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Project proposals related to purse seine FAD use within the WCPO, as requested by the WCPFC FAD Intersessional Working Group

WCPFC-SC13-2017/EB-WP-05

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Executive Summary

At WCPFC13 the Commission adopted the Report of the second meeting of the FAD-IWG (WCPFC13-2016-FADMgmtOptions-IWG02_rev2) and agreed that the outcomes therein should be further considered at SC13 and TCC13. The draft FAD-IWG02 Research Plan proposal was included as Attachment D to FAD-IWG02 report. In addition, the FAD-IWG Chair undertook to work with SPC, and the WCPFC Secretariat to further develop a costed project proposal for each of four identified research topics under three of the FAD IWG research areas, to SC13. The four research topics were entitled by the IWG as:

- FAD designs to reduce unwanted interactions with Species of Special Interest (SSIs; sharks, turtles);
- FAD designs to reduce unwanted catches of juvenile bigeye and yellowfin tuna;
- Acoustic FAD analyses;
- Fleet behaviour.

This paper provides a draft project proposal for each research topic, for discussion by SC13. Where feasible, indicative costs are included, noting that those involving sea trials and associated activities will require more detailed costings if the projects are taken forward. We note that at-sea trials are expensive, and require the collaboration and support of industry to be effective. Collaborative funding between WCPFC/CCMs, NGOs and in-kind support by industry should be considered.

We invite WCPFC-SC13 to:

- Discuss the four research proposals provided within this paper, in light of other papers provided to SC13 (in particular EB-WP-02);
- Consider convening a small working group during SC13 for more detailed discussions on each proposal;
- Consider prioritisation of any or all of these projects within the SC work plan;
- Consider and provide recommendations on the next steps for the draft FAD-IWG Research Plan (WCPFC13-2016-FADMgmtOptions-IWG02_rev2, Attachment D).

Introduction

The first FAD IWG (WCPFC, 2015) outlined a draft research plan to increase understanding of purse seine FAD use within the WCPO, the evolution of that use over time, and the potential impacts on target and non-target species. This draft research plan contained five broad research areas that included:

- FAD design;
- Tuna behaviour;
- Hotspot analyses;
- Acoustic FADs; and
- Fleet behaviour.

The research plan was further refined at the second IWG meeting in 2016 (WCPFC, 2016). Four research topics under three of the FAD IWG research areas were identified.

At WCPFC13 the Commission adopted the Report of the second meeting of the FAD-IWG (WCPFC13-2016-FADMgmtOptions-IWG02_rev2) and agreed that the outcomes therein should be further considered at SC13 and TCC13. The draft FAD-IWG02 Research Plan proposal was included as Attachment D to FAD-IWG02 report. In addition, the FAD-IWG Chair undertook to work with SPC, and the WCPFC Secretariat to further develop a costed project proposal for each topic. Those draft project proposals are provided below for discussion by SC13. Where feasible, indicative costs are included, noting that those involving sea trials and associated activities will require more detailed costings if the projects are taken forward. At-sea trials are expensive, and require the collaboration and support of industry to be effective. Collaborative funding between WCPFC/CCMs, NGOs and in-kind support by industry should be considered. Finalising the cost of at-sea trials to WCPFC will depend on the level of support by industry (e.g. the contribution of satellite buoys and tracking) and WCPFC inputs required to run the trials (e.g. scientific support, supply of additional materials, construction, etc.).

The FAD IWG, as part of the discussion on the 'FAD design' research area, also tasked SPC with the development of a review paper for SC13 on the "design of non-entangling FADs/BET or YFT interaction reduction (where practicable draw off existing research in this and other regions)". Working paper SC13-EB-WP-02 summarises the available information, and has direct relevance for discussions under the first two project proposals listed here. We recommend that SC13 review that paper prior to any small working group discussions on these project proposals.

We also note that results from the bigeye hotspot analyses are presented to SC13 in MI-WP-07, and that paper contains elements of relevance to the second and fourth project proposals provided here.

Recommendations

We invite WCPFC-SC13 to:

- Discuss the four research proposals provided within this paper, in light of other papers provided to SC13 (in particular EB-WP-02);
- Consider convening a small working group during SC13 for more detailed discussions on each proposal;
- Consider prioritisation of any or all of these projects within the SC work plan;

- Consider and provide recommendations on the next steps for the draft FAD-IWG Research Plan (WCPFC13-2016-FADMgmtOptions-IWG02_rev2, Attachment D).

