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# Proposal for a regional tuna tagging project in the Eastern Pacific Ocean

**WCPFC-SC5-2009/GN-IP-17**

**IATTC**[1]

[1] Inter-American Tropical Tuna Commission, La Jolla, USA

INTER-AMERICAN TROPICAL TUNA COMMISSION

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## REGIONAL TUNA TAGGING PROJECT

## INTRODUCTION

During 2008, a steering committee (Appendix I) was formed to review and comment on a proposal for tagging tunas in the eastern Pacific Ocean, and to provide expert advice to assist in the implementation of the project. The proposal presented at the 78th meeting of the Commission in June 2008[1] has been revised, based on comments from committee members. The revised proposal is included below.

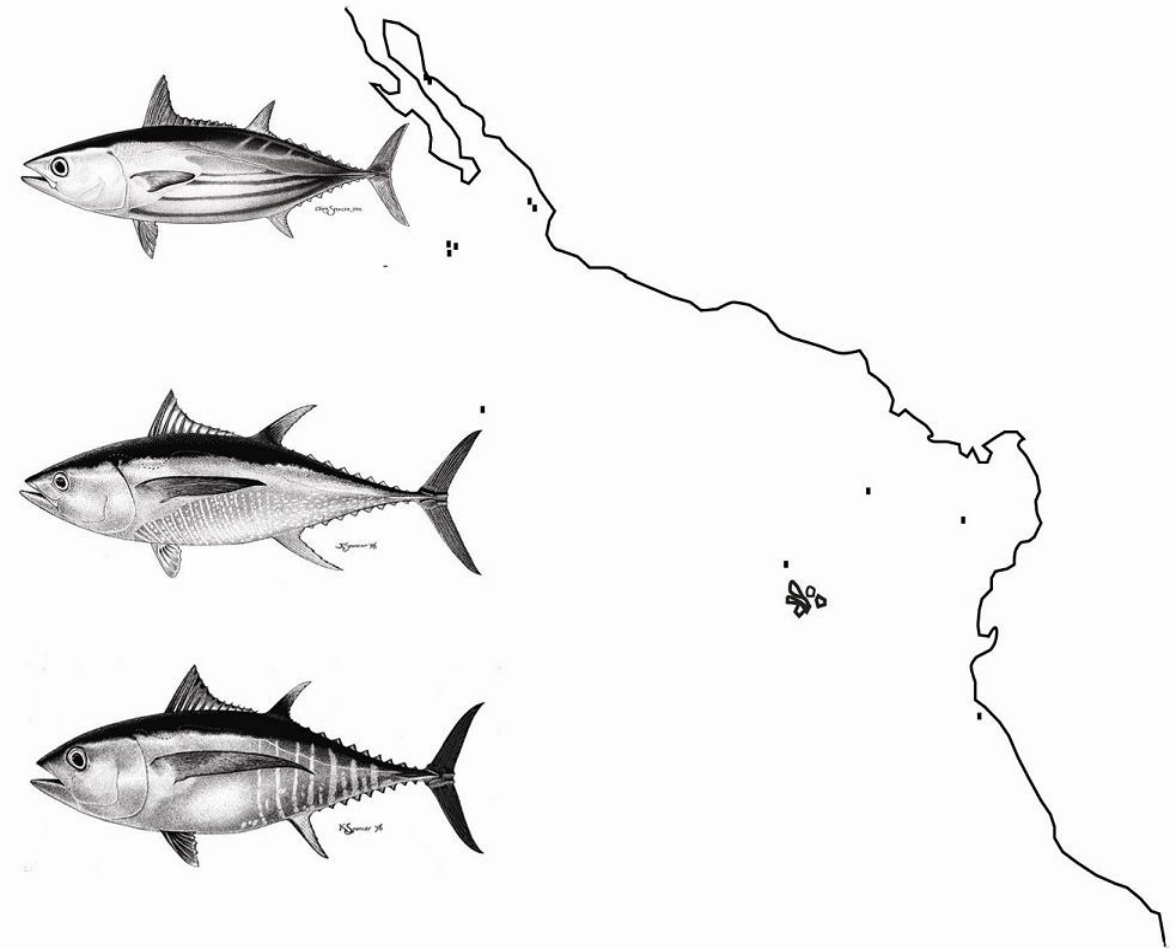
**CONTENTS**



[1] http://www.iattc.org/PDFFiles2/IATTC-78-08c-Regional-tagging-program.pdf

**Inter-American Tropical Tuna Commission**

# PROPOSAL
# for a
# REGIONAL TUNA TAGGING PROJECT
# IN THE
# EASTERN PACIFIC OCEAN



## SUMMARY

This proposal is for the creation of large-scale Regional Tuna Tagging Program (RTTP) in the eastern Pacific Ocean (EPO), with the goal of improving the stock assessment and management of bigeye, yellowfin, and skipjack tunas in the EPO. The project would be implemented and managed by the Inter-American Tropical Tuna Commission (IATTC), in consultation with a Steering Committee of outside experts. The total proposed budget for this project is US$ 4.6 million.,.

The objectives of the project are (i) to obtain data that will contribute to, and reduce uncertainty in, EPO tuna stock assessments; (ii) to obtain information on the rates of movement and mixing of tuna in the EPO, between this region and other adjacent regions of the Pacific basin, and the impact of the use of fish-aggregating devices (FADs) in the purse-seine fishery on the movements of the fish at all spatial scales; (iii) to obtain information on species-specific vertical habitat utilization by tunas in the EPO, and the impacts of FADs on vertical behavior; and (iv) to obtain information on local exploitation rates and productivity of tuna in various parts of the EPO.

