NPFMC Tier 6 harvest control rules and data-limited stock assessment methods

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Introduction

The North Pacific Fishery Management Council (NPFMC)'s Fishery Management Plan (FMP) contains harvest control rules (HCRs) in the form of ABC and OFL specifications based on data availability for each managed stock or stock complex. The HCRs for Tier 6, the most data-limited tier managed by the NPFMC, is based on the average catch from 1978-1995, or an alternative approach approved by the SSC (NPFMC 2024 a & b). The AFSC Data-Limited Methods Working Group (DLMWG) has been tasked with developing suitable, alternative OFL and ABC specification approaches for Tier 6 stocks or Tier 6 components of stock complexes based on data availability and evolving data-limited approaches. Here we provide the language and rationale for the ABC and OFL specification for Tier 6 in the NPFMC FMPs, summarize current OFL specification approaches in use for Tier 6 stocks or Tier 6 components of stock complexes, and propose two examples of data-limited methods that the DLMWG has determined fit within the Tier 6 definition.

The purpose of this report is to request input from the PT and SSC on the acceptability of the proposed methods and data-limited methods in general. While we propose only two examples, it is important to consider that data-limited methods are ever evolving and as the DLMWG evaluates more stocks, other data-limited methods may be identified for exploration.

Tier 6 ABC and OFL Specification

As noted above, the Tier 6 HCR specifies a time frame and catch scalar for OFL. But, alternative methodologies can replace the average catch method and the time frame can be adjusted when approved by the SSC. Specifically, the FMP Amendment 44/44 (Federal Register 96+-26633) states:

> "...The sixth and final tier applies to stocks for which the only reliable information available is catch history. In such cases, the OFL would be set as the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information, and ABC would be set lower than or equal to 75 percent of that OFL.
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> ……the Council wanted to allow for the possibility that other information may become available that, while insufficient to establish OFL by a higher tier, would provide a more accurate assessment of stock levels. In this event, tier (6) allows for such information to supersede catch history in determining ABC and OFLs."

There are currently seven assessments in the BSAI and GOA FMP areas in which at least one of the component species is considered Tier 6 (Table 1). These seven assessments comprise 35 species in the two FMP areas. For simplicity, the term "stocks" in this document refers to stand-alone Tier 6 stocks (e.g., GOA Atka mackerel or the GOA octopus complex, which is assessed as a single stock) and Tier 6 components of stock complexes (e.g., GOA Pacific sleeper shark, which is part of the mixed-tier GOA shark stock complex). Given that these stocks have a wide variety of data availability, most have utilized the "unless an alternative value is established by the SSC on the basis of the best available scientific

information" allowance in the Tier 6 HCR. Tier 6 stocks currently apply approaches such as using different time series or catch scalars, or quasi-Tier 5 approaches (Table 1).

There are two concerns regarding the current approaches in use for Tier 6 stocks. First, that maximum and average historical catch methods (i.e., catch scalars) are generally not recommended for data-limited species due to the high likelihood of a species becoming overfished (e.g., Berkson et al., 2011; Carruthers et al., 2014). The second is that, as the SSC and Council noted in Amendments 44/44: "Catch history bears no relationship to biomass levels". Initially, Tier 6 was a catch-all category for species that are not targeted and generally considered to be lightly exploited. The approach for specifying OFL and ABC was intentionally designed to be constraining. That is, the ABC/OFL amounts were limited by the historical incidental catches and development of directed fishing would require reliable estimates of biomass or other information. As more information has been gleaned about individual species within stock complexes, concerns arose over whether some components of the stock complexes were sufficiently protected with this precautionary approach. For example, if some species within a complex had significantly lower productivity and high susceptibility, the Tier 6 approach may be less precautionary than expected.