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References

Peatman, T., and Allain, V. 2017. Summary of purse seine fishery bycatch at a regional scale, 2003-2016. WCPFC-2017-SC13/ST-WP-07.

WCPFC (2015). 1st meeting of the FAD Management Options intersessional working group. Summary report. WCPFC12-2015-22_rev3.

WCPFC (2016). 2nd meeting of the FAD Management Options intersessional working group. WCPFC-2016-FADMgmtOptionsIWG02_rev2.

FAD Project #1	
Project	**FAD designs to reduce unwanted interactions with Species of Special Interest (SSIs; sharks, turtles)**
Objectives	Identify FAD design features that lead to lower interaction rates with key SSIs, while minimising the impact on catches of target tuna species.
Rationale	• Builds upon work in all other Oceans on the design of lower- and non-entangling FADs (e.g. WCPFC-2016-FADMgmtOptionsIWG02-OP02; SC13-EB-WP-02). • Builds upon work by organisations such as ISSF in the development of SSI-friendly designs. • Provides region-specific information on the efficacy of SSI reduction and impacts on tuna catch levels in the WCPO. • Provides a scientific basis for potential CMMs in this area. • Given concerns of FAD beaching on reefs and shorelines, could also contribute to studies of appropriate biodegradable FAD materials.
Assumptions	• The information provided in SC13-EB-WP-02 is considered by SC13 to provide insufficient evidence of the potential effectiveness of non-entangling designs in the WCPO, and hence local trials are needed. Note that if SC13-EB-WP-02 is considered by SC13 to provide sufficient evidence, this project should be revised to focus on extension, to ensure rapid uptake and deployment of non-entangling FAD designs, and to ensure the cost effectiveness of those designs for all WCPO fleets, in particular those domestic fleets of PICTs. • The relationship between design and SSI interactions can be gained through tracking FADs from construction, through deployment, to setting activity by any fleet, and SSI interactions. • If tracking is not possible, the regular removal of a set-upon FAD from the water can be undertaken so observations of its sub-surface structures and the occurrence of captured SSIs can be made. • Periodic removal of tracked designs may also be necessary to identify changes over time (e.g. unravelling of bound netting, degradation of components). • A coordinated trial of designs, in collaboration with industry, is suggested as the most efficient approach. Cost, material availability and environmental impact would be key factors in assessing the merit of various designs. • Sufficient data are available across different designs and locations to allow statistical analyses to be effective. • Where specific field trials are undertaken, they might be able to be performed at the same time as trials required under FAD project #2 to create cost efficiencies.
Scope	Through review of existing studies and best practices in other oceans (see SC13-EB-WP-02) identify plausible non-entangling FAD designs, in collaboration with industry. This should include sub-FAD structure depth and mesh size, removal of netting on the surface of FADs and alternative platform widths. Implement at-sea FAD trials across the WCPO [deployment and fishing activity] to be completed within 18 months. This will most effectively be

	performed in partnership with observers and industry to ensure marking, deployment and monitoring of FADs in a coordinated way. Two levels of industry participation are anticipated: (1) the fleets that deploy the FADs and are actively engaged in the research. (2) All other fleets that find the FADs from (1) and set upon them. Information from (2) will be critical to the success of the research. Using ISSF Technical Report 2016-18A as a guide: • Fleets deploy a given number of FADs per vessel (e.g. 10-20 FADs per vessel to reach a significant large number of FADs). • Maximum 4 standardized designs tested, constructed in port and deployed in the same area as traditional FADs, so their effectiveness could be compared with that of the traditional FADs for the same spatial and temporal strata. • Deployment site, design and the code of the geo-locating buoy should be registered. Every FAD should be well identified so that data can be retrieved and followed if ownership changes. • If a trial FAD is encountered at sea register: the catch (if any), interactions with SSI, the condition of the FAD and the new code for the buoy if the original has been replaced. • Where possible, use trajectories and sounder of attached buoys to assess ability of alternative designs to aggregate tuna even if they are not visited or fished by purse seiners, as well as following their lifetime if they are not retrieved. • Collaboration between industry, related parties, and the science services provider to collect and analyse data. • Collaborate with industry to identify the cost of alternative FAD designs relative to 'standard' designs. Analysis of results should be presented to WCPFC SC (approximately 2 years after the trial begins). SC and TCC of that year to provide recommendations for a draft CMM on appropriate FAD designs.
Links to other work	The IATTC and ISSF have done considerable work on the design of non-entangling FADs (see SC13-EB-WP-02).
Timeframe	24 months
Budget Note: Costed on a fieldwork required basis. If project is extension related (i.e. trials of designs not required on the basis of SC13-EB-WP-02 findings), project budget	1 year FTE at SPC (data analysis) 1.5 year FTE at SPC (technical and fieldwork, travel) Project management Observer training Approximate total budget: US$446,000* Note overlap with Project #2 – if both are undertaken concurrently then some personnel costs can be 'shared' across the two projects. (Approximate total budget if Projects 1 and 2 undertaken simultaneously: $871,000) *Final costings will depend on the approach undertaken within at-sea trials, including the level of practical and financial contribution by industry. Note this will need to include the purchase of necessary FAD materials, including marking and tracking components, facilitation of liaison with industry representatives, and any related travel.