To achieve these objectives, bigeye, yellowfin, and skipjack tuna would be tagged with conventional, archival and acoustic tags throughout the range of the purse-seine and longline tuna fisheries in the EPO. A commercial pole-and-line vessel, suitably modified for tagging, would be chartered for six four-month-long tagging trips, two months apart, over a three-year period. One or more smaller pole-and-line vessels would be chartered for two two-month-long tagging trips each year in coastal areas and near islands between northern Mexico and Peru. Tunas associated with floating objects, including FADs, seamounts, and dolphins, and in unassociated surface schools, would all be targeted for tagging.

Adequate measures to maximize the return of fish with recaptured tags will be crucial to the success of the project. Wide publicity, attractive rewards, lotteries, and tag-seeding experiments will be conducted to achieve, and verify, high rates of tag reporting. Data on tag releases and returns will be stored in an established database. Tag-return data will be cross-checked against other data sources (observer logs and vessel logs) to verify reported data and estimate missing data. Established and new methods will be used to analyze the data.

Subject to the results of the project, consideration should be given to establishing a long-term tagging program throughout the Pacific Ocean, in order to provide a continuous source of fishery-independent information for tuna stock assessments.

## 1. TITLE OF PROPOSAL

Regional tagging program for bigeye, skipjack, and yellowfin tuna in the eastern Pacific Ocean, 2010-2012.

## 2. OBJECTIVE

The primary objective is to conduct large-scale tagging of the three main commercial species of tunas, bigeye (*Thunnus obesus*), skipjack (*Katsuwonus pelamis*), and yellowfin (*Thunnus albacares*), captured in the purse-seine and longline fisheries of the eastern Pacific Ocean (EPO). The data obtained would improve the scientific basis for estimation of the exploitation, movements, natural mortality, and growth rates of these species in the EPO.

## 3. BACKGROUND INFORMATION AND JUSTIFICATION

In the EPO, purse-seine catches of bigeye and skipjack tunas have increased substantially in the past decade (Anonymous, 2008). The rapid changes in the fishery have made it difficult to assess its effect on those stocks. Evaluations conducted in recent years (Anonymous, 2008; Hampton and Maunder, 2005) have shown the need for caution in managing this changed situation, but above all the need for better scientific information on which to base management decisions.