Therefore, it is necessary to explore data-limited approaches that may make use of data streams and information other than historical catch. The current Tier 6 HCRs allow for these alternative methods to be adopted for management as indicated by the SSC report from the NPFMC meeting in December 2022:

> *"…The SSC emphasized that there is considerable flexibility within the tier structure to consider innovative alternatives for how to use available catch and biomass time series when determining reference points.*" SSC December 2022

Alternative Data-Limited Methods for NPFMC Tier 6 stocks

The DLMWG conducted a prioritization exercise and presented the results to the 2024 September Joint Groundfish Plan Team meeting and the October SSC meetings (Tribuzio et al. 2024). The DLMWG has directed attention to six priority stocks (Table 2). The DLMWG then worked through the FishPath Decision Support Tool (Dowling et al. 2023) for each of the priority stocks, which included multiple rounds of completing the survey and discussion of the results as a group. This process was a first step to identify the appropriateness of different data-limited methods (Table 2).

The DLMWG is now evaluating data-limited methods for the priority stocks. Two alternative data-limited approaches have been identified as suitable for at least two stocks: only reliable catch series (ORCS) and decision trees.

ORCS (Only Reliable Catch Series)

The PT and SSC first reviewed a proposal to use the ORCS approach for assessment of the Pacific sleeper shark of the shark stock complexes in both FMPs in the 2022 BSAI/GOA Shark Stock Complex assessments (Tribuzio et al. 2022). The ORCS approach is based on the concept of "pretty good yield", where a large percentage of MSY can be produced on a long-term basis over a broad range of stock sizes (Hilborn 2010). For data-limited situations, this means that successful management outcomes are possible even if the stock status is not precisely known (Berkson et al. 2011). The original ORCS approach was revisited, refined, and simulation-tested in Free et al. (2017). Free et al. (2017) tested six other catch-only methods and found that the ORCS approach performed the best, with the fewest stocks becoming overfished.

The DLMWG is adapting the refined ORCS method for the Pacific sleeper shark portion of the shark stock complexes in both FMPs (Tribuzio et al. 2022). The DLMWG is working to discuss relevant attributes for inclusion and applying sensitivity tests to attribute rankings, weighting schemes, and attribute breakpoints in response to PT and SSC comments (see below). Results from these analyses will be presented during the next full BSAI and GOA Shark Stock Complex assessments in 2026.

"*The SSC in principle supports the development of the ORCS approach, which has the potential to make better use of available information about the stock and provides a way to use life history information for a Tier 6 approach. However, the SSC concurs with the GPTs that the ORCS approach should be further vetted and refined through the proposed data-limited methods / Tier 6 working group (if established) or by the authors and GPTs before use in setting harvest specifications. Regarding the list of attributes, the SSC supports the GPTs recommendation to consider different attributes or a different weighting approach to better reflect the peculiarities of Pacific sleeper shark and its important life history characteristics such as late maturity and longevity.*" SSC Dec 2022

"*The Team recommended that the authors continue to explore the ORCS approach and to determine customization and weighting methods for the attribute table that are appropriate for the BSAI shark complex*." BSAI PT Nov 2022

"*The Team recommended that a working group be formed to investigate alternative data-limited methods and harvest control rules for Tier 6 stocks. In particular, this WG should investigate how the ORCS approach might be applied to Tier 6 stocks with particular conservation concerns*." GOA PT Nov 2022

Decision Tree Approach

The decision tree can be a suitable addition to the NPFMC Tier 6 HCR when catch data are unreliable, catch history is not representative of stock biomass, fishery-independent surveys poorly sample the stock, or biological data are unavailable or minimal. The decision tree begins with a pre-established Tier 6 HCR (e.g., existing OFL set at maximum or mean catch over a representative time period). Then the status or trends in a combination of indicators, which are based on available data from fishery-dependent or -independent sources, are used to recommend any changes to the harvest recommendations, if needed (Hartford et al. 2021). The combination of indicators can include relative abundance trends (e.g., time series trends using fishery-dependent or -independent data) and indicators of change in the demographics of the stock (e.g., range shifts or shrinkage). Often the performance of each indicator is categorized into one of three groups, generally representative of low/falling, medium/stable or high/increasing (Figure 1). The harvest advice could then be scaled based on the indicator performance. Recommendations could either directly impact the harvest specifications (e.g., if both indicators are low/falling, there could be a reduction in the ABC or OFL) or inform a risk table.