will need to be revised	
Additional considerations	This project will necessitate additional data collection by fisheries observers, irrespective of whether it relates to additional trials, or, extension. This has consequence for forms, data management and observer training. If FADs are not able to be tracked from markings or similar, this research will require fishers to lift all FADs for descriptions to be made (there are other technical solutions such as camera ROVs and/or research divers however they are likely overly costly). Understanding the vertical behaviour of silky sharks at FADs within the WCPO would help inform how deep the FAD underwater structure should be checked. This project if it proceeds to extension/implementation will have direct costs for fishers with the lifting of existing FADs require to update them with non-tangling designs. Obviously the period of implementation will determine if this occurs faster or slower than the normal frequency of lifting, and hence the incurred cost.

FAD Project #2	
Project	**FAD designs to reduce unwanted catches of juvenile bigeye and yellowfin tuna**
Objectives	Identify any FAD design features that lead to lower catch rates of undersized/juvenile bigeye and yellowfin tuna, while minimising the impact on catches of larger target tuna species.
Rationale	• Builds upon trials underway in the IATTC area in collaboration with ISSF, but given oceanographic differences between regions WCPO trials may be required if designs in IATTC area focus on depths shallower than the WCPO thermocline depth. • Represents an area of work not yet pursued in the WCPO that could provide a simple management intervention to reduce FAD impacts. • Builds upon EU-funded work identifying factors influencing BET hotspots. • Provides a scientific basis for potential CMMs in this area. • Two key and related FAD design features may influence undersized/juvenile bigeye and yellowfin mortality: depth of the FAD, and its speed of drift.
Assumptions	• BET hotspot analyses provide some indication of potential FAD characteristics that can be examined within this project. • Can relate the design of FADs noted by observers and/or others directly to subsequent fishing sets that have reliable catch composition estimates. • A coordinated trial of designs, in collaboration with industry, is suggested as the most efficient approach. Cost and environmental impact would be key factors in assessing the merit of various designs. • Periodic removal of tracked designs may also be necessary to identify changes over time (e.g. change in the depth of the structure or unravelling of bound netting, degradation of components that might modify drift speed). • Sufficient data are available across different designs and locations to allow a statistical analysis to be performed. • Where field trials are required, they could possibly be performed at the same time as trials required under FAD project #1 to create cost efficiencies.
Scope	While Project #1 benefits from existing activities and research in other oceans, the background on FAD designs to reduce juvenile tuna catch is less mature. However, the proposed scope is comparable to that proposed for Project #1. Use relevant results from the BET hotspot analyses and from information available from ISSF studies in the IATTC area, and in collaboration with industry, identify plausible FAD designs to trial. Implement at-sea FAD trials across the WCPO [deployment and fishing activity] to be completed within 18 months. This will most effectively be performed in partnership with industry and observers to ensure marking, deployment and monitoring of FADs in a coordinated way. Two levels of industry participation are anticipated: (1) the fleets that deploy the FADs and are actively engaged in the research. (2) All other fleets that find the FADs from (1) and set upon them. Information from (2) will be critical to the success of the research. Understanding how the real working depth of sub-surface FAD structures interacts with oceanographic features during the period of the drift, and the resulting influence on species biomass and catch will be important. Equipping FAD sub-surface structures with depth/temperature sensors, which are tracked for the

