AGREEMENT ON THE INTERNATIONAL DOLPHIN CONSERVATION PROGRAM

37TH MEETING OF THE PARTIES

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DOCUMENT MOP-37-03

AIDCP UNFUNDED RESEARCH PROJECTS

This document is a research plan based on proposals presented by the IATTC staff at the 35th Meeting of the Parties (MOP-36-06) in October 2017, the discussions generated during that meeting, subsequent revisions by the staff, and a feasibility study for an at-sea survey of the dolphin populations of the eastern tropical Pacific (MOP-37-02).

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INTRODUCTION

As of July 2018, the AIDCP has a budget surplus of US$ 1.75 million, mainly because in recent years a number of vessels have paid for services (*e.g*. onboard observers) that were not fully utilized (Document MOP-36-06). This surplus can be spent on projects of interest to, and in support of, the AIDCP. At the previous Meeting of the Parties, in October 2017, the IATTC staff presented five appropriate research proposals (Document MOP-36-06) for consideration. This document presents a research plan based on those proposals presented in October 2017 at the 35th Meeting of the Parties (MOP-36-06), the discussions generated during that meeting, subsequent revisions by the staff, and a feasibility study for an at-sea survey of the dolphin populations of the eastern tropical Pacific (MOP-37-02).

Four studies are described: 1) a ship-based survey to estimate abundance of dolphin stocks in the eastern tropical Pacific (ETP), 2) a field study to detect whether dolphin cow-calf separation occurs during chase or release, 3) a stock assessment study, and 4) a study to record movement patterns and estimate tag loss for potential mark-recapture efforts. Two proposals previously presented in Document MOP-36-06 are not included, as they are currently being re-evaluated: a life-history sampling program (Proposal 3 in Document MOP-36-06) and a proof-of-concept drone survey study (Proposal 5 in Document MOP-36-06).

The funding required for each of the four studies is shown in Table 1. The ship-based abundance survey will require additional funding, as the amount currently available (US$ 1.75 million) is insufficient to cover the survey's costs. The cost of administrative support, in terms of time of existing staff, is not included. Projects that are funded will be integrated into the staff's research program.

TABLE 1. Cost of proposed research projects, in US$		
1.	a. Full at-sea abundance survey (includes trial survey)	5,681,670 – 17,538,580
	b. Trial survey only	1,401,480 - 4,332,820
2.	Cow-calf separation	340,000[a]
3.	Stock assessment	238,000
4.	Movement and tag loss	430,000[a]

[a] Assumes that vessel time will be provided at no charge. See specific proposals for details.

1. SHIP-BASED DOLPHIN ABUNDANCE SURVEY

1.1. Background

As a result of the suspension of the US National Marine Fisheries Service's (NMFS) dolphin surveys in the ETP since 2006, there are currently no reliable indicators with which to monitor the abundance of the ETP dolphin populations. This lack of information poses obvious problems for management. For example, the IATTC's Antigua Convention 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 dolphin mortalities are both sustainable and insignificant, because the AIDCP's Stock Mortality Limits for the purse-seine fishery are based on estimates of abundance.

In October 2016, the IATTC hosted a workshop to evaluate options for monitoring dolphin stock status, using both conventional and novel methodologies. The conclusion of the workshop was that, while novel methodologies such as drone-based surveys and genetic mark-recapture methods should be explored in the future, ship-based surveys are currently the only method that will produce reliable estimates of dolphin abundance.

Following this workshop, funding was provided to design a new ship-based line-transect survey for ETP dolphin stocks. The design was presented at the meeting of the IATTC Scientific Advisory Committee in May 2018 (SAC-09), and is described in detail in Document MOP-37-02. Recent research suggests that previous estimates of abundance may be biased; the new design includes the use of drones to evaluate whether this bias exists, and is thus more extensive than previous ship-based surveys.

