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Stock Assessment Classification and Gap Analysis for Federally Managed Stocks in the Alaska Ecosystem Complex

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February 2023

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Stock Assessment Classification and Gap Analysis for Federally Managed Stocks in the Alaska Ecosystem Complex

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Executive Summary

A consistent approach to tracking and classifying stock assessments is needed to set priorities that are at the level and frequency most appropriate for each stock. A major focus of the Next Generation Stock Assessment Improvement Plan (NGSAIP) is developing a portfolio of "right-sized" assessments (Lynch et al. 2018) and includes a new stock assessment classification system that focuses on tracking the current status of the stock assessment enterprise and establishing targets for each stock's assessment. The NGSAIP stock assessment classification system includes categorization of five data input attributes, a high-level description of the assessment model complexity, and the age of the assessment. Current and target levels of the classification system are calculated following guidelines detailed in the NGSAIP (see chapter 10 in Lynch et al. 2018). By comparing current status to targets, we can identify regional stock assessment gaps on a stock-by-stock and data-category-by-data-category basis. This provides an important planning tool to inform strategic decisions for stock assessments, and track performance of the stock assessment enterprise. It also gives the National Marine Fisheries Service (NOAA Fisheries) a strong business case to justify continued investment in stock assessments.

This document reviews the efforts of staff from the Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G) to classify all managed North Pacific Fishery Management Council (NPFMC) stocks using the NGSAIP stock assessment data classification system. Current and target levels for the five data attributes are provided for a total of 69 groundfish, crab, salmon, and scallop stocks from the Gulf of Alaska (GOA), Bering Sea and Aleutian Islands (BSAI), Eastern Bering Sea (EBS), and the Arctic fishery management areas. Results for the gap analysis are summarized by data attribute over all stocks combined, by Fishery Management Plan (FMP), and by stock groupings. This information may be useful for strategic planning purposes and to identify future research priorities for all managed NPFMC stocks in a consistent and transparent fashion.

Background

Nationally, the demand for technical management advice from stock assessments greatly exceeds current capacity. Even for the North Pacific, where the Alaska Fisheries Science Center (AFSC) and their management partners at the North Pacific Fishery Management Council (NPFMC) have a well-developed system of data collection, stock assessment, and provision of management advice, there are needs for increased data collection and analysis to inform more holistic management, particularly given regional climate impacts. A major focus of the Next Generation Stock Assessment Improvement Plan (NGSAIP; Lynch et al. 2018) is developing a portfolio of "right-sized" assessments. The portfolio approach described in the NGSAIP provides a basis to maximize assessment resources, guide future investments, and best meet management needs to achieve sustainable fisheries. There are five main components to this portfolio approach are as follows:

1. Classify stock assessments conducted by the National Marine Fisheries Service using the stock assessment classification system. This classification system provides a nationally consistent approach to categorize assessment analyses based on five data input attributes, in addition to the Model Category (i.e., complexity of the assessment model) and Assessment Age (years since the assessment was completed; see table 10.1 of Lynch et al. 2018).
2. Establish stock-specific assessment targets for assessment frequency and each of the five data input attributes.
3. Develop annual prioritized lists of stocks for assessment using the process outlined in the stock assessment prioritization guidance (Methot 2015, Lynch et al. 2018).
4. Conduct regional gap analyses by comparing current stock assessment classification levels with the identified targets. Gaps may be analyzed on a stock-by-stock and data category-by-data category basis as well as summarized at broader levels for evaluation and planning.
5. Use the results of the gap analyses to guide strategic planning, track performance, and provide a strong business case to justify additional investments in the stock assessment enterprise where most needed. Stock assessment gap analysis results will also guide other strategic planning efforts (e.g., survey prioritization).

This document describes the efforts of staff at the AFSC and the Alaska Department of Fish and Game (ADF&G) on components 1, 2, and 4 of the portfolio approach listed above. The AFSC addressed the third component during an earlier exercise with the NPFMC. Details are not included in this document; please refer to Hollowed et al. (2016) for more information. Briefly, the stock assessment prioritization process for Alaska resulted in a trial modification of the assessment schedule for some stocks pending re-evaluation. Because AFSC staff and its partners assess all managed NPFMC stocks on a regular schedule, there was not a need to develop annual prioritized lists for stock assessment planning. The last item described for the portfolio approach, using results of the gap analysis to inform planning, will be an ongoing process within each region and at the national level.

AFSC and ADF&G staff agreed to 'pilot test' the target setting process for stock assessment data input attributes on NPFMC groundfish and crab stocks to help refine the guidance. Stocks managed in Alaska waters vary widely from data-rich to data-limited, and the associated stock

assessments cover single-species to multi-species stock complexes. Thus, this grouping provided a robust variety of assessed stocks to test the process on and identify potential issues. Recently, remaining NPFMC stocks were analyzed by AFSC and ADF&G staff, including salmon, scallops, and Arctic species (e.g., Arctic cod, saffron cod, snow crab).

Classifying Stock Assessments and Setting Targets Methods

Identifying the List of Stocks

We created an initial list of stocks for classification and target setting based off the list of NPFMC stocks managed under the crab and two groundfish fishery management plans (additional stocks managed by the NPFMC were added later). This information is available in the Species Information System database (SIS; https://www.st.nmfs.noaa.gov/sis). To further refine this stock list, we split out complex members based on current (or near-term expected) assessment structure or data differences. For example, we considered data-rich indicator stocks assessed with an age-structured model separate from the remainder of the complex species modeled using data-limited techniques. We considered a total of 69 stocks and stock complexes under NPFMC management for the Alaska regional stock classification and gap analysis exercise. This included some complex members that we considered separately from the remainder of the complex.

Collecting Information from Regional Experts

We added the names of the lead assessment analyst as the 'point of contact' for each stock in the assembled stock list (the assessment of all managed stocks in Alaska at regular intervals make this possible). In-house stock authors at the AFSC provided information for a majority of the groundfish and some crab stocks (n = 58), but we also coordinated with stock authors and subject matter experts at ADF&G to complete remaining forms (n = 11; crab, salmon, and scallop stocks). We collected feedback for classification and gap analysis activity from this group of distributed assessment analysts quickly and consistently using a Google form (Appendix A). The form included questions on the current level of data used in stock assessments as well as expert opinion on the target levels required for each of the five data input attributes described in the NGSAIP (Table 1). These five data input attributes represent an updated version of the data input categories defined in the original Stock Assessment Improvement Plan (NMFS 2001) and previously used to track stock assessments.