Purse-seine fisheries throughout the Pacific now focus a large proportion of their effort on tunas associated with drifting fish-aggregating devices (FADs), a mode of fishing that has evolved to become highly efficient for harvesting all three species of tunas (Fonteneau *et al.,* 2000). For scientists, it has created problems in calculating indices of species-specific catches per unit of effort for the purse-seine fishery, thus creating uncertainty in the indices of abundance and in the management recommendations for these species. This is partially a result of a lack of understanding of the characteristics and dynamics of the aggregations that are associated with FADs. The spatial and temporal dynamics of tunas within these aggregations should be thoroughly investigated in order to quantify several important life history characteristics of tunas, including movements, behavior, residence times, and vulnerability to fishing gear.

In the EPO, schools of tuna within large multi-species aggregations associated with FADs have been exploited by large purse-seine vessels since 1994 (Lennert-Cody and Hall 2000; Anonymous, 2008), predominantly between 5°N and 15°S. The practice of deploying FADs and targeting the tunas that associate with them has increased over the past decade, and has contributed to a significant increase in the catch of bigeye, from an annual average of about 5 thousand metric tons during 1964-1993 to 46 thousand metric tons during 1996-2003, although the greatest component of the catch of this fishery is skipjack (Anonymous, 2008).

Bigeye tuna is the primary target species of the longline fleet fishing in the EPO. Longline and total catches of bigeye from the EPO historically exceeded those from the western and central Pacific Ocean (WCPO), but since 2004 the total bigeye catch from the WCPO has exceeded that of the EPO (Anonymous, 2008)**.**

The longline fishery targets medium to large bigeye, while the purse-seine fishery catches primarily small to medium bigeye. In the EPO, there is a reasonable concern that the purse-seine fishery is affecting the longline fishery and that large catches of small bigeye have reduced the stock size and the sustainable catches. The catches, and standardized catch rates, of the longline fishery have declined in recent years, from an annual average of about 86 thousand metric tons during 1986-1994 to about 51 thousand metric tons during 1995-2003 (Anonymous, 2008). Although the fishing effort of the predominant Japanese longline fleet has decreased in recent years, that of the fleets of Korea and Chinese Taipei has increased.

Knowledge of current levels of exploitation, as well as movements, natural mortality, and growth rates of bigeye, skipjack, and yellowfin tunas, are essential for stock assessments. Although stock assessments have been performed for these species in the eastern Pacific (Anonymous, 2008), there are uncertainties in some of the assumptions and parameter estimates utilized in these analyses. The proposed tagging

program would provide a direct means for estimating exploitation, movement, natural mortality, and growth rates for these three species. Valid estimates of these parameters would improve confidence in stock assessments, help quantify the degree of interaction between the purse-seine and the longline fisheries, and permit better management decisions. The tagging data will also be incorporated into integrated assessment models from which these parameters can be both estimated and utilized. The current assessment of skipjack tuna is unreliable due to the unavailability of an index of stock abundance. Estimates of exploitation rate and abundance from the tagging program are therefore essential to produce a reliable stock assessment for skipjack tuna. The bigeye tuna assessment is sensitive to the mean length at age assumed for large fish. Ageing using otoliths is problematic for large bigeye tuna, and growth rates estimated from the tagging program are needed. The assessments of all three species are sensitive to both the absolute level of natural mortality and the age-specific changes in natural mortality. The values currently assumed for natural mortality are based on little information, and data from the tagging program are essential to provide more confidence in the current assessments. The stock assessments currently assume that tunas in the EPO comprise single stocks, and it is not known if different spatial scales are more appropriate for assessment and management. Obviously, all three species of tunas move across the regional management boundary at longitude 150ºW, in both directions. However, considering the characteristic restricted movements of these species and the historical dynamics of the fishing fleets, regional assessments and management recommendations have been most appropriate. This proposed tagging program will provide the up-to-date information on tuna movements and exploitation that is required to evaluate the appropriate spatial scales for assessments and management.