	duration of a scientific trip and retrieved, regularly feed-back information, or pop off the FAD after a given period, should be used. Using ISSF Technical Report 2016-18A as a guide: • Fleets deploy a given number of FADs per vessel (e.g. 10-20 FADs per vessel to reach a significant large number of FADs). • Maximum 4 standardized designs tested, constructed in port and deployed in the same area as traditional FADs, so their effectiveness could be compared with that of traditional FADs for the same spatial and temporal strata. • Deployment site, design and code of the geo-locating buoy should be registered. Every FAD should be well identified so that data can be retrieved and followed id ownership changes. • If a trial FAD is encountered at sea, register: the catch (if any), the condition of the FAD and the new code for the buoy if the original has been replaced. • Where possible, use trajectories and sounder of attached buoys to assess ability of alternative designs to aggregate tuna even if they are not visited or fished by purse seiners, as well as following their lifetime if they are not retrieved. • Collaboration between industry, e.g. ISSF and the science services provider to collect and analyse data. • Collaborate with industry to identify the cost of alternative FAD designs relative to 'standard' designs. Analysis of results should be presented to WCPFC SC (approximately 2 years after the trial begins). SC and TCC of that year to provide recommendations for a draft CMM on appropriate FAD designs.
Links to other work	Note that due to the nature of the thermocline in the WCPO and the impact of the thermocline on tuna behaviour, in particular for bigeye tuna, results from the EPO may not be of specific use in the western or central WCPO.
Timeframe	24 months
Budget	1 year FTE at SPC (data analysis) 1.5 year FTE at SPC (technical and fieldwork) Associated travel and subsistence to relevant WCPFC meetings Project management Observer training Approximate total budget: US$526,000* Note overlap with Project #1 – if both are undertaken then some personnel costs can be 'shared' across the two projects. (Approximate total budget if Projects 1 and 2 undertaken simultaneously: $871,000) * Final costings will depend on the approach undertaken within at-sea trials, including the level of practical and financial contribution by industry. Note this will need to include the purchase of necessary FAD materials, including marking and tracking components, temperature/depth sensors, facilitation of liaison with industry representatives, and any related travel.
Additional considerations	This project will necessitate additional data collection by fisheries observers, irrespective of whether it relates to additional trials, or, extension. This has consequence for forms, data management and observer training.

	The field work component of this research may require additional data collection on catch composition for specific sets from a trip (with the catch kept separated and subject to a census in port). There may be the potential to geo-fence FADs used in these trials with special requirements around reporting and access to enhance the data collected.

FAD Project #3	
Project	**Acoustic FAD analyses**
Objectives	Identify whether limiting sets to only those FADs that have a large biomass beneath them can reduce the proportion of 'non-target' species caught.
Rationale	• Larger purse seine sets on FADs tend to have higher proportions of skipjack and commensurately lower proportions of yellowfin and bigeye (Lawson 2008, WCPFC-SC-4-ST-WP3). • Acoustic data from echo-sounder buoys can provide, given sufficient equipment, environmental conditions and interpretation skills, sufficient information on the biomass of tuna under a FAD. • Acoustic information has shown promise for discriminating skipjack from other species, if not yet routinely using commercial fishing equipment. However, there is a need to identify signals that discriminate other species within the WCPO, building on existing work by ISSF in this area. • Acoustic information has also suggested some ability to differentiate fish sizes. • The acquisition of acoustic FAD data has the potential to provide insight into dynamics of the interaction between tuna and FADs. • Information could inform FAD design options, FAD deployment, remote identification of size and abundance of tuna under echo-sounder-equipped FADs, and spatial management considerations. • Incentivising limiting setting activity to only FADs with large biomass could reduce the proportion of non-target species caught. • In addition, acoustic FAD data could provide 'ground truthing' for the effective soak time of FADs, stock assessment biomass estimates (see WCPFC-SC12-2016/SA-IP-14), FAD density effects on movement and catch rates of target spp.
Assumptions	• There is a consistent relationship between biomass levels on FADs andtuna species composition across the WCPO, as indicated in Lawson (2008), WCPFC-SC-4-ST-WP3. • Biomass can be accurately assessed through acoustic buoys, noting that it depends on the equipment used, environmental conditions and the interpretational skills of the user. • Existing acoustic information can be made available for analysis, combined with sufficient information to relate that information to a setting event. • Target strength information from other studies is sufficiently robust and comparable to that in the WCPO that it can be used directly. • The analysis can be undertaken over sufficient space/time to ensure any influences of those factors can be examined statistically.
Scope	The scope of work is divided into three stages. The ability to undertake the second stage will depend on access to existing data, in particular acoustic biomass estimates, and the ability to relate set-level events to FAD-specific acoustic data. *Stage 1. Examination of existing data to investigate the relationship between total biomass/catch and the proportion of small bigeye/yellowfin* Based upon existing combined logsheet/observer data from FAD sets, investigate the relationship between total biomass/catch size and the

