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Applying rapid risk assessment methods to bycatch in the WCPO

WCPFC-SC17-2021/SC17-EB-IP-10

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Considerations for SC17:

- Note that SPC in collaboration with the IATTC is evaluating the performance of EASI-Fish as a tool for assessing fishery impacts on data poor and bycatch species.
- Note the benefits of re-establishing a specific project for assessing the vulnerability of bycatch and species of special interest to fishing activities in the WCPFC jurisdiction. This would facilitate broader collaboration on the topic among WCPFC members and other organisations to routinely evaluate the impacts of fishing on bycatch.

Background

WCPFC is increasingly utilising or proposing the use of rapid risk assessment methods to evaluate the vulnerability of data-poor stocks and species of special interest to fishing activities occurring within its jurisdictional boundaries (Tremblay-Boyer & Berkenbusch 2020; Neubauer et al. 2019; Peatman et al. 2019; Neubauer et al. 2018; Fu et al. 2017; Hoyle et al. 2017). These tools can be sensitive to the equations and variables used to summarise the population dynamics (Hordyk & Curruthers 2018) and the extent of fishing mortality (Murua et al. 2021). These sensitivities often mean that there is no one method that fits all purposes, and choice of method is therefore based on what assumptions are considered acceptable given the question posed.

The most recent of these tools is EASI-Fish (Griffiths et al. 2019), developed at the IATTC. EASI-Fish estimates fishing mortality based on the 'volumetric overlap' of each fishery with the distribution of each species. Fishing mortality is then used in a length-structured per-recruit model to assess population vulnerability status using conventional biological reference points (Griffiths et al. 2019). EASI-Fish also applies Monte-Carlo simulation methods to capture uncertainty in estimated vulnerabilities (Griffiths et al. 2019). These two features are advantageous as they allow presentation of vulnerabilities using metrics consistent with those regularly used in stock assessment of tuna species in the WCPFC.

The IATTC has broadly applied this method to 24 species of epipelagic and mesopelagic teleosts, sharks, rays, sea turtles and cetaceans in the Eastern Pacific Ocean as part of the method development. They have recently applied the approach to mobulids (Griffiths & Lezama-Ochoa, 2021) and leatherback turtles (Griffiths et al. 2020) and are considering a broader application to sharks in 2022. Since WCPFC has predominately been applying these types of risk assessment methods to sharks, SPC has commenced discussion with IATTC scientists to evaluate the application of EASI-Fish to sharks in the WCPO as test species. This will enable the results to be compared against existing WCPFC risk assessment results but also (for the same species that IATTC include) evaluate method sensitivities to basin-scale features and trends.

SPC has also commenced discussions with colleagues at CSIRO to use and contribute to their information system for fisheries ecological risk assessments. The CSIRO system includes a repository of information on species' life-histories, which is fundamental to all the rapid risk assessment methods that WCPFC have previously applied, and to EASI-Fish. This will ensure that WCPFC members have access to information tailored to the WCPO region.

The purpose of this Information Paper is to inform SC17 that SPC in collaboration with the IATTC and CSIRO is evaluating the performance of EASI-Fish as a tool for assessing fishery impacts on data poor and bycatch species. We expect to be able to provide SC18 will a full evaluation.

Benefits to WCPFC

1. A performance evaluation of EASI-Fish providing SC18 and future SCs with the information to determine the merits of routinely applying this and other rapid risk assessments methods to WCPFC bycatch species.
2. The vulnerability profiles generated by EASI-Fish should complement the routine catch estimates that WCPFC requests for purse-seine and longline caught bycatch.
3. The generation of the vulnerability profiles should also identify the key components of the WCPFC fisheries that influence each species' vulnerability. This information should assist with developing key indicators for monitoring WCPFC fisheries.
4. The base information required for EASI-Fish (growth, maturity, distribution) will also contribute to regional initiatives to forecast impacts of climate change on WCPO fisheries and ecosystems.
5. WCPO information in global information systems, such as Aquamaps, Fishbase, and BMIS are updated and validated.
6. Potential ongoing collaboration and coordination with IATTC to apply consistent methods and approaches and align the preparation of vulnerability profiles for bycatch and species of special interest. This should prove beneficial for populations in the central Pacific that may be shared between the two organisations.