Table 1. -- The five main data input categories used in the stock assessment process, defined by increasing levels from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Level	Definition
Catch *Important Considerations: Assessments using traditional statistical methods often assume high or complete certainty in the understanding of fishery removals; limited catch monitoring may be sufficient for stocks that are subject to little or no fishing*	
0	No quantitative catch data
1	Some catch data, but major gaps for some fishery sectors or historical periods such that their use in assessments is not supported
2	Enough catch data establish magnitude of catch and trends in catch for a major fishery sector in order to apply a data-limited assessment method; this includes fisheries that are closed and it is known that negligible catch is occurring
3	Catch data is generally available for all fishery sectors to support quantitative stock assessment, but some gaps exist such as low observer coverage, high levels of self-reported catch, weak information on discard mortality
4	No data gaps substantially impede assessment, but catch is not without uncertainty (e.g., recreational catches estimated from surveys)
5	Very complete knowledge of total catch
Size/Age Composition *Important Considerations: Assessments that include composition data produce more complete descriptions of the effects of fishing on populations and may improve the ability to estimate natural mortality when estimated within the model; collection and processing of size/age data requires significant resources and may not be worth the effort for lower value stocks*	
0	No composition data collected
1	Some size or age composition data has been collected, but major gaps in coverage, and not used in stock assessment
2	Enough size or age composition data has been collected to enable data-limited assessment approaches
3	Enough size or age composition data is collected over a sufficient time series to be informative in age/size structured assessment models
4	Enough age composition data has been collected over a sufficient time series to enable assessment methods that need age composition data from the fishery
5	Very complete age and size composition data, including, as needed on stock-specific basis, knowledge of ageing precision, spatial patterns or other issues

Abundance *Important Considerations: Abundance trends are useful indicators of stock dynamics for baseline monitoring for unassessed stocks, but fishery catch rates alone can lead to biased conclusions about abundance and stock dynamics*	
0	No indicator of stock abundance or trend in stock abundance over time
1	Fishery-dependent catch rates (CPUE) are available, but high uncertainty about their standardization over time; or expert opinion on degree of stock depletion over time
2	Fishery-dependent catch rates (CPUE) are sufficiently standardized to enable their use in full assessments; data from fishery-independent sources are not available or sufficient to estimate abundance trends
3	Limited fishery-independent survey(s) provide estimates of relative abundance; however, the temporal or spatial coverage of the stock is limited or the sampling variability is high
4	Complete fishery-independent survey(s) provide estimates of relative abundance, and the survey(s) cover a large proportion of the spatial extent of the stock with several years of tracking at a level of precision that supports assessments
5	Calibrated fishery-independent survey(s) or tag-recapture provide estimates of absolute abundance
Life History *Important Considerations: Detailed biological information isolates fishing impacts on a stock and improves assessment precision and accuracy; less important stocks may be successfully managed with less complete life history data*	
0	No life history data
1	Estimates of most life history factors not based on empirical data; instead derived using proxies, meta-analyses, borrowed from other species, or without scientific basis
2	Estimates of some life history factors based on stock-specific empirical data, but at least one derived using life history proxies, meta-analyses, borrowed from other species, or without scientific basis; generally supports data-poor assessments that use life history information
3	Estimates of most life history factors based on stock-specific empirical data
4	Data are sufficient to track changes over time in at least growth
5	No major gaps in life history knowledge, including detailed stock structure, spatial and temporal patterns in natural mortality, growth, and reproductive biology

Ecosystem Linkage *Important Considerations: Ecosystem dynamics (e.g. environment, climate, habitat, predator-prey relationships) may be considered at multiple phases in the assessment or management process (e.g., sensitivity runs, survey design, informing ABC, etc.) and may be linked to a variety of processes in the assessment (e.g., mortality, growth, recruitment, fecundity, catchability); including ecosystem dynamics in an assessment model does not always improve management advice; some stocks may not have evidence or available data to suggest stock/fishery dynamics are tightly coupled with a variable ecosystem feature*	
0	No linkage to ecosystem dynamic or consideration of ecosystem properties (environment, climate, habitat, predator-prey, etc.) in configuring the assessment (i.e., equilibrium conditions assumed for ecosystem)
1	Ecosystem-based hypotheses inform the assessment model structure (e.g., defining the stock boundaries and/or spatial or temporal features) and/or are used for processing assessment inputs (e.g., abundance index), but no explicit linkage to any ecosystem drivers (environment, climate, habitat, predator-prey, etc.)
2	The assessment includes some form of variability or effect to explicitly account for unidentified ecosystem dynamic(s) (e.g., time/space "regimes", random variation, or other approaches to changing features without direct inclusion of ecosystem data)
3	One or more assessment features is linked to a dynamic (i.e., data) from at least one of the following categories: environment, climate, habitat, predator-prey data (e.g., covariate)
4	The assessment model is linked to at least one ecosystem dynamic; and one or more process studies directly support the manner in which environmental, climate, habitat, and/or predator-prey dynamics are incorporated (e.g., consumption rates measured and covariate informed by results)
5	The assessment approach is configured to be coupled or linked with an ecosystem process (e.g., multispecies, coupled biophysical, climate-linked models)

Working with the stock authors and experts (from both the AFSC and ADF&G), we completed data collection on classifications in ~2.5 months. Lead assessment authors completed one form for each stock or stock complex on the stock list. In addition to providing information on current and target data levels, authors also provided additional stock information to calculate baseline data targets (see chapter 10 in Lynch et al. 2018) and reasoning behind the selected data targets. Additional stock information for calculating baseline data targets included the following:

- Metrics on catch targeting or bycatch
- Level of recruitment variability
- Feasibility of absolute abundance estimation
- Habitat reliance for the stock or stock complex
- Whether the current assessment model exhibited issues that could be address by including ecosystem dynamics

To help participants understand the process and requirements, a summary document including definitions and descriptions of the classification and gap analysis activity was prepared (Appendix B). We shared this document with stock authors during an initial webinar where participants could ask questions and provide feedback. This webinar, held prior to distributing the form, was an important initial step towards improving consistency in the form responses. However, participants had additional questions on setting data targets for specific assessment situations once they viewed the form. We held two additional Q&A sessions via webinar during the scoring process and maintained an accessible running frequently asked questions (FAQ) document to participants to reference. These additional efforts proved particularly useful in helping authors complete forms accurately and consistently. Although some of the information provided in the FAQ document is specific to the Alaska assessment program, many of the questions identified common issues; the document is provided in Appendix C for reference.

A particular consideration for authors when setting data targets was the specific management needs for the stock, related to fishery value, ecosystem importance, and other factors. Realistically, it is neither necessary nor feasible to conduct the most data-rich, ecosystem-linked assessments for every stock every year. Additionally, management advice for stable stocks (e.g., low variability in annual catch advice) may benefit little from frequent reassessment, while conducting data-intensive assessments of minor stocks may not be worth the effort when such stocks can be reasonably managed using more data-moderate assessment approaches. Establishing reasonable data targets to support decisions regarding data collection, assessment approach, and assessment frequency, is essential to ensure efficient use of assessment and management resources. This process requires the target data levels to reflect a critical consideration of the assessment and management needs for the stock and the data requirements to meet those needs.