Regional tuna tagging projects conducted recently in the WCPO (Hampton and Gunn, 1998; Hampton and Williams, 2005), around the Hawaiian Islands (Itano and Holland, 2000), and in the EPO (Schaefer and Fuller, 2005a; Anonymous, 2007), have demonstrated that bigeye exhibit relatively restricted geographical movements, similar to those of yellowfin and skipjack tunas, showing regional fidelity (Hunter *et al.,* 1986; Sibert and Hampton, 2003). However, genetic investigations of the population structure of these species, through analysis of mitochondrial DNA, could not reject the null hypothesis that each of these species shares a common gene pool (Scoles and Graves, 1993; Grewe and Hampton, 1998). Also, there has been no tagging of bigeye in the EPO near the management boundary between the EPO and the WCPO. These results clearly indicate a need to determine the levels of mixing among the stocks for inclusion in the regional assessments. Although concurrent tagging in regions across the Pacific is probably the best method for obtaining this important information, with modern methods of analysis it is not essential. Since 2007, large numbers of skipjack and yellowfin tunas, along with some bigeye, in various regions of the WCPO (Leroy *et al*., 2008), as part of the Pacific Tuna Tagging Project (PTTP), including tagging of bigeye in the equatorial central Pacific Ocean at the 155°W meridian during 2008 (Itano, 2008). Preliminary results indicate both eastward and westward dispersion of fish from the release locations. These tagging efforts in the WCPO have been well funded, and will continue during 2009.

In addition to tagging the three species of tunas externally with conventional plastic dart tags, we propose implanting geolocating archival and acoustic tags in limited numbers of each of these species. The data recovered from archival tags allow detailed movement paths to be reconstructed, and this information, together with the information obtained from conventional tag recoveries, is very useful for estimating stock structure, movements, and mixing rates. The data on behavior and habitat utilization from archival tags is useful for habitat-based standardization of longline catch and effort data used in stock assessments (Langley *et al*., 2005), and also potentially for standardization of purse-seine catch and effort data. The archival tag data also provide on both small- and large-scale resolution of residence times, complementing the results from conventional tagging, and providing long-term information on geographical and spatial distributions (Gunn and Block, 2001; Schaefer and Fuller, 2002; Schaefer *et al*., 2007; Schaefer and Fuller, 2008). Acoustic tags, used in conjunction with ultrasonic telemetry, would provide data on fine-scale behavioral differences between skipjack tuna and other species within aggregations associated with FADs, and may reveal opportunities for capturing skipjack without capturing bigeye, yellowfin, and other species of concern associated with FADs (Schaefer and Fuller,

2005b).

This proposed tagging project is in accordance with the general aspirations of the fisheries research community, which include the need to conduct regional research projects to achieve Pacific-wide goals. It was the consensus of scientists from regional research organizations throughout the Pacific Ocean attending the prioritization workshop of the Pelagic Fisheries Research Program at the University of Hawaii in November 2005 that Pacific-wide tagging experiments are necessary to address many of the important scientific issues, including movements and mixing rates, surrounding bigeye and other primary market species of tunas. Also, the Pacific Tuna Tagging Project stresses the importance of a Pacific-wide approach in the tagging of tropical tunas (Hampton *et al*., 2007). The IATTC scientific working group considered tagging experiments to be of such high priority that it convened a workshop in October 2007 entitled "Using Tagging Data for Fisheries Stock Assessment and Management." A regional tuna tagging program in the EPO was recently listed as the first recommendation in the report of the 9th IATTC Stock Assessment Review Meeting, convened in May 2008.

The IATTC would welcome and encourage the participation of scientists from donor governments and organizations in the at-sea work, data analyses, and reporting of results.

