La Niña and El Niño conditions of different magnitude. Thus, potential changes in the environment need to be investigated to determine whether it played a role in the increase in YFT catches, either due to increase in biomass or changes in availability. |
| Relevance for management | The implication for management of the different hypotheses that explain the increase in YFT catches (e.g., target switching, environmental effects in productivity or availability) are very different, thus determining their plausibility will be necessary to provide sound scientific advice for management. |
| Duration | 1 year |
| Work plan and status | 2024: Produce maps of YFT catches, catch rates and length compositions over various key environmental variables, individually and in combination, for periods before and after the implementation of C-21-04 ,and examine shifts in YFT suitable habitat. |
| External collaborators | |
| Deliverables | SAC-15 INF-L |

| **PROJECT N.2.a. Develop models of the effects of climate change on pre-recruit life stages of tropical tunas** | |
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| **THEME:** Interactions among the environment, the ecosystem. and fisheries<br>**GOAL:** N. Improving our understanding of the EPO ecosystem<br>**TARGET:** N.2. Understanding the effects of long-term climate drivers<br>**EXECUTION**: Early Life-history Group | |
| **Objectives** | Investigate experimentally the effects of important climate change factors on early life stages of tropical tunas, and incorporate those results into models that can predict climate change effects on the distribution and abundance of tropical tunas |
| **Background** | Tuna populations are key components of pelagic ecosystems, but the effects of climate change on tuna biomass, distributions and recruitment are almost unknown<br>The Achotines Laboratory provides an essential experimental center for investigations of the effects of climate change factors on pre-recruit life stages of tropical tunas<br>A study of the effects of ocean acidification on yellowfin egg and larval stages was conducted at the Achotines Laboratory in 2011 and the results published in two papers in 2015 and 2016, with an additional two papers in preparation<br>A new study investigating molecular effects of ocean acidification and ultraviolet irradiance on yellowfin eggs and embryos was conducted by University of Miami scientists at the Achotines Laboratory in late 2019.  The IATTC early life history group is collaborating on the study.<br>The effects of additional climate change factors, such as ocean warming and anoxia, can be studied at the Achotines Laboratory and incorporated into models of multifactor effects on pre-recruit life stages |
| **Relevance for management** | Potential impacts of climate change on early life stages are an important consideration in future assessments of tunas in the EPO, and experimental results can allow models to be parameterized to include climate change effects on pre-recruit survival and spawning and nursery habitat |
| **Duration** | 4 years |
| **Work plan and status** | January 2018-June 2022: Completion of analyses and manuscripts from the 2011 study describing ocean acidification effects on larval otolith morphology and genetic expression of resistant traits in yellowfin<br>May 2020 – June 2022:  Completion of analyses and manuscript from the 2019 molecular study led by University of Miami<br>January 2020-December 2023: There are plans to develop experimental investigations to study the effects of ocean warming and anoxia on pre-recruit life stages of yellowfin |
| **External collaborators** | ABARES and AFMA, Australia; Secretariat of the Pacific Community, Macquarie University, Australia<br>Drs. Rachael Heuer, Christina Pasparakis and Martin Grosell, University of Miami |
| **Deliverables** | Presentations for SAC-09, SAC-10 and SAC-11<br>Publication of results in several scientific journals |

| PROJECT N.2.a. Develop models of the effects of climate change on pre-recruit life stages of tropical tunas |
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| **Updated**: March 2024 |
| **Progress summary for the reporting period**<br>Analysis of the effects of ocean acidification on yellowfin larval otolith morphology has been completed; studies of the genetic expression of resistant traits continue.<br>The larval otolith analysis was completed and submitted as a manuscript in late 2022. The genetic analysis of expression of resistant traits in response to ocean acidification has been slower<br>The experimental results from the 2011 study have been used in several modeling efforts to estimate the impacts of ocean acidification on yellowfin in the Pacific Ocean<br>The molecular study of ocean acidification effects led by University of Miami was conducted at the Achotines Laboratory in late 2019 with 3 scientific publications produced |
| **Challenges and key lessons learnt**<br>Combining rearing larval tunas with precise control of the physical carbonate system was particularly challenging. A large collaborative research group, with expertise in larval ecology, carbonate system testing, and modeling was developed to complete the study.<br>Studies of the effects of additional climate change factors, such as ocean warming and anoxia, will require additional funding, which to-date has not been secured. |
| **Reports/publications/presentations**<br>Presentations:<br>• SAC-10, SAC-11 and SAC-12<br>• 69th Tuna Conference (May 2018) and 71st Tuna Conference (May 2021)<br>• 42nd Larval Fish Conference (June 2018) and 43rd Larval Fish Conference (May 2019)<br>• Four scientific papers using experimental results from the 2011 study presented modeling predictions of the effects of ocean acidification on yellowfin abundance in the Pacific Ocean, and the most recent publications during 2022 and 2023 were:<br>• Nicol, Simon, Patrick Lehodey, Inna Senina, Don Bromhead, Andrea Y. Frommel, John Hampton, Jon Havenhand, Daniel Margulies, Philip L. Munday, Vernon Scholey, Jane E. Williamson, and Neville Smith. 2022. Ocean futures for the world's largest yellowfin tuna population under the combined effects of ocean warming and acidification. Frontiers in Marine Science 9:816772.<br>• Wexler, Jeanne, Daniel Margulies, Vernon Scholey, Cleridy Lennert-Cody, Don Bromhead, Simon Nicol, Simon Hoyle, Maria Stein, Jane Williamson, and Jon Havenhand. 2023. The effect of ocean acidification on otolith morphology in larvae of a tropical, epipelagic fish species, yellowfin tuna (*Thunnus albacares*). J. Experimental Marine Biology and Ecology 569(2): 151949.<br>• Three manuscripts summarizing results of the 2019 molecular study led by University of Miami with IATTC collaboration have been published, and the most recent publication during 2023 was:<br>Heuer, Rachael, Yadong Wang, Christina Pasparakis, Wenlong Zhang, Vernon Scholey, Daniel Margulies, and Martin Grosell. 2023. Effects of elevated $CO_2$ on metabolic rate and nitrogenous waste handling in the early life stages of yellowfin tuna (*Thunnus albacares*). Comparative Biochemistry and Physiology, Part A 280, 111398.<br>• SAC-12-15 Review of research at the Achotines Laboratory |
| **Comments:**<br>The multirelational analyses of experimental results from the 2011 study was completed in 2023. |

| PROJECT N.2.b: Supporting climate-ready and sustainable fisheries: using satellite data to conserve and manage life in the ocean and support sustainable fisheries under climate change | |
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| **THEME:** Interactions among the environment, the ecosystem and fisheries<br>**GOAL:** N. Improving our understanding of the EPO ecosystem<br>**TARGET:** N.2. Understanding the effects of long-term climate drivers<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Produce forecasted dynamic species and vessel distributions under different anomaly and climate change scenarios in the near, mid and long-term based on changing environmental drivers.<br>Quantify shifts in overlap among species and vessels given shifting habitat for both. Understand the impact of climate anomalies, changing oceanographic conditions and future scenarios on forecasted dynamic species and vessel distributions with a specific focus on forecast skill and accounting for uncertainty. |
| **Background** | Balancing short, medium and long-term sustainability, food security and economic objectives in a changing environment is a challenge to fisheries management.<br>Current conservation measures have not been specifically designed to adapt to a changing environment, particularly in the medium-long term.<br>Previous research has documented distributional shifts of pelagic predators and fishing effort in response to climate-driven changes, but no particular study has been conducted for the tropical tuna and bycatch species in the EPO.<br>A better understanding of climate-induced shifts in the spatial distribution of target and non-target species is needed to develop climate-resilient fisheries. |
| **Relevance for management** | Understanding tuna stocks and fishers' response to medium and long-term changing ocean conditions is important to develop subsequent policy and management strategies and ensure climate-resilient fisheries in the EPO. |
| **Duration** | 24 months, extended to 36 months due to COVID-19 |
| **Work plan and status** | 2021 – Develop vessel distributions models; gather model outputs from target species; assemble projected environmental data.<br>2022 – Develop forecasted target and vessel distributions; target species and vessels models validation; gather distribution model outputs from bycatch species; develop forecasted bycatch distributions; bycatch models validations.<br>2023 – preparation of dissemination material; present at the SAC, the Bycatch WG and other IATTC meetings of interest.<br>2024 – the project has now been taken over by the IATTC scientific staff |
| **External collaborators** | San Diego State University-Conservation Ecology Lab, The Ocean Conservancy |
| **Deliverables** | A series of climate change medium and long-term projected dynamic species distributions for both target and non-target species and vessels.<br>Compilation of reliable environmental data for different climate scenarios.<br>Web-based tools and forecast products. Open source code to allow replication.<br>Dissemination material, including documents and presentations for the Scientific Advisory Committee and the Bycatch working Group in 2021 and 2022. |

| **PROJECT N.2.b: Supporting climate-ready and sustainable fisheries: using satellite data to conserve and manage life in the ocean and support sustainable fisheries under climate change** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| Several coordination and discussion meetings have been conducted with the [FaCet](#) (Fisheries and Climate Toolkit) group in 2020, 2021, 2022, and 2023. |
| In house produced dynamic size-specific tropical tuna species distribution models (e.g. [SAC-10 INF-D](#)) as well as key bycatch species models (e.g., EP leatherback turtle) have been shared with collaborators, which will be used as a baseline to assess the impact of climate change on species' future distribution. Similar methods are expected to be applied to additional key bycatch species (e.g., sharks). |
| Dynamic vessel distribution models may also be explored to infer fleet's response to species distribution changes. |
| A profound investigation on potential data sources for different climate scenarios is being conducted, including multi-model outputs and uncertainty sources. |
| A better understanding and assessment of impacts other type of large-scale environmental processes will be explored, in particular, the effect of marine heatwaves on species distribution and fleet's productivity and behavior. |
| The integration of online resources and platforms is being discussed with partners to better disseminate projects results and methods. |
| The project has been now taken over by the permanent IATTC staff. |
| **Challenges and key lessons learnt** |
| The uncertainty associated with climate projections may need to be considered in detail, and solutions explored to find the best way to incorporate it in the final products. |
| **Reports/publications/presentations** |
| A website has been created, [here](#). |
| A presentation was given at AGU 2020, which can be found [here](#). |
| **Comments:** |
| Similar Pacific-wide efforts are being explored, which need to be coordinated, and possibly expanded with existing projects at the IATTC. |

| **PROJECT O.2.a: Develop and implement analytical tools for understanding the trophic ecology of apex predators** | |
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| **THEME:** Interactions among the environment, the ecosystem. and fisheries<br>**GOAL:** O. Improve understanding of the EPO ecosystem<br>**TARGET:** O.2. Improve analytical tools to evaluate anthropogenic and climate impacts on the EPO ecosystem<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| Objectives | To further develop and validate statistical tools for the analysis of complex datasets in trophic studies of apex predators.<br>To enhance external collaborations and professional development through the analysis of Atlantic bluefin tuna diets in relation to biological and environmental variables. |
| Background | IATTC staff have developed an innovative approach for analyzing complex diet data using classification trees. The approach has been used for regional diet studies of yellowfin tuna in the EPO and for a broad-scale global comparison of yellowfin, bigeye and albacore diets.<br>To facilitate more widespread adoption of the method, it requires validation of regional studies in other ocean basins, given the importance of spatio-temporal differences in available prey taxa.<br>Collaboration with other scientists studying the trophic ecology of apex predators can assist with validating the approach, while also enhancing collaborative relationships. |
| Relevance for management | Optimizing statistical tools to analyze trophic data is crucial for understanding the trophodynamics of apex predators in the EPO and whether predator-prey relationships may be impacted by fishing.<br>Diet analyses are fundamental for the identification of ecological functional groups, which are required in the development of ecosystem models to understand the potential ecological impacts of fishing.<br>Integrating environmental factors into analyses of regional studies provides managers with information on effects of climate change on variation in forage communities to verify observed global patterns. |
| Duration | 9 months |
| Work plan and status | Jun 2018: data analyses<br>Aug – Nov 2018: Discuss preliminary outputs with collaborators and implement necessary collaborator inputs into method development<br>Nov 2018-Mar 2019: Manuscript preparation |
| External collaborators | Massachusetts Division of Marine Fisheries; numerous other universities and government agencies |
| Deliverables | Manuscript summarizing the revised approach, using an Atlantic-wide analysis of bluefin trophic ecology as a case study. |

| **PROJECT O.2.a: Develop and implement analytical tools for understanding the trophic ecology of apex predators** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period** |
| Improvements have been made to a statistical tool for analyzing complex diet data, developed in collaboration with scientists at CSIRO (Australia), used to represent trophic interactions in ecosystem models |
| IATTC staff were invited by the Principal Investigator (PI) at the Massachusetts Division of Marine Fisheries to collaborate on this project. IATTC staff conducted exploratory analyses in 2022 and ran classification trees, collaborated with the PI, and contributed to a draft manuscript in 2023. |
| **Challenges and key lessons learnt** |
| The project had previously been stalled pending provision of data by external collaborators and then by COVID-19. Data assembly and quality checking of the various datasets by external collaborators was completed in late 2022. |
| Several external researchers are involved in this project, and the primary challenge has been engaging in collaborative efforts in a timely manner due to prioritization of other projects. |
| **Reports/publications/presentations** |
| The statistical tool is being used by various organizations, including IRD (France) and SPC. |
| A manuscript is expected to be submitted for a peer-review publication in 2024. |
| **Comments:** |
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| **PROJECT O.2.b: An updated ecosystem model of the tropical EPO for providing standardized ecological indicators for monitoring of ecosystem integrity** | |
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| **THEME:** Interactions among the environment, the ecosystem, and fisheries<br>**GOAL:** O. Improve our understanding of the EPO ecosystem<br>**TARGET:** O.2. Improve analytical tools to evaluate anthropogenic and climate impacts on the EPO ecosystem<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Update the Ecopath ecosystem model developed for the eastern tropical Pacific Ocean (ETP) by Olson and Watters (2003).<br>Convert the model to Ecopath with Ecosim (EwE) software version 6.5.<br>Update the model with annual catch, discards, fishing mortality and fishing effort data for each functional group from 1993 to present.<br>Calibrate the model with new catch and effort time series to improve the reliability of model forecast outputs.<br>Produce annual ecological indicators for inclusion in the *Ecosystems Considerations* report as standardized measures of ecosystem integrity. |
| **Background** | IATTC is committed, through the Antigua Convention, to ensuring the long-term sustainability of all target, associated and dependent species impacted by EPO tuna fisheries.<br>Although the IATTC undertakes stock assessments for economically important species and ecological risk assessments (*e.g*. PSA, EASI-Fish) to prioritize research and management of non-target species, these single-species assessments do not take into account possible impacts on ecosystem dynamics through changes in the strength of trophic linkages due to anthropogenic and/or climate impacts.<br>Olson and Watters (2003) developed an Ecopath ecosystem model of the ETP for 1993, with dynamic simulations extended to 1999.<br>No further updates or development of ecosystem models for the EPO have been undertaken by the IATTC staff, due to the departure of key members with ecological modelling expertise. |
| **Relevance for management** | The ETP model will be available in EwE 6.6, which can more rapidly provide annual updates of a range of ecological indicators to provide standardized measures of the integrity of the ETP ecosystem.<br>The ETP model can be used to simulate 'what if' hypotheses relating to changes in fishing activities (*e.g*. use of FADs) and/or climate drivers on the ETP ecosystem structure, and individual functional groups and key species.<br>Conservation and management recommendations for vulnerable species may be developed, based on model outputs. |
| **Duration** | 36 months |
| **Work plan and status** | Jun–July 2018: Convert model to EwE version 6.5.<br>Mar 2019: Update model with new catch data for 1993-2017.<br>Apr–May 2019: Produce ecological indicator values for 1993-2017 and run hypothetical fishery scenarios and present findings at SAC-10.<br>Jun–Dec 2019: Collaborate with the Stock Assessment Group to update time series of biomass, fishing mortality and catch data for the ETP.<br>Jan–Mar 2020: Calibration of model to new data time series. |

