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Proposal for conducting a scientific survey by Chinese fishery research vessel "Song Hang" in the WCPFC area

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Summary

According to WCPFC Convention principles "on the need to collect and share data, including information from national research programs"(Article 5) and "The function of promoting the conduct of relevant scientific research and disseminating the results thereof is one of the functions of the Commission" (Article 10), China as a member country is planning to conduct a five-year scientific survey program using its fishery research vessel "Song Hang" with longline as main gear in the WCPFC convention area. The survey will collect fundamental data and conduct experiments to improve the commission's scientific research and support better management advice. The first survey would cover an area in the high sea from 127°E to 139°E and 9° N to 15°N between late August and October in 2021 (time may slightly change). A total of about 70 stations would include in this first survey with the following main activities: 1) Collecting fishery-independent data including catch and effort and biological data for common species caught by longline; 2) Sampling tissue for the study of the stock structure of target and bycatch species; 3)Assessing the influence of different types of longline hooks and baits on catch rate and survival rate of bycatch species; 4) Investigating the mechanisms of moving and aggregating of main species by incorporating environmental factors, and 5) Conducting tagging and releasing experiments for sharks and other bycatch species when incidentally caught. It suggests that the Scientific Committee can provide suggestions to refine the survey plan and endorse this proposal.

PART A. ADMINISTRATIVE SUMMARY

- Project Title:

China's scientific survey for fishery resources in the WCPO from 2021 to 2025

- Organization:

Shanghai Ocean University, Shanghai, China

- Administrative Contact:

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- Principal Investigator:

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- Commencement and Completion Date:

This is a five-year scientific survey program from 2021 to 2025. The first cruise intends to take place from late Aug 2021 to late Oct 2021.

- Project Budget:

Fully funded by The Ministry of Agriculture and Rural Affairs (MARA) of China and supported by Shanghai Ocean University

PART B: PROJECT DESCRIPTION

1 Background

According to WCPFC Convention principles "on the need to collect and share data, including information from national research programs"(Article 5) and "The function of promoting the conduct of relevant scientific research and disseminating the results thereof is one of the functions of the Commission" (Article 10), China as a member country of WCPFC is planning to conduct a five-year scientific survey program using its fishery research vessel "Song Hang" with longline as main gear in the WCPFC convention area. This series of research survey is supported by the Ministry of Agriculture and Rural Affairs (MARA) of China and conducted by Shanghai Ocean University, focusing on the tuna and bycatch resource in the WCPFC convention area.

Through this project, we look forward to providing essential information to supplement the current scientific database of the commission. We also hope that the survey will be a joint project with participants from SPC and other member scientists in the future. The duration of this project could be more than five years relying on the funding.

2 Objectives

The main objective of this project is based on various CMMs and recommendations raised by SC, including support and encouragement for CCMs to undertake scientific research to understand fisheries and species covered by the Convention (see Appendix 5).

The survey will be conducted to collect fundamental data and conduct experiments to improve the commission's scientific research and support better management advice. Five tasks would be included in the first voyage in 2021, which is as below:

a) Collecting fishery-independent data, including catch and effort, length-frequency, length-weight data (to estimate various conversion factors), biological sampling (larvae survey, growth, stomach content, etc.).
b) Investigating stock structure (tissue bank) and spatial distribution of longline target and bycatch species.
c) Investigating the influence of different types of longline hooks and baits on fishing selectivity, catchability, and survival rate onboard.
d) Collecting environment data for ecosystem model, including temperature, salinity,

transparency, dissolved oxygen, pH, nitrogen, et al.

e) Tagging and releasing experiments for sharks, marine mammals, and turtles if possible. The project would also be used to monitor bycatch migration and releasing mortality.

3 Project Outputs and Form of Results

a) We will submit a series of working papers and survey reports to the SC for review.

b) We will submit observer reports of the survey to the WCPFC database. We will have two independent observers trained by Shanghai Ocean University and authorized by China Overseas Fisheries Association on board.

c) We are glad to share biological samples to the "WCPFC's Tuna Tissue Bank", including otoliths, muscle, gonads, stomach contents, other genetic material.

d) We are willing to share the environmental data with modelers who work on the regional ecosystem models.

4 Methods including sampling designs

Given the capacity and schedule of the “Song hang” research vessel, we plan to survey from late Aug to late Oct in 2021. This survey would cover an area from 127°E to 139°E and 9°N -15°N on the high sea. This survey includes 70 stations, but half of them are only for the environment survey without fishing behavior. For more details about spatial distribution, please refer to Figure 1.