We reviewed submitted forms once all forms were complete to check for any inconsistencies, missing elements, or double entries and worked with authors to resolve any outstanding issues; this process was completed in July 2019.

Current Stock Assessment Classifications

Current stock assessment classifications for the five data input attributes describe how comprehensively the most recent assessment for each stock or stock complex was completed. We required participants to base classifications on information *actually used* in the most recently completed assessment. While there may often be additional data available to support assessments that are not incorporated into current model configurations, for this process it was important to consider current utilization within the stock assessment models. Doing so allowed decision makers to identify and prioritize gaps, as well as strategize the appropriate methods to fill gaps. To classify unassessed stocks, we asked authors to consider the level of data available and how *likely these data were to be used* in an assessment in the near-term.

Calculating Baseline Target Levels

The NGSAIP provides calculations to determine baseline target levels for each of the five data input attributes (see chapter 10 in Lynch et al. 2018). We used information collected during stock assessment prioritization (Methot 2015) on fishery importance and ecosystem importance along with information collected from the form responses as input for these calculations. Note that generally, the target calculations specified in the NGSAIP do not utilize the full range of data input levels specified. Baseline target levels were not calculated for stocks in the Arctic, salmon,

or scallop management areas as these stocks were not included in the stock assessment prioritization exercise that focused on crab and groundfish stocks.

We made one minor modification to the NGSAIP calculation for ecosystem linkage baseline target levels. The calculation provided in the NGSAIP specifies target levels of 0/1/2/4/5 and is calculated as a cumulative adjustment score. We found this approach did not allow for enough contrast between individual stocks. As an interim adjustment, we added level 3 to allow for additional contrast in the baseline calculated target levels. Separating level 2 from level 3 was particularly important in the NPFMC system (and likely elsewhere), where level 3 ecosystem linkages are a critical first step toward including ecosystem information within the assessment model framework.

We considered it especially important to calculate these baseline target levels for comparison against the data targets suggested by stock authors because the classification and gap analysis for Alaska stocks was a "pilot" of the national guidance. Indeed, the NGSAIP states these calculated baseline target levels "should be evaluated and considered in the context of other information…" Such comparisons enabled an early and rough performance testing of the NGSAIP data target level calculations.

Finalizing Regional Assessment Targets

We established an informal regional review panel comprised of assessment program leads and leaders of the NPFMC Groundfish and Crab Plan Teams. This review panel selected the final stock assessment target levels for data input attributes, utilizing the following information available from the classification process:

- Calculated baseline target levels
- Stock assessment author expert target levels
- Rationale provided by stock assessment authors

The panel reviewed and compared each of these pieces of information for each stock during July 2019. In situations where there was a difference between the calculated baseline target level and the target level identified by the stock author, the review panel discussed and 1) selected the baseline target level, 2) selected the author target level, or 3) identified a different target level. In cases where the panel made changes, they provided a rationale for transparency and record keeping. Generally, the review panel deferred to the levels provided by the stock author for both current and target levels, but they also took into consideration author rationale and the calculated baseline target levels. We provided an informational summary presentation of the results of the classification exercise to the Joint BSAI, GOA, and EBS Crab Plan Teams in September 2019.

Calculating Current Stock Assessment Information Gaps

We completed the gap analysis portion by conducting a simple comparison of the final target levels against the current level classifications. This process provided detailed information on current data gaps on a stock-by-stock and data category-by-data category basis; this information is also available to summarize at various other levels (e.g., by Fishery Management Plan (FMP) or by functional groupings, by survey targets, etc.) to support strategic planning processes.

Alaska Stock Assessment Classifications and Targets Results

Table 2 lists comprehensive results for Alaska stocks in this process, including current assessment levels and the three components provided to the review panel -- calculated baseline targets, author or expert targets (simplified to expert target in the table), and rationale. An additional column in the table provides the final target set by the review panel, which was often in agreement with the expert targets. The few exceptions where the review panel decided that it was appropriate to adjust the expert targets were based on current increases in data levels that had not been considered by the stock authors (e.g., new surveys or exploration of ecosystem linkages where process studies already exist); these adjustments were generally small (i.e., one level).

Table 2. -- Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Groundfish of the Bering Sea and Aleutian Islands Management Area							
Alaska plaice – Bering Sea / Aleutian Islands	Tom Wilderbuer, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	2	4	4	Age structured model used for current assessment
		Abundance	5	4	5	5	Process studies on herding and escapement exist for the survey and start date used in model for population availability
		Life History	4	2	4	4	Current level of information is sufficient for model
		Ecosystem Linkage	3	2	3	3	Calculated target is too low with little differentiation across stocks
Alaska skate – Bering Sea / Aleutian Islands	Olav Ormseth, AFSC	Catch	3	5	5	5	
		Size/Age Comp	3	4	3	3	Non-target stock, current data are sufficient for the model
		Abundance	4	5	4	4	Current survey data are sufficient for the assessment
		Life History	4	4	4	4	
		Ecosystem Linkage	2	3	2	2	Calculated target shows little differentiation across stocks; current level is appropriate for this stock

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Arrowtooth flounder – Bering Sea / Aleutian Islands	Ingrid Spies, AFSC	Catch	4	2	4	4	Catch accounting is available for all stocks
		Size/Age Comp	4	4	3	3	Ages are sufficient for age-structured model
		Abundance	4	3	4	4	Stock is of high ecosystem importance and has reliable and consistent surveys
		Life History	3	4	4	4	
		Ecosystem Linkage	3	2	4	4	Calculated target is too low with little differentiation across stocks; exploring linkages to the ecosystem would be helpful for understanding the recent upward trend in abundance
Atka mackerel – Bering Sea / Aleutian Islands	Sandra Lowe, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	5	5	5	
		Abundance	4	5	4	4	High degree of sampling variability in survey
		Life History	4	5	5	5	
		Ecosystem Linkage	2	4	3	3	Calculated target shows little differentiation across stocks; exploration of linkages to environment, climate, and/or habitat data is needed
Bering Sea / Aleutian Islands Blackspotted and Rougheye Rockfish Complex	Paul Spencer, AFSC	Catch	4	5	5	5	
		Size/Age Comp	4	4	5	5	Concerns over spatially disproportionate harvesting; more comprehensive age comp data will help resolve issues
		Abundance	4	4	4	4	
		Life History	4	4	4	4	
		Ecosystem Linkage	2	2	3	3	Calculated target too low with little differentiation across stocks; important to consider how recruitment varies in relation to environmental factors such as temperature