| | Apr–May 2020: Produce ecological indicator values for 1993-2018 and run hypothetical fishery scenarios and present findings at SAC-11. |
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| | Jun–Dec 2020: Explore expansion of ETP model to be spatially explicit using Ecospace. |
| | Jan–Mar 2021: Update model with new data for 1993-2019 and calibrate model to new data time series. |
| | Apr–May 2021: Produce ecological indicator values for 1993-2019 and run spatially-explicit hypothetical fishery scenarios and present findings at SAC-12. |
| **External collaborators** | None |
| **Deliverables** | A new version of the ETP model Olson and Watters (2003) that will exist in the latest version of EwE software with updated data time series of catch, effort, and also biomass and fishing mortality where available. Annual updates of ecological indicators to provide standardized measures of the integrity of the ETP ecosystem. |

| **PROJECT O.2.b: An updated ecosystem model of the tropical EPO for providing standardized ecological indicators for monitoring of ecosystem integrity** |
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| **Updated**: May 2023 |
| **Progress summary for the reporting period** |
| • Model updated with new catch data time series for 1993–2018. |
| • Ecological indicator values for 1993–2018 produced from new model and included in the *Ecosystem Considerations report.* |
| • Staff successfully completed a 1-week Ecopath training course in Florida in December 2019 to develop skills that will be necessary to construct a spatially-explicit ecosystem model of the EPO. |
| **Challenges and key lessons learnt** |
| The predator-prey matrix underlying the ecosystem model is based on stomach contents data from the early 1990s. The staff recommends, that Proposal F.3.a. be funded, to obtain updated morphometric measurements and biological samples to best represent the current dynamics of the EPO ecosystem. |
| **Reports/publications/presentations** |
| • Presentation at SAC-10 |
| • SAC-10-14 Ecosystem considerations |
| • SAC-10-15 Towards standardized ecological indicators for monitoring ecosystem health: an updated ecosystem model of the tropical EPO |
| • SAC-12-13 Ecosystem model of the EPO: progress report |
| • SAC-14-11 Ecosystem Considerations |
| **Comments:** |
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| **PROJECT O.2.c: Temporal network analysis of bycatch communities caught in purse-seine fisheries** | |
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| **THEME:** Interactions among the environment, the ecosystem, and fisheries<br>**GOAL:** O. Improve our understanding of the EPO ecosystem<br>**TARGET:** O.2. Improve analytical tools to evaluate anthropogenic and climate impacts on the EPO ecosystem<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Investigate the connectivity among bycatch species caught in the purse-seine fishery and how the structure of these community relationships changes over time and space (if feasible) in the eastern Pacific Ocean (EPO).<br>Investigate the vulnerability of those connections and the role of key bycatch species for the community/network |
| **Background** | Ecological risk assessment (ERA) is an approach currently used by IATTC staff to evaluate the ecological impact of tuna fisheries in the EPO<br>ERA can also help ensure the long-term sustainability of 'associated' and 'dependent' species that share the same ecosystem as principal tuna species<br>Scientists and managers require novel quantitative methods to reliably identify communities that may include vulnerable species<br>Temporal network analysis (TNA) may help identify the communities with vulnerable species and their evolution, and, where appropriate, help prioritize the call for mitigation measures, further detailed analysis, or the prioritization of data collection on potentially vulnerable species |
| **Relevance for management** | The proposed TNA can support ERA by identifying distinct ecological assemblages within the purse-seine bycatch |
| **Duration** | 12 months, extended to 24 months due to COVID-19 pandemic |
| **Work plan and status** | Understand the network structures that emerge from the recurrences of the relationships among bycatch species and how these networks change through time.<br>Detect bycatch communities within networks and key bycatch species as centralized actors of these communities.<br>Explore impacts of key bycatch species on their communities through control theory analysis (node removal simulation). |
| **External collaborators** | Scripps Institution of Oceanography |
| **Deliverables** | A series of dissemination material: documents and presentations for the IATTC Bycatch Working Group, as well as a peer-reviewed scientific publication |

| **PROJECT O.2.c: Temporal network analysis of bycatch communities caught in purse-seine fisheries** |
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| **Updated**: May 2024 |
| **Progress summary for the reporting period**<br>A number of meetings were organized with Scripps Institution of Oceanography during 2021-2023.<br>Exploratory analyses of different bycatch metrics by set type were conducted for 2006–2021 data.<br>Preliminary connectivity, network and temporal-network analyses were conducted for the most common bycatch species for each set type.<br>New state-of-the art algorithms and methods are currently being explored by the main researcher to better infer potential relationships between species and communities.<br>The project was led by Scripps Institution of Oceanography but passed to the IATTC scientific staff in early 2024 due to other commitments and workload. |
| **Challenges and key lessons learnt**<br>Preliminary results suggest differences in the inshore vs offshore bycatch communities and their structures and between different set types. |
| **Reports/publications/presentations** |
| **Comments:**<br>Results of the project were expected to be presented at the EBWG-02 in 2024. However, the results obtained so far in the study are not conclusive. |

**PROJECT O.2.d: Develop a workplan for restructuring IATTC's *Ecosystem Considerations* into (1) an indicator-based EcoCard and (2) a complementary *Ecosystem Status Assessment* for the EPO**

**THEME:** Interactions among the environment, the ecosystem. and fisheries
**GOAL:** O. Improve understanding of the EPO ecosystem
**TARGET:** O.2. Improve analytical tools to evaluate anthropogenic and climate impacts on the EPO ecosystem
**EXECUTION**: Ecosystem and Bycatch Program

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|---|---|
| Objectives | To use ongoing work by tuna-Regional Fisheries Management Organizations (t-RFMO's) to inform a workplan to restructure the *Ecosystem Considerations* document into two ecosystem-advice products for management consideration (1) an Ecosystem Report Card ("EcoCard") consisting of indicators considered to best represent ecosystem status on an ecoregion level and (2) a corresponding *Ecosystem Status Assessment* detailing ecosystem status.<br>Together, these products aim to support possible operationalization of the Ecosystem Approaches to Fisheries Management (EAFM) in the EPO.<br>To improve communication of ecosystem status and harmonize with t-RFMOs. |
| Background | The scope of the staff's research has expanded as a result of increasing requests by CPCs to explicitly address ecological components of the Antigua Convention (see IATTC Strategic Science Plan (SSP), IATTC-101-02a).<br>Due to the broadening array of ecological, environmental and fishery issues that are required to be understood to pursue EAFM of the EPO ecosystem, the length and complexity of the *Ecosystem Considerations* document has increased to the extent that it is not optimal for succinctly conveying key messages.<br>As a result, the staff aim to restructure the document—considering ongoing work by the other t-RFMOs—to provide a condensed visual snapshot of IATTC's progress towards the pursuit of EAFM in the EPO by developing an EcoCard. |
| Relevance for management | Developing surveillance indicators may serve as an early warning system.<br>Developing operational indicators with associated performance thresholds, may be used to provide recommendations for management advice.<br>Together these indicators may support potential operationalization of EAFM |
| Duration | 5 years |
| Work plan and status | 2024: Summarize related ongoing t-RFMO work and create discussion forums to determine frameworks and elements to monitor, including a workplan (see EB-02-02)<br>2025: Establish criteria for (1) determining spatial units (ecoregions) and (2) developing indicators<br>2026–2027: Use established criteria to develop ecoregions and indicators; provide recommendations for management considerations<br>2028: Develop the two ecosystem-advice products and corresponding guidelines |
| External collaborators | Scientists supporting the other t-RFMOs, CPCs, other relevant stakeholders |
| Deliverables | Summary paper: current t-RFMO work on EcoCards to inform an IATTC workplan for developing an EPO EcoCard (EB-02-02)<br>Development of two ecosystem-advice products (1) an EcoCard for the EPO ecosystem consisting of selected indicators chosen to best represent ecosystem status and (2) a complementary *Ecosystem Status Assessment* detailing the full suite of indicators considered for monitoring and operationalization |

| **PROJECT O.2.e: Develop a workplan to promote climate resilient fisheries at IATTC** | |
|---|---|
| **THEME:** Interactions among the environment, the ecosystem. and fisheries<br>**GOAL:** O. Improve understanding of the EPO ecosystem<br>**TARGET:** O.2. Improve analytical tools to evaluate anthropogenic and climate impacts on the EPO ecosystem<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| Objectives | To discuss the current work that IATTC is doing to understand and prepare for the effects of climate change, highlight various tools and frameworks that other countries and international organizations have developed to promote climate-resilient fisheries, and propose a climate change workplan for IATTC that will allow us to better understand, account for, and prepare for the impacts climate change may have on fisheries, its target species, non-target species, and the EPO ecosystem. |
| Background | Studies have continuously shown the impacts climate change has had on marine species and ecosystems, the fishing industry, and fishing communities. A recent IATTC resolution on climate change was adopted (C-23-10) and recognized the impacts climate change is having on its resources and fisheries and that these impacts could affect the long-term conservation and sustainability of fish stocks covered by the Convention. Many strategies and tools are being developed and are helping agencies and organizations understand these direct and indirect effects. The staff has compiled, reviewed and discuss them to develop a workplan for the IATTC's consideration so that a plan can be implemented in order to achieve climate-resilient fisheries in the future. |
| Relevance for management | Developing a workplan, framework and tools to understand the effects can lead to management measures that can anticipate, respond to, and be better adapted to change, leading to climate-resilient fisheries and ecosystems. |
| Duration | 5 years |
| Work plan and status | 2024: Review and share available workplans, frameworks and tools to promote climate resilient fisheries<br>2025: Decide on scope and objectives, develop a framework, and begin strategic tool creation<br>2026: Strategic tool development through participatory (i.e., workshop) and non-participatory (i.e., technical and scientific, non-workshop) activities<br>2027: Strategic and tactical tool development through participatory (i.e., workshop) and non-participatory (i.e., technical and scientific, non-workshop)<br>2028: Tactical tool development and actual tool application/management implementation |
| External collaborators | CPCs, and other relevant stakeholders |
| Deliverables | • Workplan that expands on the objectives listed above (SAC-15-12).<br>• Presentation for SAC and annual meetings<br>• Multiple workshops for scoping, framework and tool development, including the development of a climate framework and associated tools to help scientists and managers better understand the impacts of climate change, identify adaptation plans, implement management plans, and continue to track and monitor changes. |

| KNOWLEDGE TRANSFER AND CAPACITY BUILDING |
|---|

| **PROJECT P.1.a: Fulfil requests for development of database and data processing applications for entities outside the IATTC** ||
|---|---|
| THEME: Knowledge transfer and capacity building <br> GOAL: P. Responding to requests from CPCs and other organizations <br> TARGET: P.1. Respond to requests by CPCs <br> EXECUTION: Data Collection and Database Program ||
| **Objectives** | Provide support to CPCs through the development of data collection forms and the most appropriate computer application to allow the collection, entry, editing and analysis of locally-collected datasets. |
| **Background** | IATTC staff receives requests to develop data entry and editing solutions for data collected by outside organizations. <br> IATTC staff possesses years of experience in these tasks, which is not otherwise available to outside organizations. <br> Through a policy of capacity-building, the staff collaborates with outside organizations to develop the requested applications. |
| **Relevance for management** | Through collaboration with data collectors, the staff may be granted access to new sources of data. |
| **Duration** | Ongoing |
| **Work plan and status** | Currently developing an MS Access database to process FAD information collected through Resolution C-16-01. <br> Request for additional form to be incorporated into the OSPESCA artisanal longline database. <br> Evaluate ability to accept participation in additional requests as they occur. |
| **External collaborators** | OSPESCA |
| **Deliverables** | Completion of requested computer applications. <br> Provide technical support and training of the new applications. |

| **PROJECT P.1.a: Fulfil requests for development of database and data processing applications for entities outside the IATTC** |
|---|
| **Updated**: May 2019 |
| **Progress summary for the reporting period** <br>     All requests received have been addressed. |
| **Challenges and key lessons learnt** <br> - |
| **Reports/publications/presentations** <br> - |
| **Comments:** <br> The current system for dealing with such requests appears adequate. |

| PROJECT P.1.b: Respond to requests for scientific analyses | |
|---|---|
| THEME: Knowledge transfer and capacity building<br>GOAL: P. Responding to requests from CPCs and other organizations<br>TARGET: P.1. Respond to requests by CPCs<br>EXECUTION: Stock Assessment Program | |
| Objectives | Respond to requests by CPCs and other entities in a timely manner |
| Background | The information necessary for making important management decisions is often situation-dependent and evolves as discussions progress.<br>CPCs and other entities regularly make requests for analyses and other work that is not included in the staff work plan<br>The type of requests varies widely. |
| Relevance for management | Many requests by CPCs are directly used to inform management decisions |
| Duration | Ongoing |
| Work plan and status | The workplan cannot be anticipated |
| External collaborators | Varies |
| Deliverables | Vary. Can include reports and/or presentations to SAC and the IATTC meetings. |