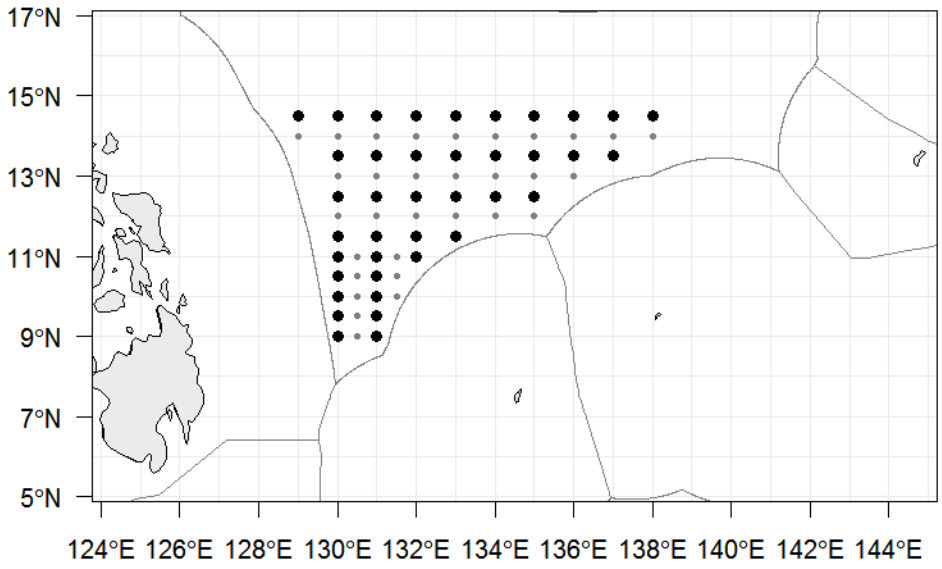

Figure 1 Spatial distribution for the scientific survey in WCPO. Black dots are both longline stations and environment stations, and grey dots are only environment stations.

4.1 Collection of fishery-independent data

Given this project is not a one-time survey but the start of a project that lasted more than five years, we plan to survey in the same season and area with the standardized fishing method. One of the most important purposes of our project is to reduce data uncertainty and address data gap issues in the current stock assessment. We understand the first survey only takes place in a very localized area (shaded in green figure 2) and may have limited contributions on reducing the uncertainty of assessment in the short term. Therefore, we are intended to extend the survey coverage in the future, and even some EEZ, with other CCMs' cooperation.

Upon SPC's suggestion, we mentioned that this survey span two periods within current tuna assessments (mostly Quarter 3 and slightly Quarter 4 in this survey). Thus, we want to adjust our future survey periods, especially the fishing period, to only be in the same quarter.

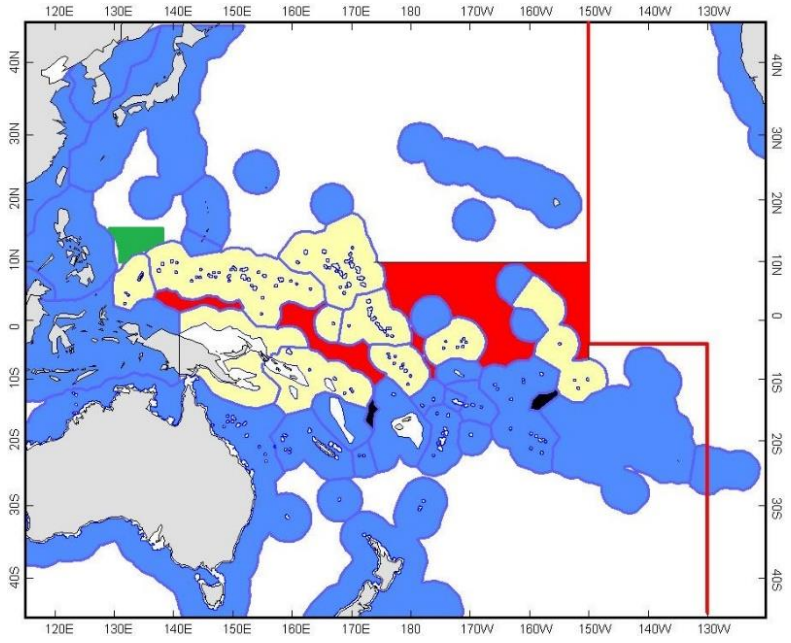

Figure 2 Map of WCPFC convention area

4.2 Investigating Stock structure and spatial distribution

The target species for tuna longline fishery is mostly bigeye tuna which can migrate throughout the whole Pacific. Understanding the stock structure and stock mixing collection of genetic/biological samples from larvae and older juveniles, and adult fish could be beneficial. This project will include the larvae survey, stomach content

analysis, and biological sampling. We have drafted the protocols in Appendix 1 and 2. In addition, we will consult with SPC and other CCMs who have interests and experience in this project. For most conditions, project staff can conduct the experiment with the professional laboratory in the "Song hang" research vessel. According to some special experimental requirements, part of the essential materials would be brought to the university and preserved by formaldehyde or pentanediol.

