

Caribbean Fishery Management Council Ecological Risk Assessment Guidance

Introduction

Regional fishery management councils can develop fishery ecosystem plans (FEPs) as a mechanism for incorporating ecosystem principles, goals, and policies into their current fishery management structure. FEPs can be used to provide context of the ecosystems within which the fisheries are managed, direct how that information should be used in the context of fishery management plans, and set policies that guide development and implementation of fishery management options. The Caribbean Fishery Management Council (Council) is embarking on the development of a FEP, as a framework for operationalizing Ecosystem-based Fisheries Management (EBFM; NOAA Fisheries 2016) in the US Caribbean exclusive economic zone (EEZ). The Council is loosely following a blueprint for developing fishery ecosystem plans established by a Lenfest Fishery Ecosystem Program task force (Lenfest Ocean Program 2016, [Levin et al. 2018](#)). The Lenfest framework lays out a logical, sequential process in five stages, with the whole cycle being repeated as the FEP Loop (Figure 1). The Council and their EBFM team are at the first stage: “Where are we now?” This first stage involves two key actions the Council intends to address at the upcoming District Advisory Panel (DAP)/Scientific and Statistical Committee (SSC) meeting. First, the DAP will be asked to provide input on the Conceptual Model being developed. Second, the SSC will be asked to provide qualitative (i.e., expert opinion) input into a Risk Assessment Model developed by the EBFM team and further informed from DAP meeting outcomes.

THE FEP LOOP

The main recommendation of the Task Force report is that FEPs be used to create a structured process for establishing goals and translating them into action. The report proposes the “FEP Loop” process.



Figure 1. The FEP Loop (from Lenfest Ocean Program 2016).

The Risk Assessment Model action involves the SSC conducting a risk assessment to determine the likelihood that one or more components of the fishery ecosystem will reach or remain in an undesirable state. This first-stage, qualitative risk assessment (Level 1, see below), derived using the SSC’s expert knowledge, will provide the baseline approach for assessing risk operating in the ecosystem within a context of foundational (i.e., habitat) ecosystem attributes. Outcomes from this qualitative exercise will inform future quantitative approaches to risk assessment, which may become feasible as appropriate data are brought to bear, but is not part of the scope at this time.

Benefits of a Risk Assessment

Risk assessments provide a standardized, yet flexible and transparent framework for quantifying the probability of undesirable events along with their impacts, and assessing tradeoffs in order to prioritize conservation and management (Holsman et al. 2017, Gaichas et al. 2018). Most risk assessments allow characterization of uncertainty, which is helpful for focusing research questions. Results of the U.S. Caribbean island-based risk assessment will also help inform and refine other aspects of the fishery ecosystem plan (e.g., conceptual model, strategic and operational objectives).

Methodology

The risk assessment methodology proposed for the U.S. Caribbean EEZ is amended and expanded from the Australian Government's Ecological Risk Assessment for Effects of Fishing (Hobday et al. 2007, Hobday et al. 2011), and includes some of the methods used in an ecosystem risk assessment conducted for the Mid-Atlantic Fishery Management Council (Gaichas et al. 2018). Following that guidance, the risk assessment for the U.S. Caribbean EEZ could proceed through four stages: Scoping (expert opinion), Level 1 (Scale Intensity Consequence Analysis), Level 2 (Productivity Susceptibility Analysis), and Level 3 (quantitative and model-based analyses).

The plan is for the SSC to review the results of scoping that was initiated by the Council EBFM team, comprised of staff from the Council, NOAA Fisheries, academia, and NGOs. Then the SSC will complete the scoring for the Level 1 assessment. An Excel-based scoring sheet will accompany this document.

Scoping

The scoping process encompasses three steps, outlined below:

Step 1. Generate lists of "units of analysis"

The unit of analysis is the component of the ecosystem that you want to evaluate risk against (e.g., species, habitats, and communities). Some activities (e.g., fishing) or ecosystem processes (e.g., food web interactions, climate-driven species distribution shifts) will impact units (e.g., species, habitats, communities) directly, whereas, broader scale factors (e.g. economic recession) may have an effect at the ecosystem level. Ideally, risk is analyzed at each unit that the Council is concerned with. For instance, the Council is responsible for the sustainable management of each managed stock, as well as to promote the protection of essential fish habitats. However, this creates an exponential number of individual risk-unit combinations to analyze. Therefore, to keep the Level 1 analysis manageable and take an ecosystem approach to the risk assessment, the following biological communities by habitat type (by island platform) were selected as the primary units of analysis:

- Mangrove communities
- Seagrass communities
- Shallow reef (< 40 m) communities
- Deep reef (> 40 m) communities
- Pelagic communities

The unit of analysis will be expanded to the island-level (Puerto Rico, St Croix, or St Thomas/St John), or region-wide, when appropriate.