Workplan

SPC has commenced work on this evaluation with support from the Pacific-European Union-Marine-Partnership (PEUMP) project, which will be pursued over the next 12 months, with the aim of reporting to SC18. Current progress and planned work are summarised as follows:

<u>Spatial Distribution</u>

Progress: Species distribution models (SDM) for 40 species of Pacific sharks and rays captured within the WCPO and IATTC Convention Areas were initially generated from Aquamaps (https://www.aquamaps.org/) and evaluated by ecologists and fishery experts. Scant presence records from the WCPO available in Aquamaps prompted the development of an ensemble approach (BioClim, MaxEnt, Generalised Linear Model, Boosted Regression Trees) where SDMs were fitted to presence only data at 0.25 degree resolution, using records from tuna fisheries active in both WCPFC[1] and IATTC[2] areas. Based on the environmental variables used[3] (mean annual sea surface temperature, mean depth, mean salinity, mean annual surface primary productivity, mean annual dissolved molecular oxygen at surface, and distance to nearest coast) only 17 species had sufficient discrimination between the presence records and locations that were randomly chosen from the Pacific Ocean (i.e. background or pseudo-absence records) to be pursued further (example provided in Annex 1).

Planned: An evaluation of the differences in spatial distributions estimated by:

- Nuanced selection of environmental variables for improved discrimination between the presence records and pseudo-absence records.
- Inclusion of known absence and count data and temporal effects on presence and absence in SDM estimation.

[1] WCPFC presence records for each species were generated from WCPFC observer and logbook data.
[2] The presence records for each species for the IATTC jurisdiction were those available in Aquamaps.
[3] We used the Pacific wide environmental data available in Aquamaps.

Life history/Population dynamics

Progress: A global literature search has been completed for the 40 shark and ray species and information compiled on their Pacific region life histories (maximum age and length, growth and maturity parameters, natural mortality, length-weight relationships, minimum and maximum depths).

Planned: Meta-analyses of the available data to generate Pacific-specific estimates and uncertainties to evaluate sensitivities of EASI-Fish vulnerability profiles to life-history parameters.

Fishing mortalities

Progress: Longline and purse-seine fisheries have been defined for the WCPFC and information compiled on length at first capture, depth range of the gear, catchability, selectivity, encounterability, relative gear efficiency, and at-vessel and post-release mortalities. Spatial overlaps with the estimated ranges of 17 candidate species of the 40 species have been calculated.

Planned: Improved estimation of catchability, selectivity, encounterability, and the relative gear efficiency for each species to evaluate EASI-Fish sensitivities to fishing mortality parameters. Spatial overlap sensitivities will be tested based on differing the level of fishing effort aggregation.

Preliminary Analyses

Progress: Vulnerability profiles have been prepared for 7 shark/ray species (oceanic whitetip (OCS), great hammerhead (SPK), pelagic thresher (PTH), silky (FAL), whale (RHN), spinetail manta (RMJ) and pelagic stingray (PLS)) using the information prepared to date (see Figure 1). These profiles are broadly consistent with previous risk and stock assessments on these species and existing knowledge on fishing impacts.

Planned: Vulnerability profiles and associated sensitivity analyses will be completed for the remainder of the 40 shark and ray species where the information base available is sufficient. These analyses should allow for the feasibility of EASI-Fish to be evaluated and reported to SC18.

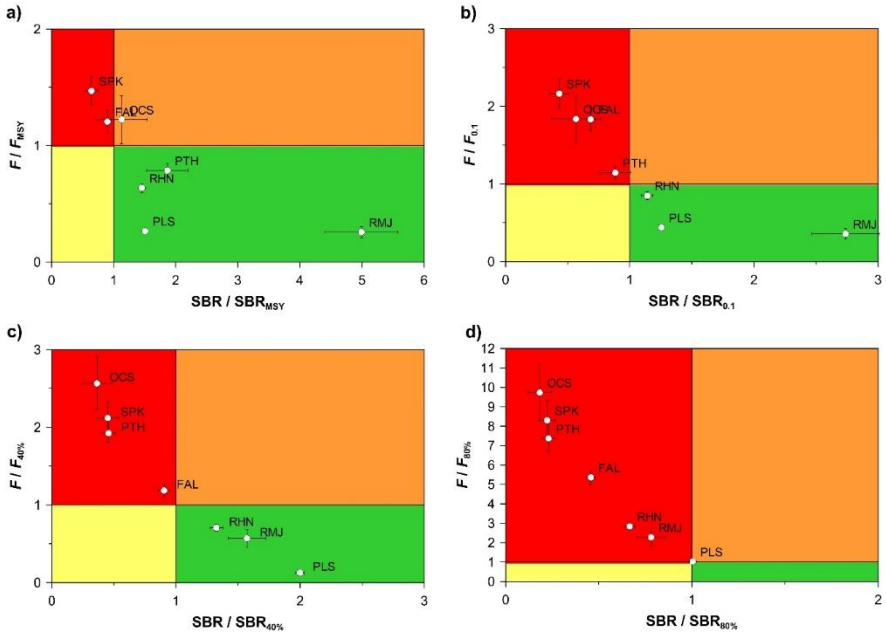

Figure 1. Example vulnerability plots (preliminary) for 7 shark and ray species caught by tuna fisheries in the Pacific Ocean for four common fisheries using four biological reference points derived from per-recruit models. Species in the red quadrant are considered to be most vulnerable.

