PROJ 113b

Development of a stock status and management advice template for consistent reporting of stock assessment outcomes, uncertainties and risk

SA-WP-10

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Data Science

Recommendations

Recommendations

Based on IPCC guidelines: Support transparency, consistency, and comparability, and are designed to support the use of scientific information in decision-making.

"...communicate the degree of certainty in key findings:

1. **Confidence in the validity of a finding**, based on the type, amount, quality, and consistency of evidence (e.g., mechanistic understanding, theory, data, models, expert judgment) and the degree of agreement. **Confidence is expressed qualitatively.**
2. Quantified measures of **uncertainty in a finding expressed probabilistically** (based on statistical analysis of observations or model results, or expert judgment)." (Mastrandrea et al. 2010)

The **first point expresses the confidence in data, models and other aspects (or assessment) that lead to the findings, while the second point expresses the uncertainty in the findings (or stock status) themselves.** This is a useful distinction, as it allows for a clear separation of the confidence in the underlying evidence from the uncertainty in the findings.

Recommendations

1. **Rename sections of the Stock Status and Management Advice report to better reflect the content:**

- Currently, reports are split into ”Stock Status and trends” and ”Management Advice” sections. However, the content of each is not always consistent with the title, and the two sections are not always clearly distinguished.
- The Stock Status section should be renamed to ”**Stock Assessment and Trends**”:
    - Outlines the evidence and modelling results used to assess the stock.
- The Management Advice section should be renamed to ”**Stock Status and Management Advice**”.
    - Measures the performance of the stock against management objectives (i.e., stock status; expressed as biomass relative to target and limit reference points)
    - Resulting advice provided to managers based on status and trends.

Recommendations

2. **Consistent section content: Stock Assessment and Trends**

(a) Describe assessment structure and rationale (Figure 1, Table 1)
(b) Describe main uncertainties considered (Table 2)
(c) Describe annual catch estimates and trends (Figure 2)
(d) Describe CPUE trends and other indicators of biomass trends (Figure 3)
(e) Describe trends in diagnostic model, including recruitment, spawning potential and fishing mortality (Figure 4-6)
(f) Describe the depletion of spawning stock biomass and associated uncertainty (Figure 7)

- Table 1. Assessment structure, including key fisheries and catch proportions. No defined format to accommodate alternative assessment methods.
- Table 2. Summary of main sources of uncertainty in the assessment, with a degree of confidence assigned to each aspect of the assessment and potential source of uncertainty.
- Figure 1. Spatial structure used in the 20XX stock assessment model.
- Figure 2. Time series of total annual catch (1000's mt) by fishing gear over the full assessment period.
- Figure 3. Time series of CPUE and/or other main abundance indices.
- Figure 4. Estimated annual average recruitment (by model region, if spatial) for the diagnostic case model, including estimation uncertainty.
- Figure 5. Estimated annual average spawning potential by model region for diagnostic case model,including estimation uncertainty.
- Figure 6. Estimated annual average juvenile and adult fishing mortality for the diagnostic case model, including estimation uncertainty.
- Figure 7. Plot showing the trajectories of spawning biomass and spawning biomass depletion (of spawning potential) by region including uncertainty arising from estimation, structural and intrinsic uncertainties (variability and process error).

Recommendations

2. **Consistent section content: Stock Status and Management Advice**

(a) Describe stock assessment results compared to the previous assessment
(b) Describe management quantities for recent years related to LRP, TRP, and/or other agreed objectives with CMMs (Table 3, Figures 7 and 8)
(c) Describe projections (where relevant; Figure 9)
(d) Describe agreed recommendations based on the results of the stock assessment (possibly more than 1 paragraph; include in Table 3 summary)

- Figure 7. Majuro plot summarising the results for each of the models including uncertainty arising from estimation, structural and intrinsic uncertainties (variability and process error).
- Figure 8. Kobe plot summarising the results for each of the models including uncertainty arising from estimation, structural and intrinsic uncertainties (variability and process error).
- Figure 9. Plot showing projected stock status under recent fishing levels, including uncertainty arising from estimation, structural and intrinsic uncertainties (variability and process error).