| PROJECT P.1.b: Respond to requests for scientific analyses |
|---|
| Updated: May 2024 |
| **Progress summary for the reporting period**<br>All requests received have been addressed. |
| **Challenges and key lessons learnt**<br>MSC certification has increased the amount of requests and current level of staff is insufficient to address all request without impacting other core staff activities. |
| **Reports/publications/presentations**<br>- |
| **Comments:**<br>The current system for dealing with such requests requires additional staff. |

| **PROJECT Q.1.a: Achotines Laboratory support of Yale University's Environmental Leadership Training Initiative (ELTI) in Panama** | |
|---|---|
| **THEME:** Knowledge transfer and capacity building | |
| **GOAL:** Q. Training | |
| **TARGET:** Q.1. Host visiting scientists and students from CPCs | |
| **EXECUTION**: Early Life-history Group | |
| **Objectives** | To support the ELTI objectives of facilitating cooperation, training and research on the conservation, rehabilitation and restoration of forest lands and watersheds in Panama, and to conserve coastal and marine living resources and ecosystems |
| **Background** | The Yale-ELTI Program has been holding training workshops at the Achotines Laboratory for several years and has created a teaching trail in the Achotines Forest which is a key component of their training workshops |
| | To demonstrate good stewardship of the Achotines Forest and surrounding watershed, the Achotines Laboratory has expanded its support of the ELTI Program and will serve as the host center for the ELTI Program and training workshops |
| | The ELTI training workshops have no footprint on the tuna research facilities at the Achotines Laboratory, and are restricted to the Laboratory conference center and the Achotines Forest |
| **Relevance for management** | The Achotines Laboratory support of the ELTI Program in Panama provides an important contribution to regional watershed restoration and conservation of coastal ecosystems in Panama |
| **Duration** | 4 years |
| **Work plan and status** | April 2018-March 2022: Four training courses will be held each year at the Achotines Laboratory, with ELTI affiliates coordinating periodic updates and annual technical reports of activities |
| **External collaborators** | Yale University, ELTI Program |
| **Deliverables** | Presentations for SAC-09, SAC-10 and SAC-11 |
| | Annual technical reports prepared by ELTI affiliates |

| **PROJECT Q.1.a: Achotines Laboratory support of Yale University's Environmental Leadership Training Initiative (ELTI) in Panama** |
|---|
| **Updated**: March 2024 |
| **Progress summary for the reporting period** <br> Fourteen training courses, focused on the conservation, rehabilitation and restoration of forest lands and watersheds in Panama, were held annually at the Achotines Laboratory during April 2019-December 2022. An agreement was finalized to continue the Achotines-ELTI initiative for the period of April 2023 through September 2023. The program was suspended at the end of September 2023 due to a shift in funding by Yale University, however, a MOU supporting terrestrial and reforestation research remains in effect between Yale University and the IATTC through 2027. |
| **Challenges and key lessons learnt** <br> - |
| **Reports/publications/presentations** <br>     Brief summaries of this initiative were included in presentations at SAC-09 and SAC-10. <br>     An ELTI technical report covering the April 2019-March 2020 period was completed. |
| **Comments:** <br> This initiative has been very successful. The Yale/ELTI Program has continued its focus on training for reforestation without any footprint on the tuna research facilities of the Achotines Laboratory. The IATTC has promoted good stewardship of the Achotines forest and is supporting watershed restoration and conservation of coastal ecosystems in Panama. |

| **SCIENTIFIC EXCELLENCE** |
|---|

| **PROJECT U.1.a: Long-term plan to strengthen research at the Achotines Laboratory** | |
|---|---|
| **THEME:** Scientific Excellence<br>**GOAL: U**. Strengthen research at the Achotines Laboratory<br>**TARGET:** U.1. Strengthen and diversify the research program at the Achotines Laboratory<br>**EXECUTION**: Early Life-history Group | |
| **Objectives** | Use of Achotines Laboratory as support for a wide array of research activities under the Strategic Science Plan<br>Improved links among early life history research, stock assessment and management of tropical tunas under a changing climate<br>Increased use of the Laboratory as support for IATTC's capacity-building activities |
| **Background** | A long-term (5-10 years) plan to strengthen and diversify the research program of the Laboratory is needed beyond 2020<br>The Director, Coordinator of Scientific Research and members of the Early Life History Group have identified areas of research emphasis to be expanded and diversified<br>Planning will include improvements in infrastructure, optimal utilization of human resources and identification of new sources of funding<br>The development of the plan will also include staff internal review, review by SAC, and external review of the draft plan and research programs of the Laboratory |
| **Relevance for management** | The plan will strengthen links among early life history research, stock assessment and management of tropical tunas<br>The plan will improve the use of the Laboratory to develop a program of great return value to IATTC Members and the goals of the Antigua Convention |
| **Duration** | 16 months. The plan will be developed during 2020 and 2021, and the implementation of the plan will extend long-term (5-10 years) |
| **Work plan and status** | November 2021 draft plan completed<br>Mid-2022 staff internal review of the plan<br>Late 2022 external review of plan<br>Late 2022 final plan developed with initial implementation of plan<br>In March 2021, a grant was awarded to the Achotines Laboratory by the Panamanian Secretaría Nacional de Ciencia, Tecnología e Innovación (SENACYT) for 2 years of funding for infrastructure and equipment improvements at the Achotines Laboratory.<br>May 2023 Early Life History Group and Chief Scientist presented an overview of the plan at SAC-14 meeting |
| **External collaborators** | Independent reviewers |
| **Deliverables** | Final plan developed by staff<br>New sources of funding for infrastructure improvements |

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**Margulies, D., Buchalla, Y., Cusatti, S., Scholey, V.,** Miyashima, A., Agawa, Y., Honryo, T., Sawada, Y. 2024. The effects of food level and stocking density on growth and survival of yellowfin tuna *Thunnus albacares* and Pacific bluefin tuna *Thunnus orientalis* larvae. Aquaculture America 2024 Conference, San Antonio, TX, USA, 18-21 February 2024.

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**Maunder, M.N.**, Thorson, J.T., **Xu, H**. 2018. Using spatio-temporal models of tagging data to deal with incomplete mixing. CAPAM workshop on the development of spatial stock assessment models, La Jolla, USA, 1-5 October 2018.

**Mauser, E., Margulies, D., Scholey, V., Cusatti, S., Tejada, L., Wexler, J., Stein, M., Honryo, T., Katagiri, R., Kurata, M., Agawa, Y., Sawada, Y.** 2019. Comparative analysis of the laboratory growth of yellowfin tuna *Thunnus albacares* and Pacific bluefin tuna *Thunnus orientalis* larvae, and growth of early-juvenile yellowfin reared in land based tanks and a sea cage. World Aquaculture Society Annual Meeting, New Orleans, LA, USA., 7-11 March, 2019.

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**Minte-Vera, C.V. Maunder, M., Aires-da-Silva, A.** Estimation of the abundance of yellowfin tuna in the eastern Pacific Ocean using fisheries-dependent data. 69th Annual Tuna Conference, Lake Arrowhead, USA, 21-24 May, 2018.

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**Román, M., Lopez, J., Aires-da-Silva, A., Pulvenis, J-F., Willey, B., Lennert-Cody, C.** 2022. The IATTC-EMS in the EPO: Where we've come from and where we're going to. 72nd Annual Tuna Conference, California, USA. May 23-26, 2022.

**Román, M.** 2022. Progress on an EMS for tuna fisheries in the EPO: Structure, IATTC workplan, and pilot EM studies. 2nd IOTC *Ad-Hoc* Working Group on the development of Electronic Monitoring Programme Standards (IOTC–2022–WGEMS02-01a_Rev1). June 13-15, 2022.

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**Román, M., Lopez, J., Moreno, G., Escalle, L., Hutchinson, M.** 2022. Review of FAD impacts on sea turtles. ISSF workshop a workshop aiming towards reducing sea turtle entanglement in drifting Fish Aggregating Devices (FADs). Honolulu, Hawaii. October 24-27, 2022.

**Scholey, V.P., Margulies, D., Mauser, E.** 2019. Research activities at the Inter-American Tropical Tuna Commission Achotines Laboratory. 43rd Annual Larval Fish Conference, Mallorca, Spain, 20-24 May, 2019.

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**Valero, J.L.** 2018. Incorporating tagging data in Stock Synthesis. CAPAM workshop on the development of spatial stock assessment models, La Jolla, USA, 1-5 October 2018.

**Valero, J.L**. 2018. Estrategias de ordenación: objetivos, estrategias y tácticas, RCE. Taller de entrenamiento, comunicación y evaluación de estrategias de ordenación para pesquerías de atunes en el OPO. San Diego, USA, 25-26 de agosto de 2018.

**Valero, J.L**. 2018. Evaluación de estrategias de ordenación mediante simulación. Taller de entrenamiento, comunicación y evaluación de estrategias de ordenación para pesquerías de atunes en el OPO. San Diego, USA, 25-26 de agosto de 2018.

**Valero, J.L., Minte-Vera, C**. 2018. Progress on MSE work at IATTC. MSE Communications Workshop, San Diego, 14-16 January 2018.

**Valero, J.L., Minte-Vera, C**. 2018. Progress on MSE work at IATTC. Tuna RFMO Management Strategy Evaluation Working Group Meeting, Seattle, USA, 13-15 June 2018.

**Valero, J.L., Maunder, M. N., Haikun Xu, Minte-Vera, C., Lennert-Cody, C., Aires-da-Silva, A.** 2018. Exploratory spatial stock assessment of Bigeye tuna (*Thunnus obesus*) in the EPO. CAPAM workshop on the development of spatial stock assessment models, La Jolla, USA, 1-5 October 2018.

**Wexler, J** 2019. Tag-recapture oxytetracycline-marking experiments to investigate daily increment deposition rate in yellowfin otoliths. Workshop to evaluate bigeye and yellowfin tuna ageing methodologies and growth models in the Pacific Ocean 23-25 January, 2019 La Jolla, California, USA.

**Wexler, J,** and **Griffiths, S.** 2019. A review of methods to determine prey consumption rates, gastric evacuation and daily ration of pelagic fishes: a precursor to experimental estimation for key predators in the eastern Pacific Ocean ecosystem. The 70th Tuna Conference, Lake Arrowhead, California USA, May 20-23, 2019.

**Wexler, J, Margulies, D., Scholey, V., Lennert-Cody, C., Stein, M.,** Frommel, A., Bromhead, D., Nicol, S., Hoyle, S., Williamson, J., Havenhand, J., Ilyina, T., Lehodey, P. 2018. The impact of ocean acidification on larval yellowfin tuna (*Thunnus albacares*) development. The 42nd Annual Larval Fish Conference, Victoria, British Columbia, Canada, June 24-28, 2018.

**Xu, H., Lennert-Cody, C.E., Maunder, M.N., and Minte-Vera, C**. 2018. Spatiotemporal dynamics of the dolphin-associated purse-seine fishery for yellowfin tuna in the eastern Pacific Ocean. 69th Annual Tuna Conference, Lake Arrowhead, USA, 21–24 May 2018.

**Xu, H., Lennert-Cody, C.E., Maunder, M.N., and Minte-Vera, C**. 2018. Spatiotemporal dynamics of yellowfin tuna in the eastern Pacific Ocean. CAPAM workshop on the development of spatio-temporal

models of fishery catch-per-unit-effort data to derive indices of relative abundance in La Jolla, USA, February 26-March 2, 2018.

**Xu, H., Lennert-Cody, C.E., Maunder, M.N., Minte-Vera, C., Valero, J., Lopez, J., Schaefer, K**., Fuller, F., Hampton, J., and **Aires-da-Silva, A**. 2018. Estimating the movement rate of bigeye tuna in the eastern Pacific Ocean. CAPAM workshop on the development of spatial stock assessment models, La Jolla, USA, 1-5 October 2018.

## Awards

The Center for the Advancement of Population Assessment Methodology (CAPAM), cofounded by Mark Maunder of the IATTC staff, received the 2018 American Fisheries Society's (AFS) William E. Ricker Resource Conservation Award for improving the quantitative methods used in fisheries stock assessment.