Step 2. Select objectives

It is important to identify objectives that managers, members of the fishing industry, and other stakeholders can agree on, and that scientists can quantify and assess. Those objectives should have clear operational definitions, be accessible to prediction and measurement, and their quantities be exposed to the risk elements. In lieu of a public scoping project, policies and mandates under the

Magnuson-Stevens Fishery Conservation and Management Act (MSA) were reviewed to identify objectives. Preliminary management objectives relevant to the units of analysis were selected to identify risks that the Council may be concerned with. The three selected objectives (listed in columns C and D of the Excel spreadsheet) were:

- Achieving optimum yield for managed species
- Maintaining structure and function of Essential Fish Habitat
- Maintaining fishery resilience (diversity, stability, employment/revenue)

Step 3. Select risk elements

A risk element is an aspect of the ecosystem that may threaten achieving the desired management objectives. It can be something that can be managed by the Council (e.g. gear type/selectivity) or completely out of the Council's control, like natural processes (e.g. climatic, oceanographic, biological) or economic forces. At this initial stage in the risk assessment, starting with a comprehensive list of risk elements is preferred. A total of 64 potential risk elements were identified (listed in column B of the Excel score sheet) across the following seven broad categories (also referred to in column A of the score sheet):

- Climate/oceanographic forces
- Ecological interactions
- Fishing activities
- Other in-water activities
- Land-based activities
- Conservation and management actions
- Socio-economic drivers

Additional risk elements may be added from the island-based conceptual models that the DAPs will develop shortly before the SSC scores the risk assessment.

Level 1 Scale, Intensity, and Consequence Analysis (SICA)

A SICA is a qualitative assessment that screens out risk elements that are judged to have low impact. The SSC should work as a group to conduct their SICA, scoring each risk element for the appropriate unit of analysis in the Excel score sheet provided. For the March 27-28 meeting, it is recommended that the SSC score at least one risk element from every category, across every relevant unit of analysis. This could help the SSC determine how best to tackle remaining risk elements, should there be insufficient time during the March meeting. The SICA is an eight-step process:

Step 1: Record risk element absence/presence

Scores for absence (0) presence (1) of each risk element in each unit of analysis are to be recorded in columns H, O, V, AC, and AJ of the scoring sheet. Only risk elements with a final score of 1 (presence) should be analyzed.

Step 2: Score spatial scale of risk element

A score for the spatial extent of each risk element in each unit of analysis are to be recorded in columns I, P, W, AD, and AK. The full extent of habitat over which a risk element can occur should be used for determining the spatial scale score for each risk element. The spatial scale score is considered in making judgements about the level of intensity of the risk element. The scores for spatial scale are as follows:

< 1 nm ²	1-10 nm ²	10-100 nm ²	100-500 nm ²	500-1000 nm ²	>1000 nm ²
1	2	3	4	5	6

Step 3: Score temporal scale of risk element

A score for the temporal extent of each risk element in each unit of analysis are to be recorded in columns J, Q, X, AE, and AL. The highest frequency should be used for determining the temporal scale score for each risk element. It may be more logical for some risk elements to consider the aggregate number of days, rather than frequency. This score is considered in making judgements about the level of intensity for each risk element. The scores for temporal scale are as follows:

Decadal (1 day every 10 years or so)	1 Day every several years	Annual (1-100 days per year)	Quarterly (100-200 days per year)	Weekly (200-300 days per year)	Daily (300-365 days per year)
1	2	3	4	5	6

Step 4: Select the most appropriate management objective(s)

Generally, the most appropriate management objective should be chosen to analyze the risk in a particular unit of analysis due to a specific risk element. However, since Level 1 is supposed to be a rapid screening tool, some management objectives were combined (under columns C and D of the score sheet) to be analyzed simultaneously for expediency. More specific, quantitative analyses could be developed during future Level 2 and 3 risk assessment activities. Initial selections for appropriate management objectives were entered in columns C and D the scoring sheet for the SSC's review.