Recommendations

3. **Consistent language: Stock assessment and trends**

- Should include a summary of the main sources of uncertainty in the assessment with **a degree of confidence** assigned to each aspect of the assessment and potential source of uncertainty, consistent with the IPCC guidelines for statements about evidence.
- A simple 3-level scale may be sufficient to achieve this - high, medium, and low confidence. While these are not explicit probabilistic statements, they provide a useful indication of the level of confidence that the **assessment team** has in each aspect of an assessment.

We note that the **confidence level is not a representation of the degree of uncertainty itself** (i.e., whether the uncertainty is substantial or minor), **but whether the assessment outcomes adequately address the uncertainties.**

Recommendations

3. **Consistent language: Stock assessment and trends**

Confidence level	Description
High	Data are representative, parameters or process well know or highly likely to be contained within prior/grid range considered
Medium	Some uncertainty about data representativeness, parameters/processes or unsure if fully captured in data/parameter scenarios/priors (e.g., single M may be used for technical reasons even though length-based M has been shown in literature)
Low	Considerable uncertainty about data/parameters/process or unlikely to be well represented in data/parameter scenarios/priors (e.g., Climate impacts, past catch unknown)

Recommendations

3. **Consistent language: Stock Status and Management Advice**

- IPCC likelihood categories should be applied together with corresponding probability statements to facilitate cross-cultural and contextual understanding.
- Assigned probability statements are a direct reflection of the degree of a posteriori uncertainty (i.e., the total uncertainty) resulting from the assessment process.
- If the model is thought to adequately represent all major uncertainties (e.g., by integrating over key uncertainties in a Bayesian model or a weighted model ensemble), then the probabilities and associated IPCC likelihood categories can be directly applied to model outcomes (e.g., to the model grid).
- If substantial uncertainties (i.e., those likely to give a substantially wider uncertainty or different outcome) are unresolved, then probability statements should be moderated to account for unresolved uncertainties.

Recommendations

3. **Consistent language: Stock Status and Management Advice**

Probability	Description
$> 99\%$	Virtually Certain
$> 90\%$	Very Likely
$> 66\%$	Likely
33-66%	About as Likely as Not
$< 33\%$	Unlikely
$< 10\%$	Very Unlikely
$< 1\%$	Exceptionally Unlikely

Recommendations

4. Tabulate uncertainties

Type	Rationale	Uncertainty	Impact	Confidence**
Data				
CPUE	Best available spatio-temporally standardised Index	Low availability of gear configuration impacting catchability	Potential hyperstability leading to over-estimating current biomass	Medium
Catch				
Best available information	Reporting early catch	Early catch probably less impactful now; total magnitude will impact productivity estimates	High	
Model				
Multifan CL	Standard tuna model in WCPFC	Low benchmark tested	Single model used for inference	High
Spatial assumptions				
9 Regions	Most parsimonious given available tags alternative spatial configurations difficult to test	Not considered	Potentially important not quantified impact unknown	Low
Key parameter uncertainty				
M steepness	Estimable given trend Not estimable in present model	Estimated Grid (50 Monte Carlo draws from prior derived from simulation)	Impacts estimation uncertainty Impacts overall structural uncertainty	Medium High
Structural uncertainties				

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Recommendations

5. **Tabulate stock status:**

Table 4: Example of a stock status table. Note, all numbers are for illustration only.

Summary				
Year: 2023	**Biomass**	Unlikely (<33%) to be above target		Stock is overfished
	Fishing mortality	Likely (>66%) to be below target		Overfishing is not occurring
	Projection	F likely (>66%) decline further		Overfishing is unlikely (<66%) to occur under current catch levels
	Recommendation	**Stock increasing towards target and F declining at current catch, no action required to reach target biomass.**		
Reference points		**Estimate [Lower–Upper]**		
Biomass	TRP (0.4 $B_{F=0}$)	3,000,000 t [low – up]		
Biomass	LRP (0.2 $B_{F=0}$)	1,500,000 t [low – up]		
Catch	MSY	250,000 t [low – up]		
Fishing Mortality	F_{MSY}	0.1 [0.08; 0.014]		
Recent estimates				**Recent trend / projection**
Biomass	B	1,800,000 t [low – up]		Biomass increasing
Depletion	$B_{recent}/B_{F=0}$	0.32 [0.18 – 0.43]		
Fishing mortality	F	0.08 [0.06 – 0.09]		F declining
Catch	C	200,000		Catch stable
Status			**Likelihood**	
Biomass	B_{recent}/TRP	0.8 [0.65 – 1.07]	Unlikely (<33%) to be above target	
	B_{recent}/LRP	1.65 [0.9 – 2.65]	Unlikely (<33%) to be below limits	
Fishing mortality	F_{recent}/F_{target}	0.8 [0.6 – 1.1]	Likely (>66%) to be below target	
	F_{recent}/F_{limit}	0.8 [0.6 – 1.1]	Very likely (>90%) to be below limits	
Projections (basis[recent catch/effort/ alternative catch])				
Biomass	$B^{proj-basis}_{proj-year}/B_{MSY}$	0.42 [0.3 – 0.53]	About as Likely as Not (33 – 66%) to be below	B_{proj} increasing
Fishing mortality	$F^{proj-basis}_{proj-year}/F_{MSY}$	0.6 [0.5 – 0.7]	Likely (>66%) to be below target	F_{proj} declining