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Bering Sea / Aleutian Islands Flathead Sole Complex	Carey McGilliard, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	4	5	5	Increased age samples would benefit the assessment and understanding of stock structure
		Abundance	4	4	4	4	
		Life History	4	4	4	4	
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks; ecosystem factors may be useful for interpreting model results or guiding future model development
Bering Sea / Aleutian Islands Octopus Complex	Olav Ormseth, AFSC	Catch	3	2	3	3	Catch accounting is available for all stocks
		Size/Age Comp	2	4	2	2	Species in complex are difficult to age and not sampled well in groundfish surveys
		Abundance	3	3	3	3	
		Life History	1	4	2	2	Surveys do not sample this complex well but some improvement in life history data would benefit the assessment
		Ecosystem Linkage	1	2	2	2	
Bering Sea / Aleutian Islands Other Flatfish Complex	Tom Wilderbuer, AFSC	Catch	5	5	4	4	Low exploitation rates on stock and a Tier 5 assessment lower catch target would be sufficient
		Size/Age Comp	1	2	1	1	Low priority stocks; not currently an age-structured assessment
		Abundance	4	4	4	4	
		Life History	2	2	2	2	
		Ecosystem Linkage	0	2	0	0	Calculated target shows little differentiation across stocks; no linkages to the environment have been explored for these Tier 5/6 stocks

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Bering Sea / Aleutian Islands Other Rockfish Complex	Ingrid Spies, AFSC	Catch	2	5	5	5	
		Size/Age Comp	1	4	4	4	
		Abundance	3	4	4	4	
		Life History	3	4	4	4	
		Ecosystem Linkage	0	2	4	4	Calculated target too low with little differentiation across stocks; a better understanding of how the abundance of this complex relates to the ecosystem would be useful
Bering Sea / Aleutian Islands Other Skates Complex	Olav Ormseth, AFSC	Catch	3	5	5	5	
		Size/Age Comp	2	2	2	2	
		Abundance	3	4	4	4	
		Life History	2	2	3	3	Only basic life history information exists for some stocks in the complex; it would be helpful for the assessment if all stocks had this available
		Ecosystem Linkage	1	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Bering Sea / Aleutian Islands Rock Sole Complex	Tom Wilderbuer, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	4	5	5	Process study would help validate comps
		Abundance	5	5	5	5	
		Life History	4	4	4	4	
		Ecosystem Linkage	4	2	4	4	Calculated target too low with little differentiation across stocks; dendrochronology studies indicate high correlation of somatic growth with bottom water temperature for this stock and recruitment studies indicate positive correlations of strong year-classes with percent of nursery in cold pool and springtime wind direction (expert level maintains assessment at current level)
Bering Sea / Aleutian Islands Shark Complex	Cindy Tribuzio, AFSC	Catch	2	5	2	2	Complex consists of rare, large species at the edge of their range and a Tier 6 assessment
		Size/Age Comp	1	4	2	2	Species are difficult to age; ongoing projects may utilize data-limited methods
		Abundance	1	4	2	2	Surveys do not sample these species well; currently developing a standardized fishery-dependent CPUE to be used with fishery-independent data sources
		Life History	1	4	2	2	Ongoing research should inform some stock specific life history parameters, but assessment will still borrow from other regions
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks; unlikely that ecosystem linkage research will be conducted for this data-limited assessment in the near future

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Greenland halibut – Bering Sea / Aleutian Islands	Meaghan Bryan, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	4	4	4	
		Abundance	3	4	4	4	
		Life History	3	4	4	4	
		Ecosystem Linkage	2	2	3	3	Calculated target too low with little differentiation across stocks; recruitment has been hypothesized to be linked to the cold pool extent and has been explored in the assessment model and should continue to be explored; additionally, with continued warming in the Bering Sea, there is concern about recruitment failure and its impact on this stock; whale depredation mortality on this stock as a model input should also be explored since there is a longline survey index that can be used and the other current slope survey is no longer funded
Kamchatka flounder – Bering Sea / Aleutian Islands	Meaghan Bryan, AFSC	Catch	4	5	5	5	
		Size/Age Comp	3	4	4	4	
		Abundance	3	4	4	4	
		Life History	3	4	4	4	
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Northern rockfish – Bering Sea / Aleutian Islands	Paul Spencer, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	4	5	5	Low age samples in some areas, and size-at-age varies spatially, so more age samples would improve assessment
		Abundance	4	4	4	4	
		Life History	4	4	4	4	
		Ecosystem Linkage	2	2	3	3	Calculated target too low with little differentiation across stocks; important to consider how recruitment varies in relation to environmental factors such as temperature
Pacific cod – Aleutian Islands	Grant Thompson, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	4	4	4	
		Abundance	3	5	4	4	Age-structured model development has been requested by NPFMC for this stock and would benefit from more frequent surveys that cover the habitat for this stock
		Life History	1	4	4	4	
		Ecosystem Linkage	2	2	2	2	
Pacific cod – Bering Sea	Grant Thompson, AFSC	Catch	4	5	5	5	
		Size/Age Comp	4	5	5	5	
		Abundance	3	5	5	5	
		Life History	4	5	5	5	
		Ecosystem Linkage	2	2	4	4	Calculated target too low with little differentiation across stocks; assessment could be improved by establishing mechanistic relationships governing the apparent large-scale movements between the Eastern and Northern Bering Sea

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Pacific ocean perch – Bering Sea / Aleutian Islands	Paul Spencer, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	5	5	5	
		Abundance	4	5	4	4	Calibrated surveys and tag-recapture not anticipated
		Life History	4	5	4	4	Current data are sufficient
		Ecosystem Linkage	2	3	3	3	
Shortraker rockfish – Bering Sea / Aleutian Islands	Ingrid Spies, AFSC	Catch	2	5	5	5	
		Size/Age Comp	1	4	4	4	
		Abundance	3	4	4	4	
		Life History	2	4	4	4	
		Ecosystem Linkage	0	2	4	4	Calculated target too low with little differentiation across stocks; additional ecosystem research would lead to better management for this stock
Walleye pollock – Aleutian Islands	Steve Barbeaux, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	5	5	5	
		Abundance	3	5	4	4	Concern for disconnect between fishery and survey - biannual summer surveys with a winter fishery
		Life History	2	5	3	3	Maturity is based on GOA pollock stock and useful to elevate but area-specific life history information not needed for assessment
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Walleye pollock – Bogoslof	Jim Ianelli, AFSC	Catch	5	2	5	5	Catch accounting is available for all stocks
		Size/Age Comp	4	4	4	4	
		Abundance	4	3	4	4	Stock is linked to International Central Bering Sea Treaty
		Life History	4	4	4	4	
		Ecosystem Linkage	0	2	0	0	Calculated target shows little differentiation between stocks; stock in minor area
Walleye pollock – Eastern Bering Sea	Jim Ianelli, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	5	5	5	
		Abundance	4	5	4	4	Current surveys are sufficient
		Life History	4	5	4	4	Current data are sufficient
		Ecosystem Linkage	4	2	4	4	Calculated target too low with little differentiation across stocks; including process information is an important component of the stock dynamics
Yellowfin sole – Bering Sea / Aleutian Islands	Tom Wilderbuer, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	4	5	5	Current ages are validated with a process study and complete size/age information is available from fishery/surveys
		Abundance	5	5	5	5	
		Life History	4	4	5	5	Genetics study would help determine if there are two spawning stocks in the Bering Sea
		Ecosystem Linkage	4	2	4	4	Calculated target too low with little differentiation across stocks; expert target maintains assessment at current level