	degree of small bigeye/yellowfin, both spatially and temporally within the WCPO. Based upon these analyses, identify the level of definition required by echo-sounder buoys to render this strategy effective. In addition, review available information on the vertical behaviour of individuals of different sizes relative to e.g. thermoclines, to examine whether a depth layer can be used to discriminate between species/sizes. *Stage 2. Examination of existing (historical) observer-based FAD set data and echo-sounder buoy data* Where data are available to link an observed FAD set event to acoustic information, compare the most appropriate set-level overall catch and corresponding species composition to available acoustic information. Where data allow, further compare to relevant operational factors (e.g. location, FAD and vessel information, regional FAD density, etc.) to identify potential relationships. *Stage 2. Undertake at-sea experimental fishing trials to identify effective acoustic equipment and operational approaches* In collaboration with industry, and building on outputs from Stages 1 and 2, design and implement a limited fishing trial of current and alternative cutting-edge acoustic gear/settings (e.g. multi-frequency) to obtain acoustic information on FAD-associated tuna biomass and species/size composition, and related fishing trials to 'ground-truth' that information based upon resulting catches. Gaining target strength measurements for single schools (in particular of yellowfin) will be particularly important. Trials should be sufficiently extensive to examine the influence of spatial and potentially oceanographic factors. Analyses of results from each stage should be presented to WCPFC SC for scientific review and where relevant for the consideration of advice to TCC and the Commission.
Timeframe	Approximately 36 months (see below)
Budget	Stage 1 1.5 year FTE at SPC USD$182,000 Associated travel and subsistence to relevant WCPFC meetings USD$10,000 Stage 2 Not costed at this time. It is likely to be on the scale of project one or two, but there may be some other cost savings to be made by incorporating some fieldwork into the 2018 or 2020 tag research voyages.
Additional considerations	If this proceeds to a fieldwork stage, additional input on the design of the at-sea component should include consideration of concurrent data collection in the context of tuna foraging and links to ecosystem modelling (e.g. SEAPODYM).

FAD Project #4	
Project	**Fleet behaviour**
Objectives	Characterisation of effort creep due to FAD use and fleet specific factors resulting in large catches of 'non-target' species.
Rationale	• Understanding how rapid developments in FAD technology and their use within the WCPO can influence FAD-related catch rates will provide additional information for key stock assessments and the harvest strategy approach, and scientific advice that can inform discussions under future tropical tuna CMMs. • Analyses will complement activities currently underway on PNA FAD tracking and those undertaken through the EU-funded 'BET hotspot' analysis presented to SC13.
Assumptions	• Sufficient data on FAD design and technology are available for analysis. • Sufficient time series of data are available to support analyses. • Information is sufficiently detailed and accurate to allow analyses to be performed. • Fishing sets can be related to specific FADs and associated FAD/vessel technological information. • Fleet behaviours that influence fishing performance can be understood. • The effort creep component of improved FAD technologies can be separated from other elements (schooling behaviour of fish, overall fleet behaviour, stock size, oceanography, other technological advances etc.).
Scope	The proposed work programme comprises a data compilation activity, subsequent statistical analysis activities and a data review activity. These are briefly outlined below: Evaluate and combine available logsheet, observer and VMS data to develop a comprehensive purse seine associated fishing data set. This data set should also include available (time series of) vessel and technical FAD characteristics, where possible. Analyse patterns of fleet activity relative to FAD setting based upon VMS/logsheet data, to assess changes in vessel searching activity, as well as trip length. This may also be compared within and outside the FAD closure period, and be related to location (e.g. distance from port), time of the year/day, the period of the trip, etc. Examine changes in the 'reliance' on FAD fishing over time, at the fleet or vessel level. Relate the reliance on FADs to geographic location. Analyse using appropriate statistical techniques factors that could influence time series or relative patterns in purse seine associated set CPUE (catch per set, but catch per day or trip may also be examined), including fleet, location, oceanography, FAD set density (as a proxy for FAD density), observed FAD design, vessel characteristics, stock abundance, etc. This may evaluate the probability of a successful set, as well as the level of catch if a set were successful.

	Identify data gaps and provide advice on potential areas of additional data collection to improve future analyses. Where observer information is sufficient, work will also examine the number and activities of supply vessels, including identifying which particular purse seine vessels each support, and the number of FADs being deployed and serviced by such vessels.
Timeframe	18 months
Budget	1.5 year FTE at SPC USD$182,000 Associated travel and subsistence to relevant WCPFC meetings USD$20,000