4.3 Investigating the influence of different hooks and baits

Investigating the influence of different types of longline hooks and baits on fishing selectivity, catchability, and survival rate onboard. Circle hook, Japan tuna hook, and J hook will be considered in this project. For baits, we plan to compare squid, sardine, and saury. We mentioned that the temperature/depth/dissolve oxygen loggers are fitted at various points. These experimental longlines provide valuable information on how different gear settings relate to other ambient conditions and resulting catch rates and size and species compositions. Therefore, we used CTD to record the above information. In addition, we will compare the measurement of observers and fishermen as well. Although the conversion factor will be from the research vessel, we hired two fishermen who used to work on commercial vessels on board. This measurement will be used to compare to the record from two independent observers.

4.4 Environment survey

For the requirement of environment data for the ecosystem model, we will collect data on temperature, salinity, transparency, dissolved oxygen, pH, nitrogen, and etc. Conductivity Temperature Depth (CTD 9-11Plus, Sea-Bird) and its MOUNTED SBE43 probe will be used to collect 0-300m vertical hydrological data of the above information at each station. Water samples were collected in layers of 25m, 50m, 75m, 100m, 200m, and 300m, and 12 bottles *250ml/ bottle per station (Appendix 3 and 4)

4.5 Tagging project

We will conduct tagging and releasing programs for sharks, marine mammals, and turtles. These programs will be used to monitor migration, habits, and releasing mortality. Three types of tags will be included in this voyage, which is as below:

Table1 Tags were used in the WCPO survey

Name of tags	number
MiniPAT w/Attached, Dart, Domeier Medium, No Dacron	9
SPLASH10-336A	2
SPOT-395A	2

The operating instructions of the above tags were trained by Wildlife Computers Inc(Yong Huang yong.huang@enfo.us).

5 Risks of the project not achieving Project Objectives

Longline fishing was usually influenced by many reasons, including sea conditions, depredation by mammals and sharks, interference of dolphins. In addition, we used a designed station without the captain's subjective issue; therefore, the zero catch may occur more often.

6 Schedule of Research plan

Table 2 Schedule of Research plan for China's survey in WCPO

Milestones	**2021**	**2022**	**2023**	**2024**	**2025**
Report of collection of fishery-independent data		X		X	
Report of sampling of biological material			X		X
Extend survey coverage to eastern high sea		X	X	X	X
Accept observers from other ROP		X	X	X	X
EM system		X?	X	X	X

7 Other Related Projects

a) EM system

Considering this research vessel is currently on another voyage and unique ship structure, the possibility of trial EM systems needs to be further discussed. And we will try to install the EM system on the 2022 cruise

b) VMS and Vessel Registration

We have completed the process of WCPFC VMS activation associated with the China Overseas Fisheries Association. At the same time, we also completed the registration, and the record of the "Song hang" research vessel has been list on the WCPFC's website.

c) Observers

To ensure our processes are entirely under WCPFC regulations, we will send two independent observers trained by Shanghai Ocean University and authorized by China Overseas Fisheries Association on board. Given the language and logistical challenges, we will welcome the observer from other ROP Observer Providers in the future.

8 Project Staff

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Acknowledgments

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Appendix 1. Investigation of larvae and larvae

The investigation and analysis methods of fish plankton (fish eggs, larvae, and juveniles) are carried out by "Marine Survey Code part 6: Marine Life Survey" (GB/T12763.3-2007).

1. Technical requirements

a. The horizontal trawl depth is 0 ~ 3 meters;
b. The duration of the horizontal trawl is 10 ~ 15 minutes,
c. The shipping speed is 1 ~ 2 knots.

2. Sampling

2.1 Sampling requirements

a. large plankton net: net length 2.8 m, network port diameter 80 cm, sieve aperture approximation of 0.505mm
b. Network flowmeter: calibration once per voyage
c. Angular arc protractor
d. heavy hammer
e. Winch and wire rope
f. Trawling speed: capture is 0.5m/s; and the net lifting range is 0.5m/s to 0.8m/s

2.2 Sample handling

The sample was fixed with a neutral sodium solution, adding 5% of the sample volume. The examples that need to use electron microscope will be set with pentanediol and adding 2% ~ 5% of the sample volume.