| PROJECT C.1.a: Purse-seine catch composition bias estimation | |
|---|---|
| **THEME:** Data collection | |
| **GOAL:** C. Improve quality and expand coverage of data-collection programs | |
| **TARGET:** C.1. Purse-seine | |
| **EXECUTION**: Stock Assessment Program | |
| **STAFF CONTACT:** Cleridy Lennert-Cody | |
| **Objectives** | Explore and develop robust statistical models to investigate and correct the possible bias in tuna catch composition, resulting from data loss during the COVID-19 pandemic of 2020-2021. |
| **Background** | The COVID-19 pandemic hindered collection of port-sampling data in 2020-2021. Some of the ports most affected were where bigeye tuna (BET) catch is unloaded. Port-sampling data are used to estimate the tropical tuna catch composition of the purse-seine fleet, and thus, there is concern that the Best Scientific Estimates of catch may be biased, particularly for bigeye tuna. <br><br> Spatio-temporal (CAR) models to estimate port-sampling species proportions from observer (logbook) data with overall good performance were developed for 2020-2021 (SAC-13-05). <br><br> Simulation results suggest the CAR model performance is robust to the type of systematic data loss that occurred in 2020. However, simulation studies need to be conducted to evaluate the robustness of the CAR model 2021 estimates. <br><br> Because the stock assessment models have a quarterly time step and the fisheries definitions differ from the areas used in the CAR modeling, it will also be important to develop fine-scale spatio-temporal models (e.g., 5°- month or 5°- quarter). |
| **Relevance for management** | Revised catch estimates for the purse-seine fishery will be essential for the benchmark assessments in 2023 and 2024. |
| **Duration** | 1.5 years |
| **Work plan and status** | 2022: Further investigate spatio-temporal modeling options to correct possible bias in tuna catch composition estimates for all three purse-seine set types. <br> 2023: Produce revised catch composition estimates for the purse-seine fishery for 2020-2021. |
| **External collaborators** | None |
| **Deliverables** | Reports for the SAC and the Commission; publications in peer-reviewed journals. |

| PROJECT C.4.b: Long-term sampling program for shark catches of artisanal fisheries in Central America: Phase 1 | |
|---|---|
| THEME: Data collection | |
| GOAL: C. Improve quality and expand coverage of data-collection programs | |
| TARGET: C.4. Artisanal longline fleet | |
| EXECUTION: Stock Assessment Program | |
| Objectives | Conduct Phase 1 (1st year) of a long-term sampling program of shark catches by artisanal fisheries in Central America, using sampling methods and logistics developed under the extended FAO-GEF project. |
| Background | Assessment modelling for shark species in the EPO is severely hampered by a lack of reliable data on shark catches. |
| | Previous work by IATTC staff identified specific data gaps and data collection needs, including the critical need for catch data from Central American fisheries, some components of which are believed generate a large fraction of the EPO catches of sharks. |
| | The FAO-GEF-funded project on developing sampling designs for the composition of the shark catches by artisanal fisheries in Central America, supplemented with IATTC capacity-building funds, was completed at the end of 2019. |
| | This extended FAO-GEF project has generated, and continues to generate, a wealth of information with which to develop sampling designs for various fleet components of Central American coastal fisheries that land sharks (SAC-10-16). However, no funding is available to implement a long-term sampling program using the methodology developed under the FAO-GEF project. |
| | Without data provided by a properly designed long-term sampling program for Central American artisanal fisheries, the IATTC will not be able to meet the goal of Resolution C-16-05 of EPO assessments of silky and hammerhead sharks. |
| | Phase 1 of the long-term sampling program will provide the necessary extensive field testing required to fine-tune sampling methodology, logistics and costs for Phase 2 (regular sampling). |
| Relevance for management | Data collected under a long-term monitoring program based on fully-tested sampling designs will allow for development of stock status indicators and conventional assessments of key shark species |
| Duration | 21 months (April 1, 2020 – December 31, 2021) |
| Work plan and status | 2021: Implement the sampling designs developed under the extended FAO-GEF project. |
| External collaborators | OSPESCA, Central American national authorities |
| Deliverables | Sampling designs and logistical plans for estimating the species and size composition of shark catches in Central American artisanal fisheries. |
| | IATTC-98-02c (2021): report on final sampling design methodology and costs. |

**PROJECT C.4.b: Long-term sampling program for shark catches of artisanal fisheries in Central America: Phase 1**

**Updated**: May 2022

**Progress summary for the reporting period:**

**March- 2020 to March 2021**

> The COVID-19 quarantine resulted in a 5-month delay to start this project (March to July 2020).
>
> After issues related to the pandemic were resolved, the sampling program began in August 2020, at which point 14 sampling technician and two data editors were hired.
>
> After January 2021, the sampling methodology changed, and field workdays increased as COVID-19 restrictions were reduced and businesses such as hotels and restaurants on shore opened.
>
> As of the beginning of March 2021, a total of 1,300 vessels were sampled. The samples contained a total of 1,986 fish, of which 49% were sharks and 28% rays, the rest of the sampled fish were dorado, billfishes and tunas. Also reported were juveniles of manta species (Fam. Mobulidae), pregnant thresher sharks, and others.
>
> New task: with the collaboration project between The Manta Trust, The Monterey Bay Aquarium, The Conservation Action Lab at University of California Santa Cruz, and the Inter-American Tropical Tuna Commission (**Project M.2.c)**, opportunistic tissue sampling started in March 2021 for mantas and devil rays to better understand their population structure.

**April-June 2021**

> Around 1,000 records were collected in this period. The most important species group reported was sharks (53%), followed by rays (24%), dorado (11%), billfishes (4%), and tuna (7%). The main shark species were silky sharks and hammerhead sharks.
>
> 65 tissue samples were collected for mantas and devil rays in Nicaragua (85%), Guatemala (15%); all samples from Nicaragua were delivered to the Conservation Action Lab at the University of California Santa Cruz (UCSC).

**July-September 2021**

> As of September 2021, a total of 4,190 samples were registered. The number of samples in this period was higher than at the beginning of the project (>1,200 samples). As a result, the catches of dorado and rays increased to 18% and 26%, respectively, and shark catches decreased by 42%.
>
> 77 tissue samples were collected for mantas and devil rays in Nicaragua and were delivered to UCSC for analysis.

**October-December 2021**

- The number of records decreased in this period (<800 samples). The catches of sharks and rays decreased compared to the last period, to 33% and 19% respectively, but dorado catches increased (30%).

- A total of 4,964 samples were registered; these data were distributed in order of the number of samples: Nicaragua (38%), Panama (28%), Guatemala (14%), El Salvador (13%), and Costa Rica (6%). The countries with the highest distribution of large pelagic catches was Nicaragua (61% sharks, 24% dorado, 11% billfishes, and 4% tuna); followed by Costa Rica (64% sharks, 20% dorado, and 8% billfishes and tuna); El Salvador (69% sharks, 15% dorado, 11% billfishes and 5% tuna); Guatemala (82% sharks, 10% dorado, 1% billfishes and 6% tuna); and the catch of sharks and related species in Panama had the least interaction with others large pelagic species (97% sharks, 1% dorado, and 1% tuna).

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| • Because the project was nearing completion (December 2021), sampling days were reduced in the last month. The sampling technicians worked in the field until 15 December. The remaining days were used to prepare the final report. <br> • All the tissue samples from Nicaragua and Guatemala have been sent to UCSC for analysis. The staff is in process of obtaining CITES permits to export the samples from Ecuador at the moment. |
| **Challenges and key lessons learnt** <br> Due the pandemic, numerous issues were encountered related to all data collection, which varied by country; in particular, there was a ban on fishing activity in areas with the potential for a high density of fishers and buyers. Also, size composition sampling had to be suspended to avoid close contact between fishers an samplers . However, these issues were overcome as the COVID-19 pandemic regulations became less restrictive, so sampling days and biometric data collection increased. <br> The effects of the pandemic are evident, with the number of *pangas* changing considerably at many sites. Although 2020–2021 catch rate data are still being analyzed, preliminary results indicate that sites where catches of silky shark and hammerhead sharks were identified from the fisher interviews in 2019 as primary and secondary sites seem to actually operate as tertiary sites (no catch of those sharks) or vice-versa. |
| **Reports/publications/presentations** <br> Lennert-Cody, C.E., Mccracken, M., Siu, S., Oliveros-Ramos, R., Maunder, M.N., Aires-da-Silva, A., Carvajal Rodríguez, J.M., Opsomer, J., Barros, P., 2022. Single-cluster systematic sampling designs for shark catch size composition in a Central American longline fishery. Fisheries Research 251 (2022) 106320, p. 14.  https://doi.org/10.1016/j.fishres.2022.106320 <br> Oliveros-Ramos, R., Lennert-Cody, C.E., Siu, S., Salaverría, S., Maunder, M.N., Aires-da- Silva, A., 2019. Pilot study for a shark fishery sampling program in Central America. Inter-Am. Trop. Tuna Comm. Doc. SAC-10-16. <br> Oliveros-Ramos, R., Lennert-Cody, C.E., Siu, S., Salaverría, S., Maunder, M.N., Aires-da- Silva, A., Carvajal Rodríguez, J., 2020. Pilot study for a shark fishery sampling program in Central America. Inter-Am. Trop. Tuna Comm. Doc. SAC-11-13. |
| **Comments:** <br> The project concluded in December 2021. Unfortunately, it was not possible to obtain financial support from the Members for its continuation. |

| PROJECT D.2.a: Pilot study of electronic monitoring (EM) of the activities and catches of purse-seine vessels ||
|---|---|
| THEME: Data collection ||
| GOAL: Investigate use of new technologies (pilot studies) ||
| TARGET: D.2 Electronic monitoring ||
| EXECUTION: Bycatch and Gear Technology group ||
| Objectives | A proof-of-concept study to evaluate the types of data that can be reliably collected by electronic monitoring (EM) on Class 1-5 purse-seine vessels. |
| Background | Fisheries management and assessments require complete catch and bycatch information.<br>Logbook data for Class 1-5 vessels provide basic catch information for target species, but no information on tuna discards and incomplete information on catches of non-target species.<br>EM systems may provide cost-effective and practical solutions. |
| Relevance for management | Better-quality and higher-resolution data on catches and discards of target and non-target species by unobserved purse-seine vessels would improve the staff's stock assessments and management advice |
| Duration | 23 months |
| Work plan and status | 2018: January-February: Identify EM capabilities from manufacturers.<br>March-May: Survey of infrastructure configuration and fishing operations of small vessels. Identify candidate vessels; purchase EM equipment.<br>June 2018-January 2019: collect EM and observer data on small purse-seine vessels.<br>2019: February-April: process EM data.<br>May-August: Statistical comparisons of EM and observer data; write project report.<br>September-November: if proof-of-concept warranted, development of a sampling design for a pilot study using EM aboard small purse-seine vessels. |
| External collaborators | Collaboration of fishing industry, observers and technology companies is essential. |
| Deliverables | May 2018: Progress report to SAC-09 meeting. |

| PROJECT D.2.a: Pilot study of electronic monitoring (EM) of the activities and catches of purse-seine vessels |
|---|
| **Updated**: May 2022 |
| **Progress summary for the reporting period:**<br>      Since the previous report (Oct 2020), the IATTC staff in combined effort with Digital Observer Services (DOS) has been generating and analyzing EM data; to date, the resulting EM-data from 22 fishing trips have been analyzed (12 trips IATTC; 10 trips DOS). Also, the EM standards document (SAC-11-10) was presented in the SAC.<br>      Progress will be reported at SAC-12, including a condensed document with the staff recommendation to the CPCs on the minimum standards for EM (EMS-01-01), and the workplan for the implementation of EM in the EPO (EMS-01-02). |
| **Progress summary for the reporting period:**<br>**2020:**<br>      June: IATTC staff started generating EM-data for all four participant vessels.<br>      October: IATTC staff presented the document on minimum standards for EM (SAC-11-10) for tuna fishery, including purse-seine vessels.<br>**2021**:<br>January - March:<br>    Produced and analyzed EM-data for 22 fishing trips.<br>    Write project report.<br>      April:<br>    EM workshop to discuss the document SAC-11-10 and minimum standards for data collecting based on the results of this project.<br>      May:<br>    Submit the final report of the project.<br>    Presented a draft for final minimum standards recommendations (document EMS-01-01) and a workplan to present revised standards on the purse-seine fishery, based on the results of the project, as part of the implementation of an EMS in the region (document EMS-01-02). |
| **Challenges and key lessons learnt**<br> COVID-19 pandemic delayed the review of EM-data for 3 months. The delay was mitigated by subcontracting DOS for generation of EM data. |
| **Reports/publications/presentations**<br>May 2019:<br>Progress report presented at SAC-10.<br>      SAC-10-12 Electronic monitoring of purse-seine vessel activities and catches<br>July 2019:<br>Presentation: *Progress of electronic monitoring testing in the Eastern Pacific*. Side event hosted by the ISSF at 94th Meeting of the IATTC.<br>October 2019:<br>Participation: *SPC/FFA/PNAO DCC Longline Electronic Monitoring (EM) Planning Workshop*. Honiara, Solomon Islands. To gain and share experiences on EM with other RFMOs. Participation sponsored by The Pew Charitable Trusts.<br>October 2020:<br>Progress report at SAC-11<br>Proposal for minimum standards in EM for the EPO (SAC-11-10).<br>March 2021<br>Project terminated. |

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| April 2021 |
| An EM workshop was held to discuss the document SAC-11-10, to present a compilation of the EMS recommendations, and to present a workplan for EMS implementation. |
| May 2021 |
| Progress report at SAC-12. |
| EM sampling coverage and EM data review rates analyses for the purse-seine fishery. |
| **Comments:** |
| For Class-6 vessels, the objective is to assess which activities of the on-board observers can be performed by EM (Project D.2.c, now combined with this project). |


| **PROJECT E.1.a: Evaluate potential improvement of growth model for bigeye in the EPO based on presumed annuli counts from otoliths of large fish** | |
|---|---|
| **THEME:** Life-history studies for scientific support of management | |
| **GOAL:** E. Life history, behavior, and stock structure of tropical tunas | |
| **TARGET:** E.1. Age and growth of tropical tunas | |
| **EXECUTION**: Biology and Ecosystem Program | |
| **Objectives** | Evaluate the potential improvement in accuracy of the growth model for bigeye in the EPO resulting from including more age-at-size data for large fish |
| **Background** | Growth model for bigeye is based on validated counts of daily otolith increments, corroborated by extensive tagging data, but age-at-size data for larger fish (150-200 cm) are lacking |
| | High-confidence tagging data for bigeye >150 cm are limited |
| | The National Research Institute for Far Seas Fisheries (NRIFSF) of Japan's collections of otoliths from large bigeye captured in the EPO are now available for evaluating age estimates from counts of presumed annuli |
| **Relevance for management** | Improving the accuracy of the bigeye growth model, particularly for larger fish, would help resolve some of the uncertainty regarding the status of the stock, and improve the framework on which management advice is based |
| **Duration** | 24 months; initiated November 2017 |
| **Work plan and status** | Fish Ageing Services (FAS) in Australia counted annuli on 140 pairs of bigeye otoliths from up to 20 fish within each 10 cm length interval between 110 and 200 cm and estimated the ages of the fish |
| | FAS age estimates for 110-150 cm fish will be compared to published age-at-size data |
| | Growth rates for 150-180 cm fish based on EPO tagging data will be compared with growth rates based on the FAS age estimates. |
| | Age estimates from otoliths of 150-200 cm fish will be combined with the existing data set and used in an integrative growth model. |
| **External collaborators** | NRIFSF, Japan |
| **Deliverables** | Presentation for SPC-OFP bigeye pre-assessment workshop, 2018 |
| | Potential update of bigeye growth model for use in stock assessments |

