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COMMITTEE ON ADMINISTRATION AND FINANCE

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

APPENDIX 2: PROPOSAL FOR A REGIONAL TUNA TAGGING PROGRAM IN THE EASTERN PACIFIC OCEAN

SUMMARY

This proposal is for the creation of a large-scale Regional Tuna Tagging Program (RTTP) in the eastern Pacific Ocean (EPO), for the three-year period 2019 through 2021, with the goal of improving the stock assessments and management of skipjack, yellowfin, and bigeye tunas in the EPO. The program would be implemented and managed by the IATTC staff. The total proposed budget for this program is US$ 7.3 million.

The objectives of the program are (i) to obtain data that will contribute to, and reduce uncertainty in, EPO tuna stock assessments, particularly for skipjack tuna; (ii) to 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 (iii) to obtain estimates of sex-specific growth, mortality, abundance, selectivity, and exploitation rates for those species of tuna in the EPO.

To achieve these objectives, skipjack, yellowfin, and bigeye tuna would be tagged with conventional and archival tags throughout much of 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 nine three-month-long tagging cruises, one month apart, over a three-year period. Tunas associated with floating objects, including FADs, islands, 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 program. Wide publicity, attractive rewards, lotteries, and tag-seeding experiments will be conducted to achieve, and verify, high rates of tag reporting. Tag recovery officers would be employed in the major ports in Ecuador and Mexico where purse-seine vessels unload. 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 assign confidence levels. Established and new methods will be used to analyze the data.

Two workshops will be held to elicit expert advice on the tagging program design and on the subsequent

analysis of the data collected.

Item	Years	Detail	One year	Total
Ongoing tagging program costs	2019-2021	Personnel, tags, vessel, travel, rewards	US$ 2,372,701	US$ 7,118,103
One-time expenses	2019	Equipment		US$ 68,000
Workshops	2019, 2021			US$ 100,000
Total				**US$ 7,286,103**

1. TITLE OF PROPOSAL

Regional tagging program for skipjack, yellowfin, and bigeye tuna in the eastern Pacific Ocean, 2019-2021.

2. OBJECTIVE

The primary objective is to conduct large-scale tagging of the three main commercial species of tunas, skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), and bigeye (*Thunnus obesus*), 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 sex-specific movement, growth, mortality, abundance, selectivity, and exploitation rates for those species of tuna in the EPO.

3. BACKGROUND INFORMATION AND JUSTIFICATION

In the EPO purse-seine fleet capacity has increased substantially since around 1995, along with catches of skipjack tuna. Substantial changes in the fishery dynamics over the past twenty years have made it difficult to assess its effect on these tropical tuna stocks. Assessments conducted in recent years (Anonymous, 2015) have shown the need for caution in managing this fishery, 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.,* 2013). 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, 2016), predominantly between 5°N and 15°S. The practice of deploying FADs and targeting the tunas that associate with them has evolved and increased in efficiency over the past decade, primarily due to the use of GPS buoys with echo-sounders. The greatest component of the catch by this FAD fishery is skipjack but there is also a substantial catch of small bigeye and yellowfin tuna (Anonymous, 2016).

Bigeye tuna is the primary target species of the longline fleet fishing in the EPO. 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 36 thousand metric tons during 2011-2015 (Anonymous, 2016). Although the fishing effort of the predominant Japanese longline fleet has decreased in recent years, that of the fleets of China, Chinese Taipei, and Korea has increased.

Knowledge of current levels of exploitation, as well as movements, natural mortality, and growth rates of skipjack, yellowfin, and bigeye tunas are essential for stock assessments. Although stock assessments have been performed for these species in the eastern Pacific (Anonymous, 2015), there are uncertainties in many of the assumptions and parameter estimates utilized in these analyses that could be improved. 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 stock status of skipjack tuna in the EPO is uncertain, due to the unavailability of an index of stock abundance. Estimates of abundance and exploitation rate obtained from the tagging program are therefore essential to produce a reliable stock assessment for skipjack tuna. The assessments of all three species are sensitive to both the absolute level of natural mortality and the age-and sex-specific changes in natural mortality. The values currently assumed for natural mortality are based on little information, make unconfirmed assumptions about sex-specific differences, and data from the tagging program would be highly beneficial to provide more confidence in the current assessments.