2.3 Sample analysis

Each type of sample shall have a general tag. The tag should be composed of codes representing sampling area, sampling method, network type, sampling year, and sample serial number.

Appendix 2. Longline fishery survey

1 Technical requirement

The longline facility is made up of main rope (nylon braided rope), support rope (nylon monocycle), float rope (polyester rope), float (ABS injection and round foam float), hook (16/0 day tuna hook and round hook).

For main technical parameters:

a) the boat speed is 7-9 knots;

b) the rope throwing speed is 7-8m/s;

c) the number of floating balls is 70-100;

d) Hook per basket is 12-18;

e) The water layer of the hook is 100-300 m.

2 Method

For controlling the ship, we will keep a certain speed and cast the hook in the shape of "U," "W," and "C". After throwing, we will sail to the appropriate position, drift, and wait for 6 hours; The electric buoy is used to locate the fishing tackle. The mainline is retracted by the mainline winder on the starboard forward deck.

3 The sampling

We are determining fish species and recording fishing behavior associated with the guideline of WCPFC's observer.

4 Biological determination of fish

We will keep up with the standard of tuna tissue bank(TTB) (see Smith et al., 2016 Appendix IV)

Reference

Smith, N., Sanchez, C., Roupsard, F., Calliot, S., Allain, V., Brogan, D., Farley, J., Fukufoka, S., Hosken, M., Leroy, B., Nicol, S., Park, T., Peatman, T., and E. Vourey. 2016. Project 35: Bigeye biology, and Project 35b: WCPFC Tuna Tissue Bank. WCPFC-SC12-2016/RP-P35-01. Twelfth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Bali, Indonesia, 3-11 August 2016.

Appendix 3. Survey of hydrological environment elements

1 Investigation instruments

CTD911plus (with dissolved oxygen and chlorophyll sensor), sampling bottle.

2 Environmental investigation arrangement

CTD observation preparation (15-30 minutes before arrival at each site)

a) According to the actual depth, determine the winch deceleration time when CTD is observed several meters from the bottom of the sea;
b) Turn on the power supply of the intercom to ensure smooth communication between the laboratory, cab, and winch control room;
c) Prepare water pickers (a total of 24 water containers), and make sure that the outlet of each container is closed; Remove the sensor protection covers.
d) Open the SBE9plus control interface on the laboratory computer terminal.

The observation and the sampling water layer are generally set in 0-300 m water depth.

a) sea condition is good, try to ensure the speed less than 1m/s and recover CTD;
b) sea condition is poor, the speed of lowering and recovering can be accelerated appropriately.

According to different requirements, the water samples were brought back to the university, and a laboratory salinometer measured part of the salinity for correction of CTD salinity observed values. Some of the water samples were used to study nutrients, phytoplankton composition, and Marine microplastics.

Clean the inside and outside of the water bottle and CTD body with fresh water; The CTD observation was completed by carefully cleaning the sensor with distilled water.

Appendix 4. Plankton survey

The investigation and analysis methods of plankton (zooplankton and phytoplankton) are carried out under the "Marine Survey Code," Part 6: Marine Life Survey (GB/T12763.3-2007).

1. Technical requirements

a) Vertical trawl depth: trawl depth is 200 meters;
b) During the vertical trawling field investigation, the vertical trawling (especially in the process of lifting the net) shall not stop;
c) The inclination of the wire rope shall be less than 45°.

2. Sampling

2.1 Sampling requirements

a) large plankton net: length 2.8 m, port diameter 80 cm, sieve aperture approximation of 0.505mm
b) Network flowmeter: calibration once per voyage.
c) Angular arc protractor
d) heavy hammer
e) Winch and wire rope
f) Trawling speed: capture is 0.5m/s; The net lifting range is 0.5m/s to 0.8m/s.

2.2 Sample handling

The sample was fixed with a neutral sodium solution, adding 5% of the sample volume. The samples that need to be observed by electron microscope were fixed with pentanediol, adding 2% ~ 5% of the sample volume.