Recommendations

5. **Tabulate stock status:**

Table 6: Example of a stock status table for the 2024 silky shark assessment. Note, all entries are for illustration only in the context of the present report and do not represent agree numbers or recommendations at the time of writing.

Summary: Silky shark				
Year: 2024	**Biomass**	No agreed target or limit for sharks		
	Fishing mortality	Very Likely (>90%) to be below biological reference points		Overfishing is not occurring
	Projection	No projections		
	Recommendation	**F declining but status uncertain; maintain conservation measures.**		
Reference points		**Estimate [Lower–Upper]**		
Biomass	-	-		
Biomass	-	-		
Catch	-	-		
Harvest rate	$U_{lim}(notagreed)$	0.19 [0.09 – 0.38]		
Harvest rate	$U_{crash}(notagreed)$	0.25 [0.16 – 0.48]		
Recent estimates				**Recent trend / projection**
Depletion	N_{recent}/N_0	0.44 [0.10 – 0.96]		Abundance increasing
Harvest rate	U	0.017 [0.0014 – 0.048]		F declining
Catch	C	65 189		Catch declining
Status			**Likelihood**	
Harvest rate	U_{recent}/U_{lim}	0.18 [0.02 – 0.34]	Very likely (<90%) to be below limits	
Harvest rate	U_{recent}/U_{crash}	0.13 [0.01 – 0.25]	Very likely (>90%) to be below limits	
Projections				
No projections				

Recommendations

6. **Web-based reporting tool**

A web-based reporting app, such as the tool used to provide access to reporting by CCAMLAR, could be developed to provide a consistent and user-friendly interface for accessing stock assessment reports.

This tool could allow users to easily navigate between summaries and more detailed reports, view the main results of the assessments, and access the full report in PDF format. Could also provide links to the main figures and tables in the report, as well as any supplementary material that may be available.

This will help to make the reports more accessible to a wider audience, and improve the transparency and consistency of the advice provided.

Thank you for your input!

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OBJECTIVE

Develop in consultation with assessment working groups and fisheries managers, a reporting template for stock status and management advice that will assist in making stock assessments reported to the WCPFC accountable to a consistent reporting framework.

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SCOPE OF WORK

1. Develop, in consultation with assessment team, the SPC, and fisheries managers, a template for reporting uncertainties alongside stock status and management advice for WCPFC stock assessments. Elements that should be considered as part of this reporting template are:
    a. Consistently applicable terminology around stock status, uncertainty, and management risk for all stock assessments reported to the WCPFC for efficient communication;
    b. Recommended measures/classifications of stock status, uncertainty, and risk to be provided for stock assessments in the WCPFC, including descriptions of the measures so that differences between measures can be understood by managers;
    c. Communication about the quality of information used for determining stock status and management advice,
    d. Qualification and quantification of uncertainties should consider:
        i. Data quality/quantity
        ii. Model/population: structural uncertainty, biological information/assumptions
        iii. Parameter/estimation uncertainty
    e. Specification of the key uncertainties and potential impacts – qualify the likely impact of key uncertainties for stock status and management advice, and,
    f. Provision of research recommendations to address key uncertainties.
2. Present a summary report with a proposed reporting template, with alternative options (if necessary), for consideration at SC20.