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Groundfish of the Gulf of Alaska							
Arrowtooth flounder – Gulf of Alaska	Ingrid Spies, AFSC	Catch	4	2	4	4	Catch accounting is available for all stocks
		Size/Age Comp	4	4	3	3	Size at age is used for conversion matrix that is necessary to the model
		Abundance	4	3	4	4	Data from surveys are reliable, consistent, and sufficient for this assessment
		Life History	3	4	4	3	
		Ecosystem Linkage	2	2	3	2	Calculated target too low with little differentiation across stocks; would be helpful to understand the reason for the increase in stock abundance over the past few decades, whether it is ecosystem or predator-prey or temperature
Atka mackerel – Gulf of Alaska	Sandra Lowe, AFSC	Catch	1	2	2	2	
		Size/Age Comp	1	4	2	2	Bycatch-only fishery; stock is at the range of its distribution and only needs sufficient sample sizes for a data-limited approach (currently a Tier 6 assessment)
		Abundance	0	3	1	1	Surveys do not sample this stock well and fishery CPUE would be informative
		Life History	3	4	4	4	
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks; more information on spatial boundaries would be useful

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Big skate – Gulf of Alaska	Olav Ormseth, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	4	3	3	Non-target stock, current data collection is sufficient for assessment
		Abundance	4	5	4	4	Current survey data are appropriate for the assessment
		Life History	4	4	5	5	More data are needed on stock structure and spatial patterns in life history to properly assess this stock
		Ecosystem Linkage	1	2	2	2	
Dover sole – Gulf of Alaska	Carey McGilliard, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	2	3	3	Catch of this stock has been low in recent years (but with the potential to be higher occasionally based on fishing behavior) – not reasonable to assume fishery age data will be obtainable in the near future, but fishery length data and survey age/length data is available and useful/necessary to assess the stock due to movement dynamics of the stock, time-varying growth, and knowledge of scale from the combination of proportion-at-age and natural mortality
		Abundance	4	4	4	4	
		Life History	4	2	4	4	An updated maturity schedule that covers a broad spatial and temporal extent for the stock would improve the assessment
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Dusky rockfish – Gulf of Alaska	Kari Fenske, AFSC	Catch	4	5	4	4	Catch accounting available for all stocks
		Size/Age Comp	4	4	4	4	
		Abundance	3	5	4	4	Improved survey estimates are needed – the current survey does not sample this stock's habitat well and produces high sampling variability
		Life History	1	4	2	2	More stock-specific information would be helpful
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks
Flathead sole – Gulf of Alaska	Carey McGilliard, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	4	4	4	
		Abundance	4	4	4	4	
		Life History	4	4	4	4	
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks; ecosystem factors do not appear to have a big influence on the stock that can be identified at this time
Gulf of Alaska Blackspotted and Rougheye Rockfish Complex	Kalei Shotwell, AFSC	Catch	4	5	5	5	
		Size/Age Comp	4	4	4	4	
		Abundance	4	4	4	4	
		Life History	4	4	4	4	
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Gulf of Alaska Demersal Shelf Rockfish Complex	Ben Williams, AFSC	Catch	2	2	2	2	
		Size/Age Comp	1	4	1	1	It is unlikely that projects incorporating size/age information will be utilized for these stocks
		Abundance	1	3	1	1	Stocks in this complex are typically caught at low levels
		Life History	0	4	0	0	Low catch levels do not provide enough information to inform a stock assessment that includes life history information
		Ecosystem Linkage	0	2	0	0	Calculated target shows little differentiation across stocks; assessment is Tier 6
Gulf of Alaska Octopus Complex	Olav Ormseth, AFSC	Catch	3	2	3	3	Catch accounting available for all stocks
		Size/Age Comp	2	4	2	2	Species difficult to age; groundfish surveys do not sample well
		Abundance	3	3	3	3	
		Life History	1	4	2	2	Surveys do not sample well but some improvement in life history data would be beneficial to the assessment
		Ecosystem Linkage	1	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Gulf of Alaska Other Deepwater Flatfish Complex	Carey McGilliard, AFSC	Catch	3	2	2	2	
		Size/Age Comp	0	2	0	0	Stocks in this complex are found in very low abundance and catch levels – there are too few to collect the quantity of biological samples that would be needed to support a quantitative assessment
		Abundance	4	3	4	4	Survey can provide an index of relative abundance for these species and contains information on where in the Gulf they are found
		Life History	1	2	1	1	Low abundance in the survey and biological samples are not taken
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks; could potentially hypothesize about ecosystem influences based on shifts in distribution or changes in relative abundance in the survey data
Gulf of Alaska Other Rockfish Complex	Cindy Tribuzio, AFSC	Catch	3	5	3	3	Catch accounting available for all stocks; low coverage in the eastern Gulf of Alaska; unknown how electronic monitoring will impact this stock
		Size/Age Comp	1	4	2	2	Current research will be incorporated into the future assessments to explore data-limited methods
		Abundance	3	5	3	3	Current surveys do not sample the stock well and spatial variability is high
		Life History	2	4	2	2	Many of the stocks use borrowed life history parameters
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Gulf of Alaska Other Shallow Water Flatfish Complex	Meaghan Bryan, AFSC	Catch	4	2	4	4	Catch accounting available for all stocks
		Size/Age Comp	1	2	2	2	
		Abundance	3	3	4	4	Fishery-independent biomass estimates are used for this Tier 5 assessment, and the annual variability in the design-based estimates is somewhat large, so an improvement in annual variability would improve management advice
		Life History	0	2	2	2	
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks; competitive interactions may influence changes in abundance of the individual species in this complex and it would be worthwhile to consider when interpreting biomass trends over time
Gulf of Alaska Other Skates Complex	Olav Ormseth, AFSC	Catch	3	5	5	5	
		Size/Age Comp	2	2	2	2	
		Abundance	4	4	4	4	
		Life History	2	2	3	3	Basic life history has been collected for several of the stocks in this complex, but it would be good to have data for all species and the existing data needs to be updated
		Ecosystem Linkage	1	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Gulf of Alaska Shark Complex	Cindy Tribuzio, AFSC	Catch	3	5	3	3	Low observer coverage for stocks; Tier 5/6 assessment
		Size/Age Comp	1	5	2	2	Species are difficult to age, no plans to expand research
		Abundance	3	5	3	3	Surveys do not sample the spatial extent of the stocks
		Life History	3	5	3	3	Information on the complex indicator stock informs the assessment model; other stocks in the complex would be at lower target
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks; unlikely ecosystem linkage research will be conducted for this data-limited assessment in the near future
Gulf of Alaska Thornyhead Rockfish Complex	Katie Echave, AFSC	Catch	2	5	3	3	Catch accounting available for all stocks; unknown how electronic monitoring will impact this stock
		Size/Age Comp	2	4	3	3	Better collection of complete size range (small fish) would allow for improved size compositions
		Abundance	3	4	3	3	Current surveys do not capture the full depth range of this stock
		Life History	2	4	4	4	
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Longnose skate – Gulf of Alaska	Olav Ormseth, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	2	3	3	Non-target stock, current data collection is sufficient for assessment
		Abundance	4	4	4	4	
		Life History	4	2	5	5	More data are needed on stock structure and spatial patterns in life history to properly assess this stock
		Ecosystem Linkage	1	2	2	2	
Northern rock sole – Gulf of Alaska	Meaghan Bryan, AFSC	Catch	3	5	4	4	Currently catch is reported as 'rock sole' and a proportional constant is applied to separate northern and southern rock sole from the total – the single species assessment would be improved if catch were reported at the species level
		Size/Age Comp	3	2	4	4	The current age-structured assessment uses size composition data from the fishery, but age composition data would be beneficial to better inform fishery selectivity given the variability in length at age for this species – would reduce uncertainty in selectivity that is propagated in the reference points
		Abundance	4	4	4	4	
		Life History	3	2	4	4	Current estimates are seemingly adequate for management, but if changes in growth or other biological parameters due to changing climate are occurring this would be valuable information to have
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Northern rockfish – Western / Central Gulf of Alaska	Pete Hulson, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	4	4	4	
		Abundance	3	5	4	4	Current efforts to quantify rockfish abundance may aid in increasing the information for this stock
		Life History	3	4	4	4	
		Ecosystem Linkage	2	2	2	2	
Pacific cod – Gulf of Alaska	Steve Barbeaux, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	4	5	5	There are considerable life history differences for Pacific cod over relatively small spatial scales; temporal and spatial differences in growth is prevalent for this species; some issues with age reading that are being clarified through Oxygen 18 analysis and rereading experiments
		Abundance	4	5	4	4	The current two surveys used in the assessment adequately cover the spatial distribution of the stock
		Life History	4	4	5	5	There is a growing body of evidence to suggest there may be substructure in the current stock delineation that would necessitate a different modeling approach or partitioning
		Ecosystem Linkage	3	2	5	5	Calculated target too low with little differentiation across stocks; ecosystem is driving large shifts in population dynamics; currently developing a multi-species model and climate-linked assessment to recruitment, growth, and natural mortality