2.3 Sample analysis

a) Sample number: all types of samples shall have a specific tag. The tag should be composed of codes representing sampling area, sampling method, network type, sampling year, and sample serial number.
b) Determination of zooplankton biomass: remove the impurities in the sample, calibrate volume meter volume 50 cubic centimeters, pour into the sample of the suction filter within the volume meter sample. After the moisture in the filter, we

screw on the bottom cover, reoccupy burette filled with 50 cm^3 water from tester and hole of the seawater until liquid level and the needle tip in contact. At this point, the amount of water left in the burette represents the volume of zooplankton, and the volume fraction of zooplankton is converted.

c) The mesh should be slightly smaller than the sampling mesh sieve silk, cut into a round block with the same inner diameter as the funnel, soaked with water, drained and weighed, and made the marking of the quality, which can be used many times. When measuring, the calibrating mass sieve silk is spread in the funnel. The sample is emptied and filtered for a moment. The sieve silk with the sample is removed to the absorbent paper to absorb the excess water on the sieve silk bottom table. Finally, the electronic balance is used for weighing. The wet weight of the sample was obtained by subtracting the sieve mass from the total mass, which was converted into the wet weight biomass of zooplankton (mg/m3). After weighing, the samples are poured back to the original sample bottle for species identification and individual counting.

d) Species identification and individual counting of zooplankton The samples were put into the plankton counting frame and identified and counted under a stereomicroscope. If the number of samples is large, the zooplankton samples with significant individuals such as large crustaceans and arrow worms can be counted firstly. Furthermore, the rest samples can be sampled with plankton sampling tubes (1/10 or 1/20) for identification and counting, and the number of zooplankton individuals (IND /m3) can be converted. The sample of nocticoluminescent algae can be sampled directly by plankton sampling tube (1/10 or 1/20) and counted to convert the number of nocticoluminescent algae (IND /m3).

Appendix 5. Related CMMs and recommendations raised by SC

Conservation And Management Measure For Sharks	**CMM 2019-04 para 24**	CCMs shall as appropriate, support research and development of strategies for the avoidance of unwanted shark captures (e.g. chemical, magnetic and other shark deterrents), safe release guidelines, biology and ecology of sharks, identification of nursery grounds, gear selectivity, assessment methods and other priorities listed under the WCPFC Shark Research Plan.
SC16 Summary report	**Review of 2020 bigeye tuna stock assessment Para 12**	A number of key research needs were identified in undertaking the assessment that should be investigated either internally or through directed research. a) Further biological samples should also be collected to produce more representative samples of reproductive parameters and length-weight and weight-weight conversion factors. b) This work should focus on incorporating the effects of changes in oceanography on catchability, particularly the effects of sub-surface dissolved oxygen. Efforts should also be made to account for changes in catchability over time beyond hooks-between-floats c) There should also be an evaluation of the feasibility of conducting a fishery independent survey across the WCPO to be used as an index of abundance within the stock assessments, and to improve the representativeness of biological samples.
	Review of 2020 yellowfin tuna stock assessment Para 37	Items that require directed research and additional funding for implementation: a) Evaluation of the feasibility of conducting a fishery independent survey across the WCPO to be used as an index of abundance within the stock assessments and to improve the representativeness of biological samples across the WCPO; b) Further collection of otolith samples for use in investigations of regional differences in growth with increased focus on increasing the spatial coverage of sampling for all lengths and collecting fish less than 30 cm and greater than 120 cm in all regions; c) Validation of otolith aging techniques through bomb radiocarbon and strontium chloride tagging to clarify causes of discrepancy between growth curves from otoliths, tagging increments, and size composition modal progression; d) Additional tag seeding experiments required for the estimation of reporting rates necessary to provide better estimates of natural mortality from tagging data; e) Collection of biological information to inform the

		components in the reproductive potential ogive such as fecundity, proportion female at length, maturity at length, and spawning fraction in a spatially structured context; f) Collection of biological samples for the estimation of conversion factors from length to weight, gilled-gutted to whole-weight, and gilled-gutted-trunked to whole weight to be used for the weight composition data.
Mobulid Rays **Effective 1 Jan 2021**	**CMM 2019-05 para 10**	CCMs are encouraged to investigate at-vessel and post-release mortality in mobulids including, but not exclusively, the application of satellite tagging programs to investigate the effectiveness of this measure and more effective methods of live release.
Sharks Applicability:- CMM 2019-04 became effective for all CCMs except Indonesia on 1 Nov 2020.	**CMM 2019-04 para 20 (4)**	CMM 2019-04 20 (4). Observers shall be allowed to collect biological samples from oceanic whitetip sharks and silky shark caught in the Convention Area that are dead on haulback in the WCPO, provided that the samples are part of a research project of that CCM of the SC. In the case that sampling is conducted as a CCM project, that CCM shall report it in Part 2 of its annual report.
Sea Turtle mitigation measures and related reports	**CMM 18-04 para 8(b)**	CCMs with longline fisheries other than shallow-set fisheries are urged to: a) Undertake research trials of circle hooks and other mitigation methods in those longline fisheries; and b) b. Report the results of these trials to the SC and TCC, at least 60 days in advance of the annual meetings of these subsidiary bodies.