1.2. Statement of the problem

Ship-based surveys will produce the most reliable estimates of dolphin abundance, but they are costly. An in-kind offer of a research vessel and a tuna vessel has been made by the Pacific Alliance for Sustainable Tuna, which would substantially reduce the cost. As can be seen in Tables 10-13 of MOP-37-02, the AIDCP surplus represents between 10% and 31% of the total survey cost, depending on whether in-kind vessels can be obtained and which dolphin stocks are surveyed (see MOP-37-02 for details and caveats). An alternative to applying the AIDCP funds to the total survey cost might be to fund only the cost of the trial survey (see Table 1), with the balance of the total survey cost to be obtained from other sources.

1.3. Objectives

The survey has three main objectives:

1. Evaluate whether all dolphin herds on the vessel's trackline are detected, to determine whether previous survey methodology may have led to biased estimates of abundance, and if necessary, estimate this bias.
2. Produce estimates of relative abundance that can be compared to previous estimates, so that population trends can be updated.
3. Produce estimates of absolute abundance for evaluating stock status, updating stock mortality limits, and use in population dynamics modelling.

1.4. Methods

See MOP-37-02 for a detailed description of the methodology. The survey will include two components: a trial survey and a main survey. The purpose of the trial survey is test the equipment and methods that will be used to evaluate the percentage of dolphin herds on the trackline that may be missed and, if necessary, estimate correction factors. It will also serve as a test of all survey procedures on research vessels that may not have been used in previous surveys. And, if a tuna vessel is to be used in the main survey, the trial survey will also serve to evaluate whether biases for tuna vessels are similar to those for research vessels, and to estimate calibration factors, if necessary. The timing and duration of the main survey will be the same as previous surveys, to make the new and old estimates as comparable as possible. For this same reason, most options for the new survey use two vessels.

1.5. Workplan and budget

Detailed timelines and budgets are presented in MOP-37-02, Assuming funding for the survey is secured by the end of August 2018, work on preparation for the trial survey would begin in September 2018. The trial survey, which would last 14 or 30 days, depending on whether a tuna vessel was to be used during the main survey, would take place from late July through September 2019. The main survey, which would last about four months, would take place from late July to early December 2020. The final report would be available in April 2021.

1.6. Deliverables

The survey is expected to deliver the following:

1. A field-based evaluation of the probability that all dolphin herds on the trackline are detected, and if detection on the trackline is not certain, estimates of correction factors.
2. Estimates of absolute and relative abundance for the priority dolphin stocks for 2020.
3. Updated trend estimates for the priority dolphin stocks.

1.7. Challenges expected

This survey will be the first to explore the use of drones for estimating trackline detection probability. This technology has not yet been thoroughly tested, and if the trial survey determines that it will not work, drones will not be used for the main survey, the use of a tuna vessel may be inadvisable, and only estimates of relative abundance, not absolute abundance, may be produced.

1.8. Management benefit

The survey will provide multiple management benefits. Assuming the drone technology proves viable, estimates of both absolute and relative abundance will be obtained, allowing population trends to be updated, stock status to be determined, and stock mortality limits to be revised. In addition, the results will be used to improve dolphin population dynamics models, which can also be used to determine stock status and, if sufficiently accurate, may be used to interpolate estimates of abundance between surveys, thereby potentially reducing future monitoring costs without substantially compromising the quality of advice to management.

2. COW-CALF SEPARATION DURING PURSE-SEINE SETS

2.1. Background

The question of whether dolphin calves separate from their mothers during the chase phase of purse-seine sets has been the subject of debate. One study estimated that an additional 14% mortality may be occurring due to unobserved mortality of calves resulting from such separation, and a related analysis

argued that 2-5 unobserved mortalities per set would be expected, while others consider that, in mammals, the reluctance of mothers to leave their young makes such separation unlikely. However, few field observations are available to support or refute the hypothesis that cow-calf separation occurs.

2.2. Statement of the problem

Separation of calves from their mothers is difficult for onboard observers to monitor, and observers do not collect specific data on cow-calf pairings. Any mortality that might result from such separation would not be included in the current estimates of total dolphin mortality. If cow-calf separation is occurring, and if it results in calf mortality, total dolphin mortality associated with the purse-seine fleet would be underestimated.