| PROJECT E.1.a: Evaluate potential improvement of growth model for bigeye in the EPO based on presumed annuli counts from otoliths of large fish |
|---|
| **Updated**: June 2019 |
| **Progress summary for the reporting period** |
|     Annual and daily increment counts from 70 otolith pairs, from fish 80-150 cm from the South EPO, were compared.<br>    The daily increment counts were compared to decimal ages for 133 fish 112-207 cm from the South EPO.<br>    Decimal ages for fish > 150 cm were compared with the integrated growth model for fish from the EPO, including high-confidence tagging data for fish 150-201 cm. |
| **Challenges and key lessons learnt** |
|     The decimal age estimates based on the 70 otolith pairs are greater for fish 130-150 cm than those based on daily increment counts.<br>    Distinguishing annual increments is problematic.<br>    For fish 120-150 cm from the South EPO, the decimal age estimates are on average 1.3 years greater than the age at length for fish from the equatorial EPO estimated by the integrated growth model.<br>    For fish 150-200 cm from the South EPO, the adjusted annual increment counts estimate age at length 2.4 years greater, on average, than the integrated growth model for the equatorial EPO.<br>    These results indicate that the annual age estimates should not be included in a new integrated growth model for bigeye in the EPO. |
| **Reports/publications/presentations** |
| Schaefer, K., Fuller, D., and Satoh, K. Abstract *in* Report of the workshop on age and growth of bigeye and yellowfin tunas in the Pacific Ocean, 23-25 January 2019, La Jolla, USA |
| **Comments:** |
| **-** |

| PROJECT E.2.b: Workshop to evaluate differences in bigeye tuna age estimation methods and resulting growth models utilized in current stock assessments by the IATTC and WCPFC | |
|---|---|
| **THEME:** Life history studies for scientific support of management **GOAL:** E. Life history, behavior, and stock structure of tropical tunas **TARGET:** E.2. Conduct spatiotemporal research on the reproductive biology of tropical tunas **EXECUTION**: Biology and Ecosystem Program | |
| **Objectives** | Resolve concerns about differences in age estimation methods and resulting growth models used in bigeye tuna stock assessments by IATTC and WCPFC |
| **Background** | Although there are documented differences in the life history characteristics of the bigeye stocks from the EPO and WCPO, the magnitude of the discrepancies in the estimated length-at age data, growth models, and $L_\infty$ estimates used in the recent IATTC and WCPFC stock assessments, along with the dramatic shift in stock status of WCPO bigeye population is concerning. The estimated $L_\infty$ from the WCPO bigeye growth model is 157 cm, unrealistically low, and is highly influential in the assessment model and resulting stock status determination. |
| **Relevance for management** | Age and growth models and their estimates of $L_\infty$ are highly influential in assessing the status of bigeye in integrated assessment models |
| **Duration** | 2 days |
| **Work plan and status** | Workshop to be held in La Jolla, November 2018, or as soon as possible in 2019 |
| **External collaborators** | SPC; CSIRO and FAS, Australia; FSFRL, Japan; PIFSC |
| **Deliverables** | A workshop report to be shared with all interested parties |

| PROJECT H.1.a: Improve the bigeye tuna stock assessment | |
|---|---|
| **THEME:** Sustainable fisheries<br>**GOAL:** H. Research and development of stock assessment models and their assumptions<br>**TARGET:** H.1. Improve routine tropical tuna assessments<br>**EXECUTION**: Stock Assessment Program | |
| **Objectives** | Improve the bigeye tuna stock assessment in terms of reducing the regime shift in recruitment and the bimodal pattern in management quantities |
| **Background** | • The last benchmark assessment was conducted in 2020.<br>• The last benchmark assessment showed a strong regime shift in recruitment and bimodal pattern in management quantities, making it challenging to provide management advice.<br>• An exploratory stock assessment was conducted in 2023.<br>• Two external stock assessment reviews were organized in late 2023 and many of the recommendations from the two reviews were incorporated in the current benchmark assessment. |
| **Relevance for management** | The stock assessment is used to provide management advice |
| **Duration** | 2020-2024 |
| **Work plan and status** | 2021:<br>• CAPAM natural mortality workshop (Workshop report)<br>2022:<br>• Workshop on improving the risk analysis for the tropical tunas in the EPO (Workshop report)<br>• Advance the understanding of the longline data of different fleets and potential indices of abundance (Workshop report)<br>2023:<br>• Exploratory analysis for the stock assessment of bigeye tuna in the EPO (SAC-14-05)<br>• Risk assessment methodology (Workshop report)<br>• CAPAM tuna stock assessment good practices (Workshop report)<br>2024:<br>• Benchmark stock assessment model and risk analysis (SAC-15-02) |
| **External collaborators** | |
| **Deliverables** | Report to SAC in 2023 (SAC-14-05)<br>Report to SAC in 2024 (SAC-15-02) |

| PROJECT H.1.a: Improve the bigeye tuna stock assessment |
|---|
| **Updated**: August 2024 |
| **Progress summary for the reporting period**<ul><li>A workplan to improve the bigeye tuna stock assessment has been completed.</li><li>A benchmark assessment with risk analysis was delivered in SAC 15.</li><li>The current benchmark assessment showed no sign of regime shift in recruitment and management quantities are unimodal, suggesting that the stock assessment has been greatly improved.</li></ul> |
| **Challenges and key lessons learnt**<ul><li>The results of the stock assessment are most sensitive to longline length composition data and how longline selectivity is specified in the model.</li><li>The results of the stock assessment are also strongly affected by the natural mortality vector specified in the model.</li><li>The significant decrease in the degree of the regime shift in recruitment results from the combination of changes made to the assessment model. Among these changes the most influential in reducing the degree of regime shift are adding one more time block to the selectivity of longline fishery fleets in 2011, improving the CPUE standardization model, and using the Lorenzen natural mortality curve for juvenile bigeye.</li><li>One of the biggest challenges of this benchmark assessment is the increasingly lack of longline CPUE and length frequency data since 2000. The Japanese longline fishery on which the longline data are based have contracted greatly in the EPO since 2000, leading to a large portion of the EPO having limited or even no longline data to use for computing longline index of abundance and length compositions. Consequently, longline index of abundance and length frequencies are subject to large bias and uncertainty.</li><li>Estimating the scaler of the natural mortality curve is difficult to implement in the current assessment platform. The practical solution to it is using a likelihood profile to estimate the scaler and then fix it in the assessment model. This can under-estimate the uncertainty in derived quantities because the uncertainty in the scaler is ignored by fixing it.</li></ul> |
| **Reports/publications/presentations**<ul><li>SAC-14-05</li><li>SAC-15-02</li><li>1st External review of data used in stock assessments of tropical tuna in the eastern Pacific Ocean</li><li>1st External review of modelling aspects for stock assessments of tropical tuna in the eastern Pacific Ocean</li><li>1st Workshop on improving the risk analysis for the tropical tunas in the EPO: model diagnostics for integrated stock assessments</li><li>2nd Workshop on improving the risk analysis for the tropical tunas in the EPO model weighting for integrated stock assessments</li><li>Evaluating the impacts of reduced longline fishing effort on the standardization of longline catch-per-unit-effort for bigeye tuna in the eastern Pacific Ocean<br>H Xu, MN Maunder, CE Lennert-Cody, CV Minte-Vera - Fisheries Research, 2024<br>The use of conceptual models to structure stock assessments: a tool for collaboration and for "modelling what to model"<br>CV Minte-Vera, MN Maunder, A Aires-da-Silva, H Xu… - Fisheries Research, 2024</li></ul> |
| **Comments:** |

| **PROJECT H.1.b: Improve the yellowfin tuna stock assessment** | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.1. Improve routine tropical tuna assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Improve the yellowfin tuna stock assessment by exploring the use of an age-structured length-based catch-at-age statistical model with a monthly time step |
| **Background** | The assessment of yellowfin is conducted every year, using Stock Synthesis |
| | There are inconsistencies between the indices based on CPUE for longline and purse-seine sets on dolphins |
| | Management quantities are sensitive to the longline CPUE data |
| | The current assessment is no longer considered reliable for management advice and stock status indicators are used instead |
| | Recent advances in stock assessment modelling allow several important improvements of the assessment model, with regard to a spatial stock assessment model, growth curves, time-varying selectivity, recruitment assumptions, data weighting, and diagnostics |
| | A benchmark assessment is scheduled for 2020 |
| **Relevance for management** | The stock assessment is used to provide management advice |
| | The duration of recommended seasonal closures is based on the multipliers of fishing mortality ($F$) estimated in the bigeye and yellowfin assessments |
| | Improvements in the yellowfin assessment will make the staff's management advice more accurate and precise |
| **Duration** | 2018-2020 |
| **Work plan and status** | 2019: Explore different hypotheses to explain the difference between the indices of abundance, improve estimates of growth, re-evaluate the natural mortality assumptions, apply data weighting, conduct diagnostic tests |
| | 2019: Workshop to finalize improvements to the longline CPUE and length-composition data (Project H.1.e) |
| | 2020: Re-evaluate the model assumptions |
| **External collaborators** | |
| **Deliverables** | Reports to SAC |

| PROJECT H.1.b: Improve the yellowfin tuna stock assessment |
|---|
| **Updated**: April 2021 |
| **Progress summary for the reporting period**<br><br>      Most of the research and analyses to improve the bigeye stock assessment (Project H.1.a) is also applicable to yellowfin.<br><br>      Several workshops were conducted that highlighted other areas where the stock assessment of yellowfin could be improved<br><br>February 2018: CAPAM workshop on the development of spatio-temporal models of fishery catch-per-unit-effort data to derive indices of relative abundance.<br><br>October 2018: CAPAM workshop on the development of spatial stock assessment models.<br><br>January 2019: workshop to evaluate bigeye and yellowfin tuna ageing methodologies and growth models in the Pacific Ocean.<br><br>February 2019: workshop to improve the longline indices of abundance of bigeye and yellowfin tunas in the EPO.<br><br>December 2019: An external review of the assessment of yellowfin tuna was held<br><br>May 2020: Benchmark assessment of yellowfin tuna<br><br>November 2021: IATTC-95-05 B. Yellowfin tuna (pag.50) |
| **Challenges and key lessons learnt**<br><br>      Management quantities are sensitive to the longline index, and the research had to be refocused to address several issues identified with the assessment<br><br>      Lessons learnt from work on the bigeye assessment are applicable to yellowfin<br><br>      An additional workshop to finalize the work on improving the longline CPUE and length-composition data was needed (Project H.1.e), but was not funded. Thanks to the collaboration of Japan and Korea, the work was advanced and indices from longline data were obtained<br><br>      The standardized indices by size class from purse-seine and longline data where still incompatible pointing towards spatial differences in abundance trends of the northwest area (purse-seine index) and the southeast area (longline index), consistent with the a more complex stock structure, than the high-mixing hypothesis.<br><br>      The benchmark assessment was done by modelling several hypotheses, resulting in a reference set of 48 models.<br><br>      Time and data constraints limited the stock structure scenarios that could be included in the risk analysis |
| **Reports/publications/presentations**<br><br>      See links above for workshop reports and presentations<br><br>      SAC-10 INF-F Evaluating inconsistencies in the yellowfin abundance indices<br><br>      Xu *et al.*, *Fisheries Research* 213<br><br>      External review report<br><br>      External review presentations<br><br>      SAC-11-07 Benchmark assessment of yellowfin tuna<br><br>      IATTC-95-05 B. Yellowfin tuna (pag.50) |
| **Comments:**<br>The workplan for improving the bigeye assessment was changed in 2019 to encompass both bigeye and yellowfin tuna |

| PROJECT H.1.e: Construct indices of abundance and composition data for longline fleets | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** H. Research and development of stock assessment models and their assumptions | |
| **TARGET:** H.1. Improve routine tropical tuna assessments | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Construct indices of relative abundance and length compositions from longline data for yellowfin and bigeye, ideally using spatiotemporal models |
| **Background** | Indices of relative abundance derived for longline CPUE data are the most important piece of information in the bigeye and yellowfin stock assessments |
| | Only Japanese data are currently used to create these indices |
| | A workshop was held in February 2019 to understand the data from other CPCs that could be used to improve the indices of abundance ([WSLL-01](#)) |
| | Preliminary results on constructing indices on combined data were obtained during the workshop |
| | The resulting indices are needed for the benchmark assessments of bigeye and yellowfin scheduled for 2020 |
| **Relevance for management** | The indices have a direct impact on the stock assessment, and any improvements in the indices will directly improve management advice for bigeye and yellowfin |
| **Duration** | 18 months, starting June 2019 |
| **Work plan and status** | Jun-Sep 2019: Preparatory work depending on the availability of operational level data |
| | Oct-Dec 2019: Collaborative work and workshop |
| | Jan- May 2019: Preparation of documents |
| **External collaborators** | Scientists from Japan, Korea, Chinese Taipei, China |
| | Invited researchers |
| **Deliverables** | Indices of relative abundance |
| | SAC documents |

| PROJECT H.1.e: Construct indices of abundance and composition data for longline fleets |
|---|
| **Updated**: April 2021 |
| **Progress summary for the reporting period**<br>This project was not funded but some activities took place:<br>Japanese (Dr. Keisuke Satoh) and Korean (Dr. Sung-Il Lee) scientists visited the IATTC for a second tome to continue the collaborative work<br>The longline indices of abundance by size class for bigeye and yellowfin tuna were obtained using spatiotemporal models. The indices were used in the benchmark assessment for bigeye tuna (SAC-11-06), in models for yellowfin tuna done in preparation for the external review of the yellowfin tuna assessment, and as indicators for both species (SAC-11-05)<br>One manuscript was prepared and submitted for publication in a peer-review journal |
| **Challenges and key lessons learnt**<br> The operational data essential for improving the assessment are not permanently available to the staff.<br> Matching size-composition and operational data for Japan proved difficult, and is not yet completed, the indices were obtained by modelling data aggregated into a 1° latitude by 1° longitude<br> Adding the data for Korea to the standardized indices proved difficult for two reasons:<br> the comparison with the Japanese data could not be done as operational data was only available to the staff when the scientists were present, and the visits took place in different times,<br> the aggregated data indicated that the two fleets may have different size distributions, but this differences may be due to changes in the sampling protocol (Japan changed from fishermen sampling to observer sampling after 2011, and after 2014 all measurement were taken by observers, Korean data include both fishermen and observer sampling, after 2013 a larger proportion of the data comes from observers), or small sample size (the observer coverage is less than 5%). |
| **Reports/publications/presentations**<br>SAC-11-06 Benchmark assessment for bigeye tuna<br>External review of the yellowfin tuna assessment<br>SAC-11-05 Indices used as indicators for yellowfin and bigeye tuna<br>Satoh et al, manuscript submitted |
| **Comments:** |