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Pacific ocean perch – Gulf of Alaska	Pete Hulson, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	5	5	5	
		Abundance	4	5	4	4	Current sampling is adequate; do not anticipate a calibrated survey or tagging
		Life History	4	5	4	4	Current data is sufficient for the assessment
		Ecosystem Linkage	2	3	4	4	Calculated target too low with little differentiation across stocks; future research will be conducted to integrate environmental indices into stock assessment parameters
Rex sole – Gulf of Alaska	Carey McGilliard, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	4	5	5	This stock has exhibited spatial patterns in growth that have large effects on reference points if not accounted for or if fishery age data are not included in the assessment
		Abundance	4	4	4	4	
		Life History	4	4	5	5	The maturity and fishery selectivity curves are similar and filling gaps in uncertainty about maturity could make a big difference in the reference points
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Rock sole – Gulf of Alaska	Meaghan Bryan, AFSC	Catch	3	5	4	4	Currently catch is reported as 'rock sole' and a proportional constant is applied to separate northern and southern rock sole from the total – the single species assessment would be improved if catch were reported at the species level
		Size/Age Comp	3	2	4	4	The current age-structured assessment uses size composition data from the fishery, but age composition data would be beneficial to better inform fishery selectivity given the variability in length at age for this species – would reduce uncertainty in selectivity that is propagated in the reference points
		Abundance	4	4	4	4	
		Life History	3	2	4	4	Current estimates are seemingly adequate for management, but if changes in growth or other biological parameters due to changing climate are occurring this would be valuable information to have
		Ecosystem Linkage	2	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Sharpchin rockfish – Gulf of Alaska	Cindy Tribuzio, AFSC	Catch	3	5	3	3	Catch accounting available for all stocks; low coverage in the eastern Gulf of Alaska; unknown how electronic monitoring will impact this stock
		Size/Age Comp	2	4	2	2	Current research will be incorporated into future assessments to explore data-limited methods
		Abundance	3	4	3	3	Current surveys do not sample the stock well and spatial variability is high
		Life History	2	4	2	2	Stock uses borrowed life history parameters
		Ecosystem Linkage	1	2	1	1	Calculated target shows little differentiation across stocks
Shortraker rockfish – Gulf of Alaska	Katie Echave, AFSC	Catch	2	5	3	3	Catch accounting available for all stocks; unknown how electronic monitoring will impact this stock
		Size/Age Comp	2	4	3	3	Better collection of complete size range (small fish) would allow for improved size compositions
		Abundance	3	5	3	3	Current surveys do not capture the full depth range of this stock
		Life History	2	4	4	4	
		Ecosystem Linkage	0	2	1	1	Calculated target shows little differentiation across stocks

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Walleye pollock – Southeast Gulf of Alaska	Martin Dorn, AFSC	Catch	5	2	5	5	Catch accounting is available for all stocks
		Size/Age Comp	2	4	2	2	No fishing in southeast Alaska; current data are sufficient for Tier 5 assessment
		Abundance	4	3	4	4	Survey data are reliable and consistent for this stock; assessment depends on the assumption that area-swept biomass is an unbiased estimate of stock size
		Life History	4	4	4	4	
		Ecosystem Linkage	0	2	0	0	Calculated target shows little differentiation across stocks; a minimal assessment for this stock meets management needs
Walleye pollock – Western / Central / West Yautat Gulf of Alaska	Martin Dorn, AFSC	Catch	5	5	5	5	
		Size/Age Comp	5	5	5	5	
		Abundance	4	5	5	5	
		Life History	5	5	5	5	
		Ecosystem Linkage	2	3	4	4	Calculated target too low with little differentiation across stocks; stock interacts strongly with other ecosystem components, so incorporating those interactions is likely to be important to stock dynamics