The stock assessments currently assume that for assessment and management purposes, tunas in the EPO comprise single stocks, contrary to that of historical tagging data, and it is not known if different spatial scales are more appropriate for assessment and management. Data suggest possible local depletion caused by the expansion of the floating object fishery, which needs to be considered in the assessments. 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 deemed 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.

Recent analyses of data derived from bigeye tagging experiment across the equatorial Pacific (Schaefer *et al*., 2015) have demonstrated that bigeye exhibit relatively restricted geographical movements, similar to those of yellowfin and skipjack tunas throughout the Pacific (Hunter *et al.,* 1986; Sibert and Hampton, 2003), and also exhibit various degrees of regional fidelity. Furthermore, a recent investigation of the population structure of yellowfin across the Pacific provided evidence of genetically discrete populations (Grewe *et al*., 2015). These results clearly indicate a need to elucidate stock structure for skipjack, yellowfin, and bigeye tunas in the EPO, and the levels of mixing among the stocks, for inclusion in the regional stock assessments.

In addition to tagging the three species of tunas externally with conventional plastic dart tags, we propose implanting appropriate numbers of geolocating archival tags in 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 essential for quantifying exploitation, movements, mixing rates, and stock structure (Schaefer *et al*., 2011; Schaefer *et al*., 2015). The archival tag data also provide on both small- and large-scale resolution estimates of residence times, complementing the results from conventional tagging, and providing long-term information on geographical and spatial distributions (Schaefer *et al*., 2015; Schaefer and Fuller, 2016). The data

obtained from archival tags on vertical movements, behavior, and habitat utilization (Schaefer and Fuller, 2010; Schaefer *et al*., 2011; Fuller *et al*., 2015) is crucial for understanding vulnerability and catchability of tunas by purse-seine and longline fisheries, and for further consideration in standardization of catch and effort data for use as indices of relative abundance in the stock assessments (*e.g*. Maunder *et al*. 2006).

4. DESCRIPTION OF PROPOSED ACTIVITIES

We propose to conduct a series of tag-release experiments in the EPO over the three-year period 2019 through 2021, with the goal of tagging a minimum of 100,000 tunas with conventional plastic dart tags. Skipjack, yellowfin, and bigeye tuna over as great a size range as possible, would be targeted for tagging, with an intended distribution of approximately 50% for skipjack and 25% each for the other two species. The primary tagging would be done aboard a live-bait pole-and-line vessel, with about 9 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, islands, seamounts, and dolphins, and in unassociated surface schools.

We propose to conduct three 3-month-long tagging cruises each year, one month apart, utilizing a chartered live-bait pole-and-line vessel to tag skipjack, yellowfin, and bigeye tunas throughout much of the range of the fisheries in the EPO. The tag releases would be distributed over the most appropriate areas and periods possible. Tagging cruises would focus on three primary offshore areas: 1) A northern area (10°N to 20°N), 2) a central area (10°N to 10°S), and 3) a southern area (10°S to 20°S).

Tag seeding experiments would be conducted throughout the program and simultaneously with the tagging experiments in order to estimate the recovery rates of recaptured tagged tunas, by fleets and landing ports. For this study, IATTC observers aboard purse-seine vessels could place plastic intra-muscular tags in tunas before they are frozen in the vessel's wells. In addition to dart tags, archival tags would also be implanted in skipjack, yellowfin, and bigeye 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 (US$ 250), 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 200 archival tags per year in skipjack, and 100 archival tags per year in both yellowfin and bigeye tunas, in each of the northern, central, and southern areas. The tags would be implanted in the coelomic cavities of the fish; this method has been shown to result in little tag shedding, high survival, and high recovery rates (Schaefer and Fuller, 2016). 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.