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Annex 1. Example of an ensemble Species Distribution Model for oceanic whitetip shark in the Pacific Ocean

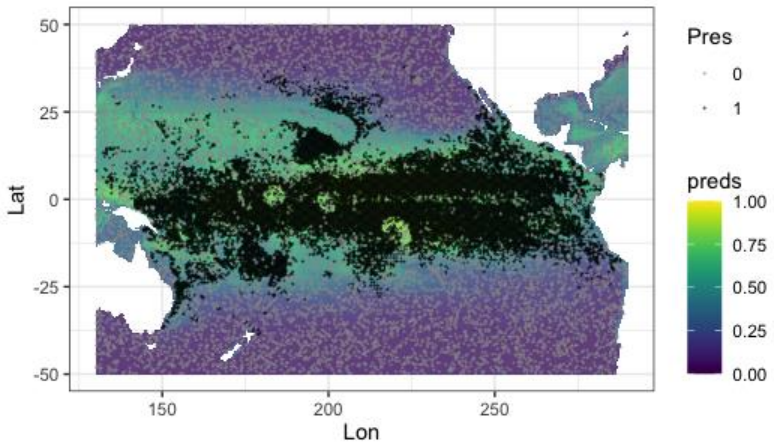

Figure A1. Model averaged predicted probabilities of presence for oceanic whitetip shark with presence locations (black dots) and background/pseudo-absence (grey dots).

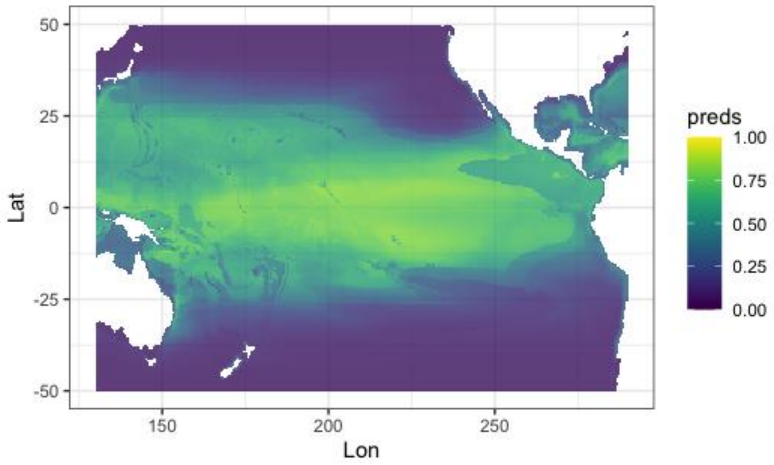

Figure A2. Model averaged predicted probabilities of presence for oceanic whitetip shark.

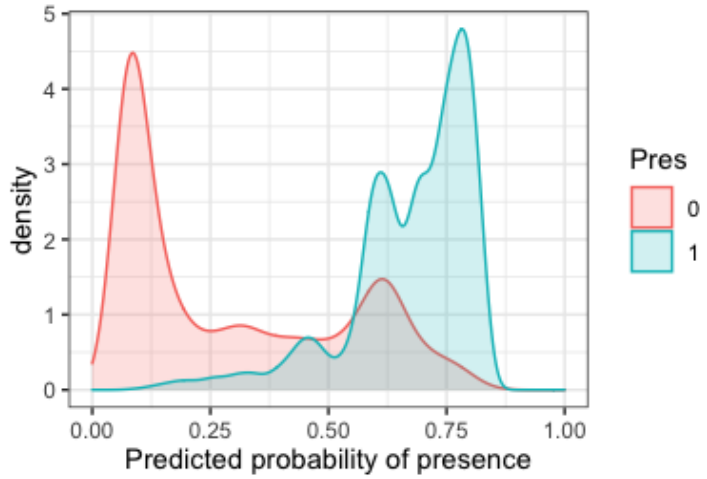

Figure A3. Predicted probability of presence (blue) and background/pseudo-absence (red) points for oceanic whitetip shark.