2.3. Objectives

The objectives of this project are to:

1. determine whether dolphin cows and calves separate during the chase phase of a purse-seine set and/or during the backdown procedure; and
2. obtain a preliminary estimate of mortality associated with such separation, if it occurs.

2.4. Methods

This study will be conducted during regular fishing operations aboard a tuna purse-seine vessel that carries a helicopter, has a Dolphin Mortality Limit (DML), and can accommodate two scientists in addition to the observer. During the chase phase of the set, the helicopter, with a fixed video camera underneath and a scientist aboard, will track the dolphin herd from behind, to observe the behavior of cows and calves and detect dolphins leaving the herd. GPS units on the helicopter and the vessel will track the paths of the dolphins and the vessel. The data recorded will be used to determine the distance that dolphins are chased, their speed, and their behavior in relation to the vessel's operations, and estimate the probability of cow-calf separation. A hexacopter (a type of small drone) with a video camera, remotely operated from the vessel, will be used to determine whether cow-calf separation occurs during backdown. No effects on catches or fishing operations are anticipated. Based on estimates of the probability of separation, and assumptions about cow-calf regrouping, estimates of unobserved calf mortality will be computed.

2.5. Work plan and budget

This research will be planned for late 2019-late 2020, depending on the availability of a purse-seine vessel and the procurement of any relevant permits. The budget assumes that there is no cost to the project for collaboration by the purse-seine vessel, which could fish normally.

Item	Detail	Cost (US$)	
		Annual	Total
Personnel and travel	1 graduate student for 2 years; 1 research technician (6 months); 1 scientist for photoanalysis; travel; sea pay	41,000	255,000
Equipment	High-resolution cameras, hexacopters, laptop computers, GPS units	85,000	85,000
Total (excluding staff time)			**340,000**
Staff time (over two years)	Logistical preparation for the cruise; field time, field office support, data analysis; report writing	0.3 FTE[a]	0.7 FTE[a]

[a] Full-time equivalent

2.6. Deliverables

In 2021, project results will be presented to the IATTC Scientific Advisory Committee (SAC), and a project report will be submitted to the Meeting of the Parties.

2.7. Challenges expected

Finding a purse-seine vessel willing to collaborate in the study is critical, but may be difficult. Customs regulations, acquiring research permits, and the vessel's unloading and fishing schedules may cause delays. As with any study at sea, research time may be lost due to weather and/or breakdowns.

2.8. Management benefit

Data collected during this project will allow questions about unobserved mortality due to cow-calf separation to be quantitatively evaluated. If a significant number of separations are observed, further analyses could estimate the population effects of potential mortality of calves. If, however, separations are not observed, or are rare events, mortality due to cow-calf separation is likely insignificant.

3. DOLPHIN STOCK ASSESSMENT

3.1. Background

Population dynamics modeling has been the preferred basis for management advice regarding dolphins in the eastern tropical Pacific Ocean (ETP). It has three clear benefits: 1) it can be used to evaluate whether the stocks have rebuilt from the depleted levels caused by the high historic mortalities, 2) it can be used to determine whether current mortality levels are sustainable, and 3) it can be used to define reference points or rebuilding targets. To reach these objectives, a population dynamics model is fitted to abundance estimates, conditioned on the historical mortalities, to reconstruct the population trajectory. However, the hiatus in the NMFS surveys since 2006 has greatly reduced the reliability of the estimates of dolphin stock abundance, because the data are now 12 years out of date. A new survey is proposed for the near future, and the resultant estimate of abundance will help to improve this situation.

However, abundance estimates are only one component of population dynamics modelling. Population dynamics models are based on many assumptions that are uncertain, and thus stock status may still be uncertain, even if accurate estimates of absolute abundance are available. Therefore, it is important to attempt to use all the available data to improve the model. There have been disagreements about whether dolphin populations are recovering at the expected rates, and if not, why not, but no comprehensive analysis has been undertaken to date to resolve the issue.