## 4. DESCRIPTION OF PROPOSED ACTIVITIES

We propose to conduct a series of tag-release experiments in the EPO over the three-year period 2010 through 2012, with the goal of tagging at least 100,000 tunas with conventional plastic dart tags. Bigeye, skipjack, and yellowfin, over as great a size range as possible, would be targeted for tagging, with an intended distribution of approximately 40-20-40% among the three species. The primary tagging would be done aboard multiple live-bait pole-and-line vessels, with about 12 months total charter time per year, to enable adequate spatial and temporal tag deployments throughout the EPO. The focus of tagging activities would include targeting tunas associated with floating objects, seamounts, and dolphins, and in unassociated surface schools.

We propose to conduct two 4-month-long experiments each year, two months apart, utilizing chartered live-bait pole-and-line vessels to tag bigeye, skipjack, and yellowfin tunas throughout the range of the fisheries in the EPO. The tag releases would be distributed over the most appropriate areas and periods possible. We would also conduct about two months of tagging each year, in coastal areas and near islands between northern Mexico and Peru, also utilizing live-bait pole-and-line vessels.

Tag seeding studies would be conducted throughout the program and simultaneously with the tagging experiments in order to estimate the recovery rates of recaptured tagged tunas. For this study, IATTC observers aboard purse-seine vessels could place dart tags in tunas before they are frozen in the vessel's wells.

In addition to dart tags, archival tags would also be implanted in bigeye, skipjack, and yellowfin tunas. Archival tags would provide information on movements, behavior, and habitat utilization for the three species throughout the EPO. Because of the high rewards paid for recovered archival tags, the recovery rate is expected to be essentially 100%, and can be used as a basis for an alternative estimate of exploitation rate that is free of recovery issues. We would deploy 75 archival tags per year each in bigeye, skipjack and yellowfin tunas. The tags would be implanted in the peritoneal cavities of the fish; this method has been shown to result in little tag shedding, high survival, and high recovery rates. Evaluations would be conducted of the spatial and temporal variation in movements, behavior, and habitat, and of the effects of oceanographic features, including bathymetry, sea-surface temperatures, ocean color, fronts, and eddies.

Yellowfin tuna frequently associate with herds of spotted, spinner, and common dolphins in the EPO, but the reasons for the association are unclear. Answering such questions as whether the association is terminated at night and reformed during the day, and the proportions of time and behavior patterns when yellowfin are associated or not associated with dolphins, is paramount to understanding the ecological relationships between these two key apex predator species within the EPO. These relationships would be

investigated using acoustic and archival tag technology.

We also propose to conduct observations and collect behavioral data on tuna aggregations associated with FADs, using a number of complementary scientific tools. Telemetry studies would employ an acoustic tracking system, in conjunction with coded acoustic tags implanted in the peritoneal cavities of bigeye, skipjack, and yellowfin tunas, to enable simultaneous data collection during trials of approximately 48 hours. These electronically-tagged tunas would act as markers within the aggregation, from which fine-scale spatio-temporal data can be collected. During each trial, the relative orientation and movements of the tuna schools making up the aggregation would be monitored and evaluated with scanning sonar and echo-sounder imaging, from which digital images would be recorded. The sonar would be used for observing the aggregation's abundance, horizontal distribution, and behavior, and the multifrequency echo-sounder to observe its vertical distribution, species composition, and behavior. In addition, an underwater video camera connected to a recording device would be suspended under the FAD, to provide additional information on species identification and behavior. These activities could be carried out efficiently within the framework of the proposed tagging cruises, and no more than 10% of the available charter time would be allocated to this component of the project. The resulting information would be extremely useful in defining the associative characteristics of the three species, and provide insights into minimizing or excluding the capture of non-target species during routine purse-seine fishing activities.