Decision trees have been simulation-tested with more informed species (e.g., Prince et al. 2011) and applied to management advice for Australian spanner crab (O'Neill et al. 2010), Californian red abalone (Hartford et al. 2019), and evaluated for broadbill swordfish (Campbell et al. 2015), among others. For each Alaska groundfish stock in which a decision tree approach is used, a framework needs to be developed in a simulation context that could evaluate indicator methods and test robustness in OFL specification approaches. Additionally, establishing initial OFL and suggested guidelines on the percentage of increase or decrease from the OFL based on indicators would involve iterations of scientific and stakeholder input and review through the Plan Team and SSC process (Hartford et al. 2021). The NPFMC (SSC and Plan Teams) could then certify the specification approach based on the best scientific information available. The development of such a decision tree would be stock specific, adequately tested, and require significant review and input in the development phase.

Decision Tree Application Example: GOA Octopus Stock Complex

The GOA Octopus stock complex is a Tier 6 example that is currently being investigated by the DLMWG. This stock complex is one of the most extreme examples of data limitations for groundfish stocks managed by the NPFMC and currently sets the OFL to the maximum historical catch from 2003-2018 and ABC as 0.75 of the OFL (Table 1). At least seven species of octopods comprise the GOA Octopus stock complex. However, species-specific fishery catch is not available and the GOA bottom trawl survey poorly samples octopus species. The primary species in the stock complex that is caught by the survey is the giant Pacific octopus (*Enteroctopus dofleini*). The giant Pacific octopus and the other octopus species hide in dens and tend to prefer untrawlable habitat, making them neither available nor susceptible to the trawl survey gear. As such, typical swept-area biomass indices are uninformative for octopus species.

The decision tree approach is a viable option for the GOA octopus stock complex, where a suite of indicators based on fishery-dependent and -independent data sources is being developed that would better give an indication of the stock complex status. Potential data sources that are currently being investigated by the DLMWG include: AFSC GOA biennial bottom trawl survey, AFSC annual longline survey, IPHC FISS annual longline survey, and fishery data. Each data source would require testing to determine how octopus catch can be best represented given the caveats. For example, there appears to be a strong relationship between the fishery catch of Pacific cod and GOA octopus in pot and hook-and-line longline gears in the Western and Central GOA. A few potential fishery-dependent indicators could be based on the proportion of observed hauls reporting GOA Octopus in the Pacific cod target hook-and-line and pot fisheries in the Central GOA and Western GOA, the presence/absence area of GOA Octopus observations, or the ratio of octopus to Pacific cod catch. Under a hypothetical example, changes in the indicators can lead to rescaling the status quo harvest specifications (e.g., Step 4 in Figure 1).

Summary

The DLMWG and lead author for the GOA Octopus stock assessment anticipate bringing forward this decision tree approach in the next scheduled full stock assessment cycle, currently planned for 2029. However, preliminary evaluation of indicators may be presented earlier, at the discretion of the author and the GOA Plan Team schedule at a September meeting.

Similarly, the DLMWG and the authors for the GOA Shark Stock Complex stock assessment anticipate bringing the refined ORCS approach for Pacific sleeper shark forward in the next scheduled full stock assessment, currently scheduled for 2026.

The purpose of this report is to update the Plan Teams and SSC of the ongoing efforts by the DLMWG and timing for anticipated products. The DLMWG request feedback on the following questions:

1. Do the Plan Teams and SSC agree that the methods described in this report and other currently available data-limited methods can continue to be explored in the context of the NPFMC Tier 6 HCR?
2. Do the Plan Teams and SSC support the anticipated work plans for the GOA Octopus and Pacific sleeper shark data-limited approaches?

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Tables and Figures

Table 1. List of Tier 6 methods used in the most recent operational assessments. * stocks following the specified Tier 6 method.