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 high-confidence recapture information on tagged fish, including data on location, date, and size. The requirements for this include: a) employing tag recovery officers (TROs) in the major ports in Ecuador and Mexico where purse-seine vessels unload; b) informing fishermen of the program, and its potential to the benefits for the fishery; c) paying adequate rewards for the return of tags, and establishing a lottery as an additional incentive; d) making it easy for unloaders to return tags still attached to tunas the same day they are found, by establishing a system by which IATTC TROs respond to cellular phone calls coming from finders during vessels unloading. 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.

2. Processing the information and entering it into a computerized database. The IATTC staff has considerable 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.

3. Analysis of tag release and recapture information. The IATTC staff has considerable experience and expertise in the analyses of both conventional and archival 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 in collaboration with IATTC staff would be encouraged. Spatially-explicit Pacific-wide assessment models are theoretically capable of integrating movement rates, growth rates, and mortality rates.

5. REPORTING

The activities and results of the program would be routinely reported on a page established on the IATTC website. Papers and presentations on the progress, including preliminary results of the program, would be given at the IATTC Scientific Advisory Committee (SAC) meetings. The final results of various aspects of the program will be published in peer-reviewed journals.

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 experienced scientific staff members for managing tagging operations, and for the analyses of the data and reporting of the results. The IATTC will also administer the tag return 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 any other organizations who participate in tagging cruises 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 (2019-2021), except for those highlighted entries which are expensed for only the initial year:

Vessels		**US$**
Dedicated tagging vessel, captain, crew and all operational expenses	270 days @ $3,000/day	810,000
Miscellaneous (port fees, etc.)		30,000
Personnel		
Assistant scientist/tagging technician (headquarters)	2 @ $65,000/year	130,000
Tag recovery officers Manta and Playas, Ecuador	3 @ $27,000/year	81,000
Tag recovery officers Manzanillo and Mazatlán, Mexico	3 @ $21,000/year	63,000
Sea pay for personnel on tagging cruises		111,552
Travel expenses		50,000
Quantitative analyst	1 @ $150,000/year	150,000
Equipment		

Plastic dart tags	33,333 @ $0.91/ea	30,333
Applicators for plastic dart tags	6,000 @ $5.00/ea	30,000
Archival tags for SKJ (Lotek LAT 2910-X)	600 @ $425/ea	255,000
Archival tags for YFT and BET (Wildlife MK9)	300 @ $900/ea	270,000
Archival tags for YFT and BET (Lotek LAT 2810)	300 @ $500/ea	150,000
Plastic intra-muscular tags (tag seeding experiments)	1,000@ $2.75/ea	2,750
Applicators for plastic intra-muscular tags	20 @ $45/ea	900
Portable computers for assistant scientists and TROs	8 @ $1,000/ea	8,000
Motorcycles for TROs in Ecuador and Mexico	4 @ $7,500/ea	30,000
Miscellaneous		35,000
Rewards		
Plastic dart tags (SKJ)	20% recovery @ $10	33,333
Archival tags (SKJ)	20% recovery @ $250	30,000
Plastic dart tags (YFT)	30% recovery @ $10	25,000
Archival tags (YFT)	30% recovery @ $250	22,500
Plastic dart tags (BET)	40% recovery @ $10	33,333
Archival tags (BET)	40% recovery @ $250	30,000
Plastic intra-muscular tags (tag seeding experiments)	90% recovery @ $10	9,000
Lotteries for Ecuador and Mexico	2 @ $10,000/ea	20,000
Meetings		
Workshops of invited experts to discuss tagging project experimental design and data analyses methods	2 @ $50,000/each	100,000
TOTAL INITIAL ANNUAL COST		**US$ 2,540,701**
TOTAL COST FOR 3 YEAR PERIOD		**US$ 7,286,103**

8. LITERATURE CITED

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