| **PROJECT I.3.a: Evaluate potential reference points for dorado in the EPO** | |
|---|---|
| **THEME:** Sustainable fisheries | |
| **GOAL:** I. Test harvest strategies using management strategy evaluation (MSE) | |
| **TARGET:** I.3. Evaluation of harvest strategies for data-limited species based on stock status indicators | |
| **EXECUTION**: Stock Assessment Program | |
| **Objectives** | Build upon the previous collaborative work and continue to develop dorado stock assessment methodologies<br>Expand the MSE for dorado by evaluating alternative reference points and harvest control rules. |
| **Background** | Some Members of the IATTC are interested in obtaining MSC certification for their dorado fisheries, and have requested guidance in developing of reference points (RPs) and harvest control rules (HCRs).<br>Other Members are seeking guidance regarding data collection, research efforts, and management options |
| **Relevance for management** | 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. |
| **Duration** | 6 months, starting January 2019 |
| **Work plan and status** | 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.<br>The performance of alternative assessment methods, HCRs and RPs will be evaluated by simulation methods, using Stock Synthesis. 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.<br>Options will include minimum size limits, 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 ($B_0$). |
| **External collaborators** | Work carried out by external contractor |
| **Deliverables** | List of candidate RPs and HCRs to be tested using a management strategy evaluation (MSE) framework;<br>Simulation study to evaluate candidate HCRs and RPs;<br>Written report summarizing the results; and presentation at SAC-10. |

| PROJECT I.3.a: Evaluate potential reference points for dorado in the EPO |
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| **Updated**: May 2019 |
| **Progress summary for the reporting period** |
| A review of potential reference points (RPs) and harvest control rules (HCRs) for dorado in the South EPO was conducted, using updated catch, CPUE, and size-composition data. |
| **Challenges and key lessons learnt** |
| This simulation study was delayed to accommodate work required for the bigeye assessment review in March 2019. |
| The lack of stock assessments for dorado in the South EPO is problematic, since determining RPs and HCRs depends on assessment estimates. |
| Obtaining complete and timely data is critical, given the dynamics of dorado and of the fishery, but this is not always easy. |
| **Reports/publications/presentations** |
| SAC-10-11 Potential reference points and harvest control rules for dorado in the EPO |
| **Comments:** |
| Project was completed |

| PROJECT L.2.b: Vulnerability assessment of elasmobranch bycatch in EPO tuna fisheries using the EASI-Fish approach | |
|---|---|
| THEME: Ecological impacts of fisheries: assessment and mitigation | |
| GOAL: L. Evaluating ecological impacts | |
| TARGET: L.2. Develop analytical tools to identify and prioritize species at risk for data collection, research and management | |
| EXECUTION: Ecosystem and Bycatch Program | |
| Objectives | To use the EASI-Fish ERA approach to assess the vulnerability status of elasmobranch species caught as bycatch in EPO fisheries<br>To identify vulnerable species using traditional biological reference points |
| Background | IATTC is committed, through the Antigua Convention, to ensure the long-term sustainability of all non-target species impacted by EPO tuna fisheries. Elasmobranchs have been identified in previous qualitative ERAs to be among the most vulnerable species to tuna fishery impacts in the EPO. However, these species lack sufficient biological and catch data for stock assessment, so data-limited approaches are required to assess vulnerability.<br>In 2019, the IATTC developed EASI-Fish (Ecological Assessment for the Sustainable Impacts of Fisheries) to quantitatively assess vulnerability using traditional biological reference points used in fisheries stock assessment (e.g. $F_{MSY}$, $SPR_{20\%}$). |
| Relevance for management | The EASI-Fish assessment will transparently identify vulnerable elasmobranch species in the EPO (and across the Pacific where applicable). Vulnerable species can then be subjected to further assessment where managers can be advised on the efficacy of potential conservation and management measures that may be implemented to reduce vulnerability to sustainable levels. |
| Duration | 12 months |
| Work plan and status | **Nov 2021-Jan 2022:** in collaboration with SPC, develop Pacific-wide species distribution models for 32 species of sharks.<br>Sep-Apr 22: complete EASI-Fish assessment and identify vulnerable species<br>May 22: present assessment results at SAC-13. |
| External collaborators | CPCs, SPC. |
| Deliverables | Paper and oral presentation at SAC-13 (SAC-13-11)<br>Scientific journal publication |

| PROJECT L.2.b: Vulnerability assessment of elasmobranch bycatch in EPO tuna fisheries using the EASI-Fish approach |
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| **Updated**: May 2024 Project completed |
| **Progress summary for the reporting period**<br>July-Sept 2021: Collated available effort and shark interaction data for 8 fisheries in the EPO from IATTC databases and publicly available publications<br>Sept 2021-Mar 2022: Collated available biological information for 32 shark bycatch species with supporting references and entered into the IATTC ecosystems database.<br>Nov 2021-Jan 2022: Developed species distribution models for 32 shark bycatch species using Maxent.<br>Jan-Feb 2022: Improved SDMs for 32 species by beginning a collaboration with SPC, who assisted in developing SDMs using an ensemble approach from 4 SDM algorithms using all data from the Pacific Ocean.<br>Feb-April 2022: Completed testing, diagnostics checks, and produced final results of EASI-Fish models for 32 shark species.<br>March-Apr 2022: Completed final report and delivered oral presentation at SAC 13 (Document SAC-13-11). |
| **Challenges and key lessons learnt**<br>Very little catch, biological and ecological information exists for most shark bycatch species resulting in the use of several approaches to estimate required model parameters<br>The IATTC database contains a large number of records where taxa are identified only to high taxonomic levels, potentially missing important presence locations that are critical for the development of SDMs, especially for rarer species.<br>Presence predictions can vary greatly depending on 1) the SDM approach used, and 2) the method used to determine probability of presence threshold values. Further research on aspects of SDMs required in this new research area.<br>The EASI-Fish assessment identified 20 shark species as "most-vulnerable".<br>Feedback from SAC 13 was very positive but comments from the Members indicated that future assessments should consider fine-scale management measures, such as those implemented within EEZs. Unfortunately, the effort data required to capture these fine-scale spatio-temporal management measures is lacking for the majority of countries and so it was agreed that increased efforts should be made to establish ongoing monitoring programs in the region. |
| **Reports/publications/presentations**<br>Griffiths, S.P., Fuller, L., Potts, J., Nicol, S., 2022. Vulnerability assessment of sharks caught in eastern Pacific Ocean tuna fisheries using the EASI-Fish approach. 13th Meeting of the Scientific Advisory Committee of the IATTC, 15-20 May 2022, La Jolla, California, USA. Document SAC-13-11. |
| **Comments:**<br>- |

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|---|---|
| **PROJECT L.2.e: Vulnerability assessment and efficacy of potential conservation measures for the east Pacific leatherback turtle stock** | |
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** L. Evaluating ecological impacts<br>**TARGET:** L.2. Develop analytical tools to identify and prioritize species at risk for data collection, research and management<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | To use the EASI-Fish ERA approach to assess vulnerability status and the efficacy of conservation and management measures prescribed under IATTC Resolution C-19-04 for reducing fishing impacts on the East Pacific stock of leatherback turtle (*Dermochelys coriacea*). |
| **Background** | IATTC is committed, through the Antigua Convention, to ensure the long-term sustainability of all non-target species impacted by EPO tuna fisheries.<br>On 1 January 2021 a revised resolution on sea turtles (C-19-04) entered into force that requires EPO tuna fisheries to implement various measures designed to reduce the bycatch of sea turtles, in particular the use of circle hooks and finfish baits in shallow longline sets.<br>EASI-Fish has been used by the IATTC as an alternative approach to traditional population models to assess the efficacy of management measures on data-limited bycatch species, including the critically endangered spinetail devil ray.<br>In collaboration with the Inter-American Convention on the Protection and Conservation of Sea Turtles (IAC) and EPO stakeholders, the staff developed a preliminary EASI-Fish assessment for 2018. The project was extended to improve on this model through the development of a dedicated species distribution model and an update of the fishing effort by coastal artisanal fisheries. |
| **Relevance for management** | EASI-Fish can rapidly and cost-effectively quantify the cumulative impacts of multiple data-limited fisheries on species under proposed management measures—either individually or in combinations—under IATTC Resolution C-19-04 to determine their potential efficacy of reducing the vulnerability of the EP leatherback turtle stock to becoming unsustainable in the long-term. This will ultimately simplify the choice of management measures required to meet conservation and fisheries objectives. |
| **Duration** | 12 months |
| **Work plan and status** | Jun-Sept 21: Collaborate with stakeholders to collate available fishing effort and leatherback presence data in the EPO.<br>Sept 21-Jan 22: Develop a new approach to use presence and absence records to produce a dedicated species distribution model (SDM) for the East Pacific leatherback turtle stock.<br>Jan 22-Apr 22: Populate EASI-Fish model with biological and fisheries data and run 70 hypothetical scenarios<br>May 22: Presented final EASI-Fish assessment results and the special distribution model to the Bycatch Working Group (BYC-11). |
| **External collaborators** | IAC, CPCs |
| **Deliverables** | Papers and oral presentations for BYC-11<br>Scientific journal publications |

| PROJECT L.2.e: Vulnerability assessment and efficacy of potential conservation measures for the east Pacific leatherback turtle stock |
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**Updated**: May 2024

**Progress summary for the reporting period**

Jun-Sept 21: Collaborated with IAC, CPCs and stakeholders to collate available fishing effort and leatherback occurrence data in the EPO.

Sept 21-Jan 22: Developed a new machine-learning approach to use presence and absence records and a series of environmental variables to produce a dedicated species distribution model (SDM) for the East Pacific leatherback turtle stock.

Jan 22-Apr 22: Populated EASI-Fish model with biological and fisheries data and ran 70 hypothetical scenarios

Apr 22: Prepared EASI-Fish assessment and SDM results to present at BYC-11.

May 22: Presented EASI-Fish assessment and SDM results at BYC-11.

June 22: Presented EASI-Fish assessment to the IAC COP10 via video.

Both technical documents presented at BYC-11 were processed and submitted, as a joint submission, to a peer-reviewed journal.

Both papers were submitted and accepted for publication in Endangered Species Research journal.

**Challenges and key lessons learnt**

The machine learning algorithm used to generate the SDM and predictions for the EP leatherback turtle is capable of depicting hotspots of species habitat suitability and describe the species environmental preferences.

The estimated fishing mortality, and hence vulnerability status, is strongly influenced by predictions from an SDM and also the threshold value used to define cells where the species is predicted to be present. Although the new SDM was greatly improved, further exploration of how to best determine threshold values is desirable.

The complex life history of leatherback turtles presented new technical challenges for the EASI-Fish model that is constructed using a single annual timestep. Further model development is required to better represent spatial heterogeneity in fishing impacts and the potential impacts of spatial closures. For example, different size classes of animals are present in different regions during the breeding season, so a 2-stage model is desirable to characterize this aspect.

International highly collaborative projects can be successful to develop studies on data-limited species that require a significant amount of data and explore and assess the potential effect of different conservation and management measures, both individually or collectively.

**Reports/publications/presentations**

Lopez J, Griffiths SP, Wallace B, Caceres V, Bustos LC, Cocas L, Vega R, Zárate P, Clavijo L, Cari I, Rodriguez-Baron JM, Carvajal JM, Piedra R, Andraka S, Rendón L, Herrera M, Suárez J, Santana H, Abrego M, Veelenturf C, Quiñones J, Perez M, Alfaro J, Mangel J, de Paz N (2022) A machine learning species distribution model for the critically endangered east Pacific leatherback turtle (*Dermochelys coriacea*). 11th Meeting of the IATTC Working Group on Bycatch, 10-11 May 2022, La Jolla, California, USA. Document BYC-11-01.Griffiths SP, Wallace B, Swimmer Y, Alfaro-Shigueto J, Mangel JC, Oliveros-Ramos R (2022) Vulnerability status and efficacy of potential conservation measures for the east Pacific leatherback turtle (*Dermochelys coriacea*) stock using the EASI-Fish approach. 11th Meeting of the IATTC Working Group on Bycatch, 10-11 May 2022, La Jolla, California, USA. Document BYC-11-02 REV. Griffiths SP, Wallace B, Swimmer Y, Alfaro-Shigueto J, Mangel JC, Oliveros-Ramos R (2020) Vulnerability status and efficacy of potential conservation measures for the east Pacific leatherback turtle (*Dermochelys coriacea*) stock using the EASI-Fish approach. 10th Meeting of the IATTC Working Group on Bycatch, 7 May 2020, La Jolla, California, USA. Document BYC-10 INF-B.

Lopez J, Griffiths SP, Wallace B, Caceres V, Bustos LC, Cocas L, Vega R, Zárate P, Clavijo L, Cari I, Rodriguez-Baron JM, Carvajal JM, Piedra R, Andraka S, Rendón L, Herrera M, Suárez J, Santana H, Abrego M, Veelenturf C, Quiñones J, Perez M, Alfaro J, Mangel J, de Paz N (In Review) A machine learning species distribution model for the critically endangered east Pacific leatherback turtle (*Dermochelys coriacea*). Endangered Species Research.

Griffiths SP, Wallace B, Cáceres V, Rodríguez LH, Lopez J, Abrego M, Alfaro-Shigueto J, Andraka S, Brito MJ, Bustos LC, Cari I, Carvajal JM, Clavijo L, Cocas L, Paz Nd, Herrera M, Lauritsen AM, Mangel JC, Perez M, Piedra R, Dávila JAQ, Rendón L, Rguez-Baron JM, Santana H, Stacy B, Suárez J, Swimmer Y, Veelenturf C, Vega R, Zárate P (In Review) Vulnerability status and efficacy of potential conservation measures to reduce bycatch of the critically endangered East Pacific leatherback turtle (*Dermochelys coriacea*). Endangered Species Research.