The successful completion of the program would require a number of activities in addition to the actual fieldwork involving tagging of fish, including the following:

1. Securing recapture information on tagged fish, including data on location, date, and size. The requirements for this include: a) informing fishermen of the program, and its potential benefits for the fishery; b) paying adequate rewards for the return of tags, and establishing a lottery as an additional incentive; c) making it easy to return the tags by establishing a system by which the IATTC technicians who go aboard the vessels in port for various purposes, such as making abstracts of the logbooks, collect the tags and information and pay the rewards. The IATTC staff will collect as much data as possible, through its field offices and observer program, and will seek the cooperation of national fisheries authorities in recovering tags and associated information, particularly from longline catches.

   Processing the information and entering it into a computerized database. The IATTC staff has previous experience with this process from earlier experiments, and in 2000 established a database in which the release and recapture data are stored; the data can be easily extracted for analyses.

2. Analysis of tag release and recapture information. The IATTC staff has considerable experience and expertise in the analyses of both conventional and electronic tagging data. However, this part of the program could be of interest to other organizations as well, and collaborations in the analyses of the data by scientists from those organizations with IATTC staff would be encouraged. Spatially-explicit Pacific-wide assessment models are theoretically capable of integrating movement rates, growth rates, and mortality rates. The current Pacific-wide bigeye stock assessment model utilizes tagging data, and all data derived from the proposed tagging experiments would be incorporated and utilized within that assessment.

## 5. REPORTING

The activities and results of the program would be routinely reported in the IATTC Quarterly and Annual Reports. The final results of various aspects of the program will be published in peer-reviewed journals, in a timely manner.

All funds would be used solely for the program, and any funds remaining on completion of the program will be reported to the donors and disposed of in accordance with their wishes. Financial accounting would be maintained in a manner that would allow complete transparency to donors, and will be identified in the IATTC's financial accounts.

## 6. FUNDING

The IATTC will commit scientific staff members for conducting tagging operations, and for the analyses of the data and the reporting of results. The IATTC will pay the costs of data collection in areas where the Commission has offices, and of data processing. The IATTC will also administer the reward program. In the budget we have assumed that the governments of nations from outside the region (*i.e.* Japan, Korea, Chinese Taipei) would be willing to pay the costs of data collection in areas not covered by IATTC staff. It is assumed that the costs for scientists of other organizations who participate in field activities or in the analyses of the data would be borne by their respective organizations.

## 7. BUDGET

Funds are requested for the following annual budget for each of the three years (2010-2012):

| **Vessels** | | **US$** |
|---|---|---|
| Dedicated tagging vessel, captain, crew and all operational expenses | 240 days @ $3,000/day | 720,000 |
| Dedicated tagging vessel, captain, crew and all operational expenses | 120 days @ $2,000/day | 240,000 |
| Miscellaneous (port fees, etc) | | 15,000 |
| **Personnel** | | |
| Assistant scientists | 2 @ $46,100/year | 92,200 |
| Sea pay | | 62,000 |
| **Equipment** | | |
| Dart tags | 35,000 @ $0.60/ea | 21,000 |
| Archival tags | 150 @ $850/ea | 127,500 |
| Archival tags | 75 @ $1,000/ea | 75,000 |
| Acoustic tags | 54 @ $600/ea | 32,400 |
| Satellite buoys for FADs | | 54,000 |
| Miscellaneous | | 15,000 |
| **Rewards** | | |
| Dart tags (bigeye) | 40% recovery @ $5 | 26,666 |
| Archival tags (bigeye) | 40% recovery @ $250 | 7,500 |
| Dart tags (skipjack) | 20% recovery @ $5 | 6,666 |
| Archival tags (skipjack) | 20% recovery @ $250 | 3,750 |
| Dart tags (yellowfin) | 30% recovery @ $5 | 20,000 |
| Archival tags (yellowfin) | 30% recovery @ $250 | 5,625 |
| Lottery | $5,000/year | 5,000 |
| **TOTAL COST ANNUAL** | | **US$1,529,307** |
| **TOTAL COST FOR 3 YEAR PERIOD** | | **US$4,587,921** |

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**Appendix I**

## IATTC Tuna Tagging Project

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