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Yelloweye rockfish – Gulf of Alaska	Ben Williams, AFSC	Catch	4	5	4	4	Catch accounting available for all stocks; total removals from sport and subsistence harvest would be problematic
		Size/Age Comp	4	4	5	5	There may be spatial patterns in growth that are not currently addressed
		Abundance	3	5	4	4	Current surveys cover only a limited spatial extent; sampling a larger proportion on an annual basis would be a substantial improvement
		Life History	4	4	4	4	
		Ecosystem Linkage	0	2	2	2	
Groundfish of the Bering Sea and Aleutian Islands Management Area / Groundfish of the Gulf of Alaska							
Sablefish - Eastern Bering Sea / Aleutian Islands / Gulf of Alaska	Dana Hanselman, AFSC	Catch	5	5	5	5	
		Size/Age Comp	4	5	5	5	
		Abundance	4	5	4	4	Demographic data is sufficient and an absolute abundance survey is not necessary to determine status/ABC
		Life History	4	5	4	4	Current data are sufficient to manage the fishery on a stock-wide basis
		Ecosystem Linkage	4	2	4	4	Calculated target too low with little differentiation across stocks; maintain assessment at current level

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Bering Sea / Aleutian Islands King and Tanner Crabs							
Blue king crab – Pribilof Islands	Buck Stockhausen, AFSC	Catch	4	2	5	5	Fishery is closed since stock is overfished and under rebuilding plan, so complete catch accounting is very important
		Size/Age Comp	2	4	2	2	No aging available for crab stocks; size-structured model is in development
		Abundance	3	3	3	3	
		Life History	2	4	3	3	Some life history data are based on red king crab and more data for the species would help reduce uncertainty in the assessment
		Ecosystem Linkage	1	2	4	4	Calculated target too low with little differentiation across stocks; fishing mortality has little influence on current stock dynamics so ecosystem linkages must be important, but process studies are needed to determine linkages
Blue king crab – Saint Matthew Island	Katie Palof, ADFG	Catch	3	2	4	4	Fishery is closed since stock is overfished and under rebuilding plan, so complete catch accounting is very important
		Size/Age Comp	3	4	3	3	No aging available for crab stocks; size-structured model is in development
		Abundance	3	3	4	4	Improve survey spatial extent would better sample the population
		Life History	2	4	3	3	Stock-specific life history information is needed for the assessment model development
		Ecosystem Linkage	1	2	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Golden king crab – Aleutian Islands	Shareef Siddeek, ADFG	Catch	4	5	4	5	Catch accounting available for all stocks
		Size/Age Comp	3	4	3	3	No aging available for crab stocks
		Abundance	2	5	2	3	Increased expert target as a limited fishery independent survey is currently occurring
		Life History	4	4	4	4	
		Ecosystem Linkage	2	2	2	2	
Golden king crab – Pribilof Islands	Benjamin Daly, ADFG	Catch	3	5	3	3	Fishery is closed
		Size/Age Comp	1	4	1	2	Increased expert target as there are some size data available to explore
		Abundance	2	4	2	3	Increased expert target as a limited fishery independent survey is currently occurring
		Life History	1	4	1	1	Fishery is closed and stock is a low priority for stock-specific life history information
		Ecosystem Linkage	1	2	1	1	
Red king crab – Bristol Bay	Jie Zheng, ADFG	Catch	5	5	5	5	
		Size/Age Comp	3	5	5	3	Decreased expert target because no aging is available for crab stocks and assessment is size-structured
		Abundance	4	5	5	5	
		Life History	3	5	5	5	
		Ecosystem Linkage	2	4	2	3	Calculated target too high; expert target increased to allow for exploring potential ecosystem linkages

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Red king crab – Norton Sound	Toshihide Hamazaki, ADFG	Catch	3	5	3	5	Catch accounting available for all stocks
		Size/Age Comp	3	4	3	3	No aging available for crab stocks; size-structured model may be in development
		Abundance	4	5	4	4	Current levels are sufficient for assessment
		Life History	1	4	1	3	Increased expert target because of current research to provide stock specific information
		Ecosystem Linkage	0	2	0	2	Allow for exploration of potential ecosystem linkages
Red king crab – Pribilof Islands	Cody Szuwalski, AFSC	Catch	5	2	5	5	Fishery is closed; catch accounting available for all stocks
		Size/Age Comp	3	4	3	3	No aging available for crab stocks; size-structured model is in development
		Abundance	4	3	4	4	Current levels are necessary for assessment
		Life History	1	4	3	1	More life history data is needed to move this stock to a Tier 3 assessment
		Ecosystem Linkage	2	2	2	2	
Red king crab – Western Aleutian Islands	Benjamin Daly, ADFG	Catch	3	5	3	3	Fishery is closed
		Size/Age Comp	1	2	1	2	Increased expert target because some size data are available to explore
		Abundance	1	4	1	1	Fishery is closed and current surveys do not sample this stock well
		Life History	2	2	2	2	
		Ecosystem Linkage	0	1	1	1	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Snow crab – Bering Sea	Cody Szuwalski, AFSC	Catch	5	5	5	5	
		Size/Age Comp	3	5	3	3	No aging available for crab stocks; assessment is size-structured
		Abundance	5	5	5	5	
		Life History	3	5	5	5	
		Ecosystem Linkage	2	5	2	3	Calculated target too high; expert target increased to allow for exploring potential ecosystem linkages
Southern Tanner crab – Bering Sea	Buck Stockhausen, AFSC	Catch	4	5	4	4	Catch accounting is available for all stocks and is adequate for assessment
		Size/Age Comp	3	5	3	3	No aging available for crab stocks; assessment is size-structured
		Abundance	4	5	5	5	
		Life History	3	5	5	5	
		Ecosystem Linkage	2	3	4	4	Calculated target is too low with little differentiation across stocks; temperature dependent growth of small crabs determines size distribution at recruitment to the model which has implications for future growth

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Fish Resources of the Arctic Management Area							
Arctic cod - Arctic Management Area	Ed Farley, AFSC	Catch	0	NA	0	0	No fishery currently or anticipated
		Size/Age Comp	1	NA	3	3	Have samples collected from surveys, but need more surveys
		Abundance	0	NA	3	3	Disparate surveys currently but additional work is planned; not many adults collected
		Life History	1	NA	2	2	Running models on tagging information to discern adult migration patterns in NBS; need additional information on spawning location and timing
		Ecosystem Linkage	1	NA	2	2	Synthesis of Arctic IERP that may include some modeling work
Saffron cod - Arctic Management Area	Ed Farley, AFSC	Catch	0	NA	0	0	
		Size/Age Comp	1	NA	3	3	
		Abundance	0	NA	3	3	Although data collected thus far could be useful if assembled, a targeted survey would be better
		Life History	1	NA	2	2	
		Ecosystem Linkage	1	NA	2	2	
Snow cod - Arctic Management Area	Ed Farley, AFSC	Catch	0	NA	0	0	
		Size/Age Comp	1	NA	3	3	
		Abundance	0	NA	3	3	Current data includes several years of bottom trawl and one year of beam trawl survey
		Life History	1	NA	2	2	
		Ecosystem Linkage	1	NA	2	2	Assembling a synthesis on pelagic-benthic coupling that will include all three managed Arctic species