3.2. Statement of the problem

The current quantitative formulation of dolphin stock assessment models cannot make use of all available data, and as a result, may not represent the best available science. Therefore, an improved model needs to be developed. Information on dolphins that is currently not used in the model includes data on sightings by observers on tuna vessels, age and color phase of mortalities, and pregnancy rates. Including all available information in the stock assessment will involve changing from a simple surplus production model to one that has more structure (*e.g*. age and life stage structure). The model can then be used to evaluate stock status, rebuilding rates, and stock mortality limits, and test hypotheses about the recovery of the stock. Other analyses that could also improve the assessment (*e.g.* including those identified at the 2018 CAPAM spatiotemporal modeling workshop) will also be considered.

3.3. Objectives

The objectives of the study include:

1. Develop a new population dynamics model for ETP dolphins;
2. Apply the model to the spotted and spinner dolphin populations;
3. Evaluate the assumptions of the model;
4. Estimate the current status, rebuilding rate, and stock mortality limits;
5. Evaluate alternative hypotheses about factors influencing the rebuilding rate;

6. Evaluate the data needed to provide adequate management advice and to differentiate among the hypotheses.

3.4. Methods

The population dynamics model would be developed in the integrated analysis framework typically used for fisheries stock assessment models, which is also used for many mammal populations and was recommended in the independent review of ETP dolphin stock assessment. This approach is flexible, allows the inclusion of alternative data sets, and fully accounts for uncertainties. The integrated analysis previously applied to the population of northeastern spotted dolphins in the ETP would be used to guide initial model development, and all previous ETP population modelling studies and available data will be reviewed to help guide the model development.

3.5. Work plan and budget

The research will be carried out from June 2019 to May 2021. If the new dolphin survey (Project 1) moves ahead, and this project were funded, the timeline would be moved to June 2020 to May 2022.

Item	Detail	Cost (US$)	
		Annual	Total
Full-time researcher		104,000	208,000
Travel		5,000	10,000
Computer equipment		-	5,000
Recruitment and other administrative expenses	Advertisements, interviews, relocation	-	15,000
Total (excluding staff time)		**109,000**	**238,000**
Staff time	Guidance on data, analyses; report writing	0.2 FTE	0.4 FTE

3.6. Deliverables

The project will produce computer code for a population dynamics model that can be used in future assessments. Progress will be reported at the meeting of the IATTC Scientific Advisory Committee (SAC) in 2020 (2021), with a presentation of final project results at the SAC meeting in 2012 (2022). A report summarizing the research will be submitted to the Meeting of the Parties in 2021 (2022).

3.7. Challenges expected

It may be difficult to find a qualified researcher to carry out the work, and this may delay the project. Also, the new abundance estimates may not be available by the completion date of this project, in which case the assessment will be presented without the new data, and will be updated when the new abundance estimate becomes available.

3.8. Management benefit

This project will generate improved estimates of stock mortality limits that are used for managing the yellowfin tuna fishery associated with dolphins. It will also provide a better understanding of the status of the dolphin stocks.

4. DOLPHIN SWIMMING SPEED, DIVING, MOVEMENTS, AND TAG LOSS

4.1. Background

Mark-recapture methods can be used to estimate abundance, and the potential for a large-scale tagging effort for mark-recapture analysis was discussed in October 2016 at the IATTC Workshop on Methods for

Monitoring the Status of ETP Dolphin Populations, where a preliminary one-year study to assess the practicality of large-scale tagging and to estimate the rate of tag loss was recommended. It was suggested that dolphins could be outfitted with satellite-linked tags during one or two purse-seine trips, and these tags could then be monitored for premature tag loss.