**Comments:**
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| PROJECT M.2.a: Evaluate the post-release survival of silky sharks captured by longline fishing vessels in the equatorial EPO, using best handling practices | |
|---|---|
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.2. Develop best practices for release of bycatch species<br>**EXECUTION**: Biology and Ecosystem Program | |
| **Objectives** | Estimate the post-release survival of silky sharks captured by longline vessels in the equatorial EPO, using archival tags |
| **Background** | Apparent severe decline in the population of silky sharks in the EPO, based on trends in standardized catch-per-unit-of-effort indices<br>Domestic longline fleets from Latin America conduct multi-species fisheries including retaining silky sharks |
| **Relevance for management** | Resolution C-16-06 on conservation measures for silky sharks stipulates to improve handling practices for live sharks to maximize post-release survival |
| **Duration** | 2016-2018 |
| **Work plan and status** | 2016-2017: 40 total silky sharks were tagged and released with satellite tags, and the resulting data have been analyzed to estimate a post-release survival rate, , and evaluate movements, dispersion, and potential entanglement in FADs<br>2017: A final report for this project was submitted to the EU (funding source)<br>2018: A manuscript is in progress and will be submitted to a scientific journal |
| **External collaborators** | INCOPESCA, Costa Rica; WWF, Ecuador; University of Hawaii |
| **Deliverables** | Silky shark post-release survival rate following capture by longline vessels, using best handling practices<br>Presentation of preliminary results at SAC-08<br>Manuscript for publication in a peer-reviewed scientific journal |

| PROJECT M.2.a: Evaluate the post-release survival of silky sharks captured by longline fishing vessels in the equatorial EPO, using best handling practices |
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| **Updated**: June 2019 |
| **Progress summary for the reporting period**<br>Manuscript accepted for publication in the *Bulletin of Marine Science*. |
| **Challenges and key lessons learnt** |
| **Reports/publications/presentations**<br>Schaefer, K.M., Fuller, D.W., Aires-da-Silva, A., Carvajal, J.M., Martinez, J. and Hutchinson, M.R., 2019. Post-release survival of silky sharks (*Carcharhinus falciformis*) following capture by longline fishing vessels in the equatorial eastern Pacific Ocean. Bulletin of Marine Science. |
| **Comments:** |

| **PROJECT M.2.b: Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation** | |
|---|---|
| THEME: Ecological impacts of fisheries: assessment and mitigation<br>GOAL: M. Mitigating ecological impacts<br>TARGET: M.2. Develop best practices for release of bycatch species<br>EXECUTION: Life-history and Behavior Group | |
| **Objectives** | Estimate post-release survival of silky sharks captured by Mexican longline vessels in the eastern tropical Pacific, utilizing a best handling practice, and define boundaries encompassing the probable distribution silky shark pupping areas in the EPO |
| **Background** | Apparent severe decline in the population of silky sharks in the EPO, based on trends in standardized catch-per-unit-of-effort indices<br>Domestic longline fleets from Latin America conduct multi-species fisheries including retaining silky sharks<br>Defining the probable distribution of silky shark pupping areas would be useful for better understanding population structure and for consideration of conservation measures including spatiotemporal closures |
| **Relevance for management** | Resolution C-16-06 on conservation measures for silky sharks stipulates to improve handling practices for live sharks to maximize post-release survival, and identification of pupping areas of the silky shark |
| **Duration** | 2018-2020 |
| **Work plan and status** | 2018-2019: 69 silky sharks will be tagged with archival tags on Mexican longline vessels, using best handling practices<br>2019-2020: The data obtained will be analyzed for post-release survival and movements during 2019 and 2020.<br>2019-2020: Exploratory analyses of silky shark size at capture data, compiled from various fisheries in the EPO, will be conducted to determine the areas and times where silky shark pupping most likely occurs |
| **External collaborators** | INAPESCA, Mexico |
| **Deliverables** | Silky shark post-release survival rate captured by Mexican longline vessels, using best handling practices<br>Probable distribution of silky shark pupping areas |

| PROJECT M.2.b: Evaluate best handling practices for maximizing post-release survival of silky sharks in longline fisheries, and identification of silky shark pupping areas for bycatch mitigation |
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| **Updated**: February 2022 |
| **Progress summary for the reporting period** |
| 57 silky sharks were tagged with archival tags on Mexican longline vessels, using best handling practices<br>The satellite data sets obtained have been compiled<br>A table of metadata has been compiled, including release and pop-up dates and locations for all tags reporting to date, along with the fate of each shark. |
| **Challenges and key lessons learnt:** |
| **Reports/publications/presentations**<br>Schaefer, K., Fuller, D., Castillo-Geniz, J.L., Godinez-Padilla, C.J., Dreyfus, M. and Aires-da-Silva, A., 2021. Post-release survival of silky sharks (*Carcharhinus falciformis*) following capture by Mexican flag longline fishing vessels in the northeastern Pacific Ocean. Fisheries Research, 234, p.105779. |
| **Comments:** |

| PROJECT M.3.b: Spatial and temporal closures and the tradeoff between bycatch and target catches | |
|---|---|
| THEME: Ecological impacts of fisheries: assessment and mitigation<br>GOAL: M. Mitigating ecological impacts<br>TARGET: M.3. Conduct spatiotemporal analyses to identify areas of high bycatch/catch ratios<br>EXECUTION: Bycatch Mitigation and Gear Technology Group | |
| Objectives | Explore the effectiveness of different types of spatial and temporal closures in reducing bycatch with the lowest losses in target catch |
| Background | A major impediment to ensuring fisheries sustainability is the impact of fishing practices on non–targeted species, particularly bycatch of marine megafauna<br>Many bycatch mitigation measures have been developed to reduce the impact on bycatch species. However, most of the measures have been designed to reduce bycatch of only one species or group of species<br>Spatial and temporal closures are another common management measure to reduce bycatch, although they have not been explored in detail in the region<br>A major concern about the efficacy of spatial and temporal closures is the potential for fishing effort to be redistributed rather than reduced. As a result, it creates a tradeoff between reduced fishing mortality inside protected areas or seasons, and a potential increase in surrounding waters or open seasons<br>However, the effectiveness of permanent or dynamic area closures at reducing multispecies bycatch is still an open question fur tuna purse seine fisheries in the EPO |
| Relevance for management | Reducing bycatch while maintaining target species catch would make the purse seine fishery more selective and cleaner. In addition, managers will be provided with the necessary information to start the conversation on different types of spatial and temporal closures that could be applied in the region, if needed |
| Duration | 2020-2021 |
| Work plan and status | Sep-Dec 2020: Data preparation and exploration; decide weights for key bycatch species and groups<br>Jan-Mar 2021: Run analysis and models<br>Apr-Jun 2021: Discussion of results and preparation of a manuscript for a peer-reviewed journal |
| External collaborators | University of Washington, School of Aquatic and Fishery Sciences |
| Deliverables | A manuscript for a peer-review journal<br>Dissemination material for the Bycatch Working Group, likely in 2022 |

| PROJECT M.3.b: Spatial and temporal closures and the tradeoff between bycatch and target catches |
|---|
| **Updated**: May 2022 |
| **Progress summary for the reporting period**<br>Jan-Sept 21: Run regional analyses for the purse seine observer data, by set type.<br>Sept 21-Jan 22: Discuss results and write scientific manuscript. |
| **Challenges and key lessons learnt**<br>Static spatial and temporal closures seem less effective to reduce bycatch than dynamic closures, particularly for highly mobile species.<br>The degree of bycatch reduction achievable for a certain quantity of target catch is related to the correlation in space and time between target and bycatch species. If the correlation is high, it is harder to find an area to reduce bycatch without sacrificing catch of target species.<br>The use of dynamic ocean management might be difficult to implement and enforce on many occasions. Nevertheless, dynamic approaches will be increasingly valuable in a constantly changing environment and underscore the need for more responsive and flexible regulatory mechanisms. |
| **Reports/publications/presentations**<br>A peer review publication and a presentation for BYC-11<br>*Pons, M., J. T. Watson, D. Ovando, S. Andraka, S. Brodie, A. Domingo, M. Fitchett, R. Forselledo, M. Hall, E. L. Hazen, J. E. Jannot, M. Herrera, S. Jiménez, D. M. Kaplan, S. Kerwath, J. Lopez, J. McVeigh, L. Pacheco, L. Rendon, K. Richerson, R. Sant 'Ana, R. Sharma, J. A. Smith, K. Somers and R. Hilborn (2022). "Trade-offs between bycatch and target catches in static versus dynamic fishery closures." Proceedings of the National Academy of Sciences 119(4): e2114508119.* |
| **Comments:**<br>- |

| PROJECT M.5.a: Develop and test non-entangling and biodegradable FADs | |
|---|---|
| **THEME:** Ecological impacts of fisheries: assessment and mitigation<br>**GOAL:** M. Mitigating ecological impacts<br>**TARGET:** M.5. Develop best practices to mitigate anthropogenic impacts on EPO habitats<br>**EXECUTION**: Ecosystem and Bycatch Program | |
| **Objectives** | Construction of non-entangling FADs from biodegradable materials, not only to decrease mortality of non-target species by net-webbing entanglement, but also minimize contributions to ocean debris and pollution by commercial tuna fishing. |
| **Background** | Non-target species are also found in association with FADs, and in some instances, may become entangled in the FADs and perish.<br>Some FAD components that are lost at sea or not retrieved, particularly those including plastics or other materials that are not readily degradable may last many years in the environment as pollutants, and threatening vulnerable ecosystems. There is an increasing interest in identifying non-entangling and biodegradable components that could be used in FAD construction, while still providing similar function in terms of tuna aggregation. |
| **Relevance for management** | Ecological impacts on vulnerable ecosystems may be considered an important factor for FAD fishery management purposes.<br>Results may be used by the Commission members in the development of best fishing practices and management measures |
| **Duration** | 29 months |
| **Work plan and status** | August 2015 – April 2017: Purchase of FAD and mooring materials. FAD deployment at test site. FAD monitoring.<br>April – December 2017: Ongoing research on alternative non-entangling and biodegradable materials to extend the durability of the FADs.<br>January 2018: Project report |
| **External collaborators** | |
| **Deliverables** | May 2016. *Ad hoc* working group on FADs. La Jolla, USA.<br>May 2017. 68th Tuna Conference. Lake Arrowhead, USA.<br>October 2017. ECOFAD meeting. Manta, Ecuador.<br>March 2018. Project final report (Phase 1) |

| PROJECT M.5.a: Develop and test non-entangling and biodegradable FADs |
|---|
| **Updated**: May 2023 |
| **Progress summary for the reporting period** |
| February–December 2018: Research on alternative non-entangling and biodegradable materials to extend the durability of the FADs. |
| December 2018: Agreement with vessel companies concerning methodology and allocation of FAD prototypes to vessels through Memorandums of Understanding. |
| April 2019: Agreement with companies regarding purchase and allocation of materials. |
| August 2019: Deployment and data collection of non-entangling devices (NEDs) and control pairs (traditional FADs). Observers record condition of NEDs and catches. Database on interactions with NEDs created. |
| June 2020: reporting of satellite buoy data attached to experimental objects starts. |
| January-December 2022: resume NED deployment for the last batch of experimental objects. |
| January 2023: 744 NEDs have been deployed by the participant vessels, with 143 sets made and with 33.6 mt of tuna caught per set, as average. Final report was presented. |
| December 2022-April 2023: Collect and analyze the satellite buoy data used in the project for the experimental objects. Write a document with updated results for the FAD WG, including trajectory and biomass data from satellite buoys. |
| **Challenges and key lessons learnt** |
| Reaching agreement with vessel captains on using a limited number of standard FAD prototypes. Simplifying the materials to purchase. |
| The flotation of NEDs made of natural materials was satisfactory during the period observed. |
| NED design using canvas and ropes made with abaca fiber showed 'very good' to 'good' condition after, at least, 2-3 months at sea. Improvements on condition were achieved by smearing this fiber with natural rubber or animal lard. 20% of FADs on board TUNACONS's vessel fleets are now using this design on a voluntary basis. |
| The use of the first selected cotton seems to be inappropriate. Modifications have been made to accommodate fleet's concerns. Modified prototypes are being currently tested. On-land trials to improve cotton condition are currently in development. |
| Preliminary analyses of tuna catches between close NEDs and FADs showed similar values. When compared to traditional FADs that were set nearby in time and space, in about 50% of the cases NED catches were greater or equal than traditional FADs' catch per set. Control pairs were greater or equal than other traditional FADs in the 36% of the cases. |
| COVID-19 pandemic caused delays on NED construction. Meetings with fleet managers and stakeholders have been held to adapt to this situation. Works have been already resumed. |
| **Reports/publications/presentations** |
| Several presentations made at skippers' workshops in the region. |
| Online technical meetings with researchers involved in similar projects in the Atlantic and Indian Oceans, and ISSF staff. |
| SAC-09; SAC-11; SAC-12; SAC-13 and SAC-14: progress reports and presentations. |
| A project overview and preliminary results presented during 2020-2021; 2021-2022, and 2022-2023 skippers' workshops (Manta-Ecuador). |
| FAD-06: progress report and staff's recommendations (FAD-06-02). |
| FAD-07: progress report and staff's recommendations (FAD-07-02). |
| **Comments:** |
| Project was suspended during March-July 2018, thus missing the fishing season off Peru. In 2020-2021, 81 NEDs were deployed off Peru and in 2019-2021, 457 NEDs were deployed west of Galapagos. A project extension proposal was approved in October 2019 for a total of 38 months. Matters related to COVID-19 pandemic and the need for new suppliers and materials led to an additional project extension proposal, approved in March 2021, for a total of 52 months. |

| **PROJECT O.1.c: A review of methods to determine prey consumption rates, gastric evacuation and daily ration of pelagic fishes: a precursor to experimental estimation for key predators in the EPO** | |
|---|---|
| **THEME:** Interactions among the environment, the ecosystem, and fisheries<br>**GOAL:** O. Improve our understanding of the EPO ecosystem<br>**TARGET:** O.1. Conduct trophodynamic studies for defining key assumptions in EPO ecosystem models<br>**EXECUTION:** Ecosystem Group | |
| **Objectives** | Review available methods to estimate prey consumption and gastric evacuation rates and daily ration to reliably estimate the consumption biomass ratio (Q/B) for tropical tunas and tuna-like fishes in ecosystem models being developed for the EPO. Recommend a reliable method(s) that is feasible, practical and cost-effective for estimating Q/B for key predators in the EPO ecosystem. |
| **Background** | Fisheries management strategies are increasingly considering impacts on ecosystems supporting target tuna species. Tuna fisheries impact apex predators in marine ecosystems and have the potential to disrupt ecosystem structure and function.<br>Ecosystem models, such as Ecopath with Ecosim, are being increasingly used to explore and forecast the potential effects of fishing and climate on marine ecosystems.<br>A key parameter in such models is Q/B. However, this highly influential parameter can be difficult to estimate experimentally, especially for large pelagic fishes.<br>A review of methods to estimate Q/B is required to determine which methods are feasible for parameterizing ecosystem models. |
| **Relevance for management** | The Antigua Convention requires the IATTC to consider the ecological impacts of tuna fisheries in the EPO. The SSP details the development of a spatially-explicit ecosystem model of the EPO. Without reliable estimates of Q/B for key species in the EPO ecosystem, the ecosystem model will produce unreliable results that will be of little use for tactical or strategic fisheries management. |
| **Duration** | 3 years |
| **Work plan and status** | Jan–Mar 2019: Collate all available literature on methodologies used to estimate prey consumption and Q/B in marine fishes, with an emphasis on predatory pelagic fishes.<br>Mar–Apr 2019: Write a comprehensive literature review of methods to estimate Q/B and make recommendations as to which method(s) may be useful for IATTC to use in the future.<br>May 2019: Present the review document at SAC-10 and at the 70th Tuna Conference<br>Jun–Dec 2019: Revise the review document for submission to a peer-reviewed scientific journal.<br>Jan-June 2020: Simulations and sensitivity analyses of a bioenergetics model for inclusion in the review document.<br>July-Dec 2020: Proposal considerations for consumption and gastric evacuation experiments of dolphinfish. Refinement of input parameters for several predatory species and development of a new age-structured consumption model.<br>Jan-May 2021: Continued development of the consumption model; simulations and uncertainty analyses. |
| **External collaborators** | University of Miami for proposed laboratory experiments |
| **Deliverables** | Information paper for SAC-10<br>Publish the literature review in an international scientific journal. |

| PROJECT O.1.c: A review of methods to determine prey consumption rates, gastric evacuation and daily ration of pelagic fishes: a precursor to experimental estimation for key predators in the EPO |
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**Updated**: May 2022