Current Tier 6 OFL Method	Stock or Stock Complex
Mean catch 1978-1995*	GOA Atka mackerel
Geometric mean of total natural mortality based on Pacific cod consumption 1984-2023	BSAI Octopus
Maximum complex catch 2003-2018	GOA Octopus
Maximum complex catch 2003-2015	BSAI Sharks
Mean species-specific catch 1997-2007, summed with other stock complex components for complex-level OFL	GOA Tier 6 sharks
Maximum species-specific catch 2013-2022, summed with other stock complex components for complex-level OFL	GOA Tier 6 Other Rockfish, GOA Tier 6 Demersal Shelf Rockfish

Table 2. Priority Tier 6 stocks and variety of potential assessment approaches based on FishPath results and information available.

Stock	Potential methods supported by data quality and availability
GOA Octopus	Indicators (sequential triggers, decision trees, CPUE, traffic lights)
GOA Pacific sleeper shark	Catch only (ORCS), Indicators (sequential triggers, decision trees, CPUE, traffic lights)
GOA Salmon shark	Catch only (ORCS), Indicators (sequential triggers, decision trees, CPUE, traffic lights)
GOA quillback (SEAK only)	Catch only (depletion analyses, ORCS), indicators (sequential triggers, decision trees, CPUE, traffic lights), dynamics model (extended depletion analysis, production model)
GOA yelloweye (outside SEAK)	Catch only (depletion analyses, ORCS), indicators (sequential triggers, decision trees, CPUE, traffic lights), dynamics model (extended depletion analysis, production model)
BSAI Octopus	FishPath not completed

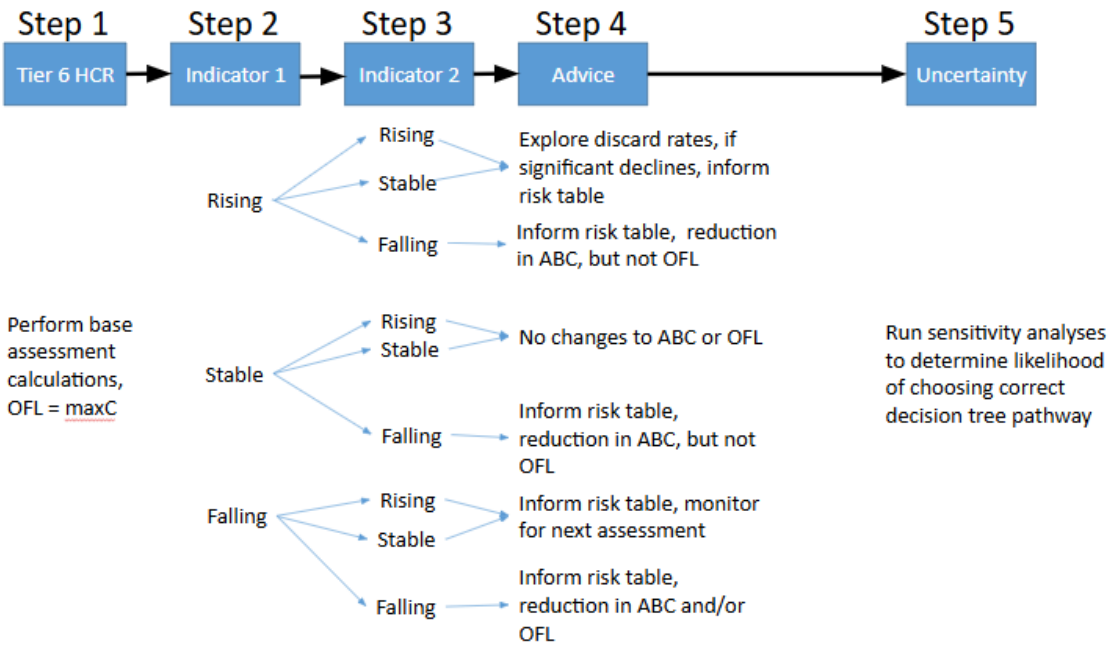

Figure 1. Hypothetical flow chart for the GOA octopus stock complex decision tree.