Large-scale tagging of ETP dolphin species was attempted previously by the US National Marine Fisheries Service (NMFS) in the 1970s, but these early mark-recapture efforts were hindered by small tag numbers that could not be read at a distance, high tag losses, and low return rates. More recently, small-scale tagging and tracking experiments have been successfully conducted in studies of the tuna-dolphin association, dolphin movements, diving patterns, social associations, stress, and abundance. Some tags were sighted after a year, others were likely lost within a short time. Since then, however, tags have been redesigned and have greater longevity in the pelagic environment.

4.2. Statement of the problem

The first step towards any tagging program in the ETP for estimation of abundance is to demonstrate, the practicality of a large-scale tagging study within the ETP. Such a proof-of-concept project has yet to be undertaken with state-of-the-art tagging technology and funding for such a project has not been available to date.

4.3. Objectives

Trials will be conducted to:

1. evaluate new tagging protocols for future tagging studies;
2. estimate tag losses to assess the feasibility of mark-recapture abundance studies;
3. obtain data on dolphin diving behavior that can be used to help estimate the probability that a dolphin herd would be missed during aerial surveys (*e.g.*, drone surveys); and
4. obtain more movement data that can be incorporated into new methods for estimating abundance.

4.4. Methods

This study will be conducted during two trips aboard a tuna purse-seine vessel that carries a helicopter, has a DML, and can accommodate two scientists in addition to the observer. The tagging will be conducted during normal fishing operations. The backdown may be delayed by up to 30 minutes to allow tags to be attached to the dolphins, and use of vessel's rafts and assistance by the crew may be required to capture and tag the dolphins.

The target is to capture 40 spotted or spinner dolphins and attach satellite tags that transmit location and dive depth data to allow estimation of tag loss rates. Radio tags and time-depth-velocity recorders (TVDRs) will also be attached to 10 spotted or spinner dolphins, which will then be tracked from the vessel for 2-4 days, and then recaptured to recover the data on swimming and diving behavior, and replace the radio tags with satellite tags.

Dolphin movements and diving behavior will be monitored until the satellite tags no longer function. Premature loss of satellite signal can be inferred as tag loss, and the rate at which these tags are lost can help evaluate the potential usefulness of tagging for mark-recapture population estimates. With an estimate of tag loss rate, the sample size required for such estimates can be calculated, and the feasibility of large-scale tagging can be assessed. The data on dive durations would allow us to calculate how often are the dolphins at the surface and thus calculate the probability that a dolphin herd would be missed during an aerial survey by drones (see Proposal 6).

4.5. Work plan and budget

This research will be planned for late 2019-late 2021, depending on the availability of a purse-seine vessel, and the procurement of any relevant permits. The budget assumes that there is no cost to the project for collaboration by the purse-seine vessel, which could fish normally.

Item	Detail	Cost (US$)	
		Annual	Total
Contracted personnel and travel expenses	1 graduate student for 2 years; 1 scientist (1 year); 1 research technician (6 months); sea pay; travel	103,000	209,000
Satellite tags	40 satellite tags, 10 radio tags, 10 TVDRs	162,000	162,000
ARGOS satellite time	US$ 150/dolphin/month		36,000
Tracking receivers and gear		23,000	23,000
Total (excluding staff time)		**288,000**	**430,000**
Staff time (over 2 years)	Logistical preparation for the cruise; data analysis; field office support; report writing.	0.3 FTE	0.5 FTE

4.6. Deliverables

In 2022, project results will be presented at the IATTC Scientific Advisory Committee Meeting, and a project report will be submitted to the Meeting of the Parties.

4.7. Challenges expected

Finding a purse-seine willing to collaborate in the study is critical, but may be difficult. Customs regulations, acquiring research permits, and the vessel's unloading and fishing schedules may cause delays. As with any study at sea, research time may be lost due to weather and/or breakdowns.

4.8. Management benefit

The Workshop on Methods for Monitoring the Status of Eastern Tropical Pacific ETP Ocean Dolphin Populations recommended that a tagging study could provide useful information that could lead to development of an alternative method for monitoring dolphin population status if shipboard surveys could not be done. This proof-of-concept study can aid in the development of new large-scale tagging protocols for estimating abundance.