**Progress summary for the reporting period**
- Review manuscript revised to update method descriptions in text and tables.
- Yellowfin tuna feeding, growth, metabolic, and reproductive data were compiled as input data for bioenergetics models using Fisheries Bioenergetics 4.0 software to examine consumption rates/energy requirements based on variations in biological/physical parameters.
- tuna.
- Limitations of the software to estimate parameter uncertainty and variability in consumption/daily ration estimates prompted development of a custom age-structured bioenergetics model at the individual and population levels.
- Model equations and VBA code complete for yellowfin; refinement of variance parameter estimates and equations for active metabolic rate (i.e. estimates of minimum and average swim speeds) continues.
- Modifications to all model input files complete and sensitivity analyses in progress.
- Life history data on dolphinfish and skipjack compiled for consumption model development.

**Challenges and key lessons learnt**
Significant challenges were encountered learning the new software and its limitations. As a result, a custom model was required to be built, which has delayed the work, but greatly improved the quality of the analyses.
Proposals to conduct gastric evacuation experiments, the sampling for predator/prey caloric values and additional experiments to refine bioenergetics parameters were delayed due to the pandemic.

**Reports/publications/presentations**
- Document SAC-10 INF-E, May 13-17, 2019; Internal summary report of Fisheries Bioenergetics 4.0 modeling simulations to estimate consumption of yellowfin tuna, *Thunnus albacares*/70th Tuna Conference, May 20-23, 2019
- A draft manuscript for the scientific journal, *Reviews in Fish Biology and Fisheries*, will be submitted for review in September 2021.

**Comments:**
This project is a critical precursor to experimental work required to estimate values of the consumption/biomass ratio (Q/B) for an ecosystem model in development for the EPO.

| PROJECT R.1.a: Workshop on training, communication and evaluation of management strategies for tuna fisheries in the EPO | |
|---|---|
| **THEME**: Knowledge transfer and capacity building<br>**GOAL**: R. Improve communication of scientific advice<br>**TARGET**: R.1. Improve communication of the staff's scientific work to CPCs<br>**EXECUTION**: Stock Assessment Program | |
| **Objectives** | Provide training and enhance communication between scientists and managers on management objectives, harvest strategies and management strategy evaluation (MSE). |
| **Background** | Several tuna RFMOs are strengthening communications among scientists, managers and other stakeholders throughout similar workshops, including an initial one for the EPO in Panama (2015).<br>The IATTC Performance Review and Strategic Science Plan recommend improving knowledge sharing, human-institutional capacity building and communication of scientific advice. |
| **Relevance for management** | Key elements of IATTC's management strategy, such as its harvest control rule and reference points, along with alternatives, are being evaluated via MSE. Improving participation and communication among all stakeholders is important throughout the development, evaluation and implementation of a management strategy |
| **Duration** | Planning and organization: 1-2 weeks<br>Workshop: 2 days (last quarter of 2018) |
| **Work plan and status** | Form organizing committee to develop workshop agenda.<br>Develop/tailor workshop materials (preferably in Spanish) to EPO tuna-management needs.<br>Likely topics: Objectives, tactics and strategies, Kobe plots, harvest control rules, reference points. MSE components, development and implementation.<br>Logistics: Confirm presenters, host country (Ecuador has expressed interest), travel, venue, accommodations, invite Commissioners (mainly from coastal CPCs).<br>Conduct workshop with a format of both presentations and hands-on sessions with MSE "toy" models to illustrate main points, issues, trade-offs, and foster dialogue among Workshop participants. |
| **External collaborators** | WWF; Ocean Outcomes; ISSF |
| **Deliverables** | Workshop report and associated materials |

| **PROJECT R.1.a: Workshop on training, communication and evaluation of management strategies for tuna fisheries in the EPO** |
|---|
| **Updated**: March 2019 |
| **Progress summary for the reporting period** <br> • The workshop was conducted in August 2018. |
| **Challenges and key lessons learnt** <br>     The full cycle of an MSE will need several iterations of dialogs with stakeholders. |
| **Reports/publications/presentations** <br>          Presentations, glossary and workshop report available on request. <br>          Interactive application (in Spanish) illustrating major MSE features |
| **Comments:** <br> The workshop was very well received. The participants from other t-RFMOs and institutions (FAO, ISSF, WWF, *etc*.) with direct experience of MSE greatly enriched the discussions. |

| Project R.1.b: Development, communication and evaluation of management strategies (MSE) for tropical tuna fisheries in the EPO involving managers, scientists and other stakeholders. | |
|---|---|
| **Objectives** | Continue support of IATTC Staff on technical development of MSE for tropical tunas. Provide training and enhance dialogue / communication among scientists, managers and other stakeholders regarding the MSE process for tropical tunas through the facilitation of a series of workshops. Elicit candidate reference points, harvest control rules, and performance measures from stakeholders to be tested in addition to the interim ones. |
| **Background and statement of the problem** | The Performance Review of the IATTC, the proposed Strategic Science Plan, and the SAC all recommended improving knowledge sharing, human- institutional capacity building and communication of scientific advice. MSE is a major objective of the IATTC and other organizations. Part of the MSE process is highly technical and done by scientists. Another part, such as defining objectives, performance metrics and candidate management strategies, requires input and participation of managers and other stakeholders. Those two parts evolve in synergy. Stakeholder participation throughout the MSE process is central to its success and will be facilitated by the understanding of the MSE process, its components and by strengthening the communication among scientists, managers and other stakeholders. Initial workshops on MSE where held in 2015 and 2018 but were restricted to Latin-American developing countries and focus on understanding of the process. |
| **Key reference(s)** | • Resolution C-16-02; IATTC Review; CAF-05-04_Appendix-1; SAC-07-07h; SAC-08-05e(ii); SAC-08-05e(iii); SAC-09 Recs |
| **Relevance for management** | Key elements of IATTC's current management strategy, such as its control rule and reference points, along with alternatives, are currently being evaluated via MSE. Technical support for better model development and relevance of the MSE results. Workshops will improve scientists, managers and other stakeholder communication. The current proposal will advance the MSE process for tropical tunas to assess the performance of interim Harvest Control Rule (HCR) and alternatives. Results will facilitate adopting a permanent HCR for tropical tunas as per Res. C-16-02 |
| **Duration** | 18 months (from second half of 2019 through 2020). Continuation via |
| **Work-plan** | Continue support of IATTC Staff on technical development of BET MSE. Development/tailoring of MSE Workshop materials and online resources to EPO tropical tuna fisheries including presentations and hands-on working sessions. Conduct two Workshops in 2019 (Asia in English, Latin America in Spanish) with managers and other stakeholders aiming to improve understanding of the MSE process, elicit objectives, performance metrics, alternative control rules, and risk. Conduct two 2020 Workshops with managers and other stakeholders to show initial results and gather feedback, plus a technical Workshop |
| **Collaborators** | External contractor, other external tuna and communication experts |
| **Challenges encountered and anticipated** | Need for continuing workshops to cover specific topics related to IATTC's MSE work. Turnover of commissioners and their staff makes important to revisit workshops. 2nd IATTC MSE Workshop postponed due to COVID pandemic, rescheduled as videoconference during May 2021 |
| **Deliverables** | Reporting to SAC of MSE development, progress, and preliminary results. 1st IATTC MSE Workshop conducted in December 2019, Workshop report and associated training and online materials. |

| PROJECT T.1.a: External review of bigeye tuna assessment | |
|---|---|
| THEME: Scientific Excellence<br>GOAL: T. Implement external reviews of the staff's research<br>TARGET: T.1. Facilitate external reviews of stock assessments<br>EXECUTION: Stock Assessment Program | |
| Objectives | Review the assessment model used for bigeye tuna<br>Improve the assumptions made in the assessment |
| Background | The bigeye tuna stock assessment was last independently reviewed in 2010<br>Several issues have been identified in the stock assessment<br>The CAPAM workshop series has identified several modelling good practices that should be incorporated into the bigeye tuna assessment<br>Major improvements to the stock assessment are underway, including modelling of spatial structure<br>Review of the assessment is important to get external input into improving the assessment |
| Relevance for management | The results of the bigeye assessment are used for management advice<br>Improvements in the stock assessment will improve the management advice |
| Duration | The project will extend over 2019, but the workshop will be a single week in Fall |
| Work plan and status | Early 2019: Identify review panel<br>Mid 2019: Prepare documents describing major developments in the model<br>Fall 2019: Hold workshop<br>Fall 2019: Write workshop report |
| External collaborators | Independent reviewers |
| Deliverables | Workshop report |


| PROJECT T.1.a: External review of bigeye tuna assessment |
|---|
| Updated: May 2019 |
| **Progress summary for the reporting period**<br>The review was conducted in March 2019 by a panel of 7 independent reviewers<br>The panel identified several potential improvements to the assessment |
| **Challenges and key lessons learnt**<br>Several hypotheses were identified to explain the regime shift in recruitment, a few were able to substantially reduce the shift, but the cause could not be clearly identified |
| **Reports/publications/presentations**<br>Presentation at SAC-10<br>Documents prepared by the staff for the review<br>Report of the Review panel |
| **Comments:** |

| PROJECT T.1.b: External review of yellowfin tuna assessment | |
|---|---|
| THEME: Scientific Excellence<br>GOAL: T. Implement external reviews of the staff's research<br>TARGET: T.1. Facilitate external reviews of stock assessments<br>EXECUTION: Stock Assessment Program | |
| Objectives | Review the assessment model used for yellowfin tuna<br>Improve the assumptions made in the assessment |
| Background | The yellowfin tuna stock assessment was last independently reviewed in 2012<br>Several issues have been identified in the stock assessment<br>The CAPAM workshop series and research on the bigeye tuna assessment have identified several modelling good practices that should be incorporated into the yellowfin tuna assessment<br>Review of the assessment is important to get external input into improving the assessment |
| Relevance for management | The results of the yellowfin assessment are used for management advice<br>Improvements in the stock assessment will improve the management advice |
| Duration | The project will extend over 2019, but the workshop will be a single week in winter |
| Work plan and status | Mid-2019 identify review panel<br>Fall 2019 prepare documents describing major developments in the model<br>Winter 2019 Hold workshop<br>Winter 2019 Write workshop report |
| External collaborators | Independent reviewers |
| Deliverables | Workshop report |

| PROJECT T.1.b: External review of yellowfin tuna assessment |
|---|
| Updated: May 2020 |
| **Progress summary for the reporting period**<br>      Review held December 2019<br>      Workshop report completed |
| **Challenges and key lessons learnt**<br>-No single model identified and multiple models need to be considered |
| **Reports/publications/presentations**<br>         Workshop report |
| **Comments:** |

| **PROJECT X.1.a: Workshop to advance spatial stock assessments of bigeye tuna in the Pacific Ocean** | |
|---|---|
| **THEME:** Scientific excellence<br>**GOAL:** X. Promote the advancement of scientific research<br>**TARGET:** X.1. Continue the annual CAPAM workshops<br>**EXECUTION**: Stock Assessment Program | |
| **Objectives** | Bring together researchers to present and discuss the development and application of spatial stock assessments<br>Improve the bigeye tuna stock assessment |
| **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<br>Substantial progress has been made in both the statistical methodology and the practical implementation (e.g. software) of spatial stock assessment models<br>Tagging data show substantial directional movement of bigeye tuna in the EPO. 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. |
| **Relevance for management** | Knowledge gained from the workshop will be uses to improve the bigeye tuna stock assessment<br>Improvements in the bigeye assessment will improve management advice |
| **Duration** | October 2018 |
| **Work plan and status** | April 2018 – invite keynote speakers<br>August 2018 – prepare background material<br>October 2018 – Conduct workshop<br>November 2018 – Write workshop report<br>May 2019 – report to SAC |
| **External collaborators** | |
| **Deliverables** | Workshop report |

| PROJECT X.1.a: Workshop to advance spatial stock assessments of bigeye tuna in the Pacific Ocean |
|---|
| **Updated**: May 2019 |
| **Progress summary for the reporting period**<br>    The workshop was held in October 2018, with 10 invited presentations and 18 contributed presentations<br>    IATTC staff gave six presentations and conducted a tutorial on implementing spatial models in Stock Synthesis |
| **Challenges and key lessons learnt**<br>There are few examples of spatial models used for management advice |
| **Reports/publications/presentations**<br>    Six presentations by staff members<br>    A special issue of *Fisheries Research*, containing the presentations from the workshop, has been published (https://www.sciencedirect.com/journal/fisheries-research/special-issue/101C0G9RFPW) |
| **Comments:**<br>The workshop informed the staff's assessment of bigeye in the EPO |