Step 5: Score the intensity of the risk element by community type

The intensity of a risk element should be judged based on the spatial and temporal scale of the risk element (i.e. exposure) and its detectability relative to the unit of analysis. The SSC will score intensity (under columns K, R, Y, AF, AM) based on their expert judgment, referring to the scores for spatial and temporal scale and the scoring descriptions below.

Level	Score	Description
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale

Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

Step 6: Score the consequence of intensity of the risk element in each community type

The consequence of a risk element is a measure of the likelihood of not achieving the management objective for the selected unit of analysis. The consequence score should be based on existing information and/or the expertise of the SSC (recorded under columns L, S, Z, AG, AN). The rationale for assigning each consequence score should be documented (under columns N, U, AB, AI, AP). In the absence of agreement or information, the highest score (worst-case scenario) considered plausible should be selected. *When scores for intensity and consequence are expected to be similar throughout the region, island platform, and/or similar community types across islands, it will be documented (under columns E, F, G) to alleviate the need to score every risk element across every community type, on every island platform.*

Level	Score	Description
Negligible	1	Impact unlikely to be detectable at the scale of the stock/habitat/community
Minor	2	Minimal impact on stock/habitat/community structure or dynamics
Moderate	3	Maximum impact that still meets an objective (e.g. sustainable level of impact such as full exploitation rate for a target species).
Major	4	Wider and longer term impacts (e.g. long-term decline in CPUE)
Severe	5	Very serious impacts now occurring, with relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase).
Intolerable	6	Widespread and permanent/irreversible damage or loss will occur-unlikely to ever be fixed (e.g. extinction)

Step 7: Record confidence/uncertainty for the consequence scores

The information used at this level is qualitative and each step is based on expert judgment. The confidence score (recorded under columns M, T, AA, AH, AO) should reflect the levels of uncertainty for steps 2, 3, 5, and 6 (spatial scale, temporal scale, intensity, and consequence). The rationale should be documented (under columns O, T, Y, AD, AI).

Confidence	Score	Rationale
Low	1	Data exists, but is considered poor or conflicting No data exists Disagreement between experts
High	2	Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

Step 8: Document rationale for the above steps

The rationale forms a logical pathway to the consequence score. Capture rationale for both the consequence and confidence scores (under columns N, U, AB, AI, AP). This is the last step of a Level 1 (SICA) risk assessment.

References

- Gaichas, S.K., DePiper, G.S., Seagraves, R.J., Muffley, B.W., Sabo, M.G., Colburn, L.L., and Loftus, A.J. 2018. Implementing Ecosystem Approaches to Fishery Management: Risk Assessment in the US Mid-Atlantic. *Front. Mar. Sci.* 5:442. <https://doi.org/10.3389/fmars.2018.00442>
- Hobday, A.J., Smith, A.D.M., Webb, H., Daley, R., Wayte, S., Bulman, C., Dowdney, J., Williams, A., Sporcic, M., Dambacher, J., Fuller, M., Walker, T. 2007. Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra. July 2007.
- Hobday, A.J., Smith, A.D.M., Stobutzki, I.C., Bulman, C., Daley, R., Dambacher, J.M., Deng, R.A., Dowdney, J., Fuller, M., Furlani, D., Griffiths, S.P., Johnson, D., Kenyon, R., Knuckey, I.A., Ling, S.D., Pitcher, R., Sainsbury, K.J., Sporcic, M., ... Zhou, S. 2011. Ecological risk assessment for the effects of fishing. *Fisheries Research*. 108: 372-384. <https://doi.org/10.1016/j.fishres.2011.01.013>
- Holsman, K., J. Samhouri, G. Cook, E. Hazen, E. Olsen, M. Dillard, S. Kasperski, S. Gaichas, C. R. Kelble, M. Fogarty, and K. Andrews. 2017. An ecosystem-based approach to marine risk assessment. *Ecosystem Health and Sustainability* 3(1):e01256. 10.1002/ehs2.1256
- Lenfest Ocean Program. November 2016. Building Effective Fishery Ecosystem Plans: A Report from the Lenfest Fishery Ecosystem Task Force.
- Levin, P. S., Essington, T. E., Marshall, K. N., Koehn, L. E., Anderson, L. G., Bundy, A., ... Smith, A. D. M. 2018. Building effective fishery ecosystem plans. *Marine Policy*. <https://doi.org/10.1016/j.marpol.2018.01.019>
- NOAA Fisheries. 2016. Ecosystem-Based Fisheries Management Policy of the National Marine Fisheries Service, National Oceanic and Atmospheric Administration.