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Salmon Fisheries in the EEZ off the Coast of Alaska							
Chinook salmon - Eastern North Pacific Far North Migrating	Steve Heinl, ADFG	Catch	5	NA	5	5	
		Size/Age Comp	4	NA	4	4	Not as difficult to age, but not sure of sampling outside of Alaska
		Abundance	4	NA	4	4	
		Life History	4	NA	4	4	FW and marine survival is unknown for the south
		Ecosystem Linkage	2	NA	2	2	Taku run is forecast based on a sibling model, then decreased by 50% due to unknown environmental factors causing error in the forecasting model
Coho salmon - Auke Creek	Steve Heinl, ADFG	Catch	5	NA	5	5	
		Size/Age Comp	5	NA	5	5	Colecting smolts and age composition; CWT at all three systems of fry
		Abundance	5	NA	5	5	
		Life History	5	NA	5	5	
		Ecosystem Linkage	2	NA	2	2	
Coho salmon - Berners River	Steve Heinl, ADFG	Catch	5	NA	5	5	
		Size/Age Comp	5	NA	5	5	
		Abundance	4	NA	4	4	
		Life History	5	NA	5	5	Jacks are really rare so info may not be necessary
		Ecosystem Linkage	2	NA	2	2	

Table 2. -- (Cont.). Results of the Alaska stock assessment classification and gap analysis exercise listed by stock. Current and target levels range from no information available (Level 0) to complete knowledge (Level 5) (after Appendix A; Lynch et al. 2018).

Stock	Expert	Data Attribute	Current Level	Calculated Target	Expert Target	Final Target	Rationale
Coho salmon - Hugh Smith Lake	Steve Heinl, ADFG	Catch	5	NA	5	5	
		Size/Age Comp	5	NA	5	5	
		Abundance	5	NA	5	5	
		Life History	4	NA	4	4	Available information may be as good as what can be expected for this stock
		Ecosystem Linkage	2	NA	2	2	
Scallop Fishery off Alaska							
Weathervane scallop - Alaska	Tyler Jackson, ADFG	Catch	5	NA	5	5	No changes expected in observer program; fishery stable
		Size/Age Comp	4	NA	5	5	Age precision is being worked on currently
		Abundance	3	NA	3	3	No anticipated changes to scope of the survey ocver the next five years; survey covers where 80% of harvest is taken but only a small footprint of where the stock occurs
		Life History	3	NA	4	4	Will be working on time-varying growth potential use in assessment model
		Ecosystem Linkage	0	NA	0	0	

Comparison of Baseline and Expert Targets

In general, there was good agreement between the expert targets and the calculated baseline targets. Where differences existed, they tended to be minimal (+/-1). However, some clear patterns emerged that merit discussion. The expert targets for the ecosystem linkage attribute were often higher than the calculated targets for stocks managed under the BSAI Groundfish FMP; we note calculated ecosystem linkage scores had little differentiation between these stocks. Differences between the expert and calculated targets across data attributes for stocks managed under the GOA Groundfish and the EBS Crab FMPs were mostly due to authors that did not think large data gaps existed for their stocks (i.e., current level scores close to target level scores). Some groups of stocks such as the data-limited stocks in the GOA and several of the EBS crab stocks had expert targets consistently lower than the calculated targets across all data attributes.

Gap Analysis Results

We summarized current and target levels by data attribute for all stocks, then at the FMP level, and finally by taxonomic level; however, other grouping may be useful for various planning purposes. Overall all stocks, current catch data were most available and had the highest average targets; ecosystem linkage was the lowest for both current and target, as well as showing the largest average gap between current and target averaged across all species (Fig. 1). Average current and target levels by FMP grouping shows that the salmon fisheries in the U.S. Exclusive Economic Zone (EEZ) had the highest of both current and target levels, while the Arctic FMP had the lowest, although there were very few stocks in both these groups (Fig. 2). Average current and target data levels by taxonomic grouping shows that the "other" category (octopus, sharks, and skates) have both the lowest level of data currently used in assessments as well as the lowest targets (Fig. 3). Averaging across all data attributes, "other" stocks had the lowest levels of current and target data, while salmon had the highest. Average current and target levels across all data attributes were similar between flatfish and gadid stocks, and between crab and rockfish stocks. Crab stocks had the largest gap between average current and target levels overall attributes, while flatfish had a fairly small gap and salmon had no gap overall. Of course, information on an individual stock basis is most informative for fine-scale details into these patterns (Table 2).

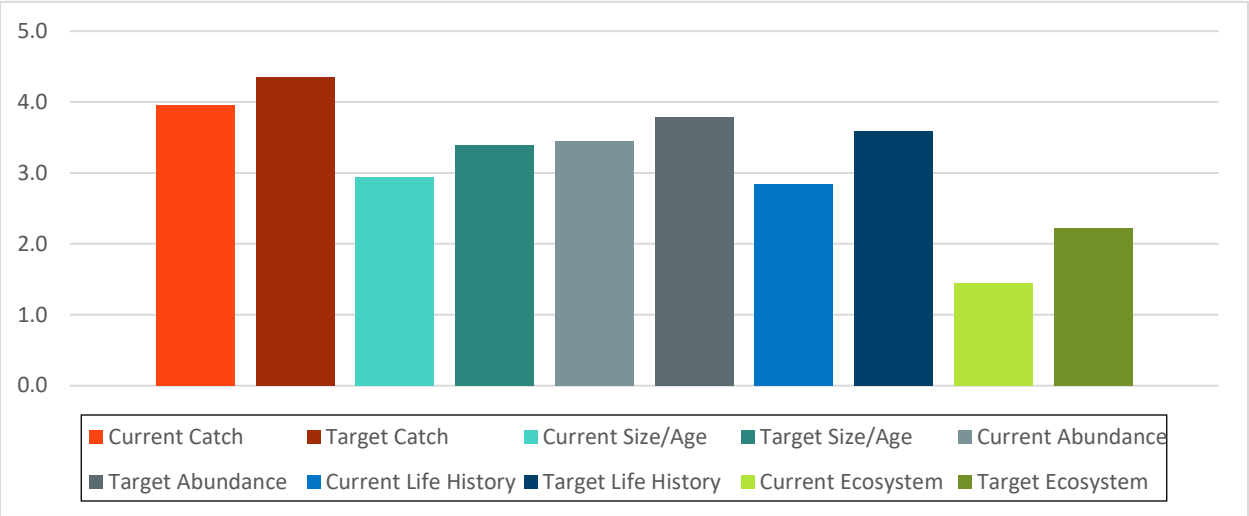

Figure 1. -- Comparison of current and target data input levels, averaged across all NPFMC managed stocks included in the Alaska stock assessment classification and gap analysis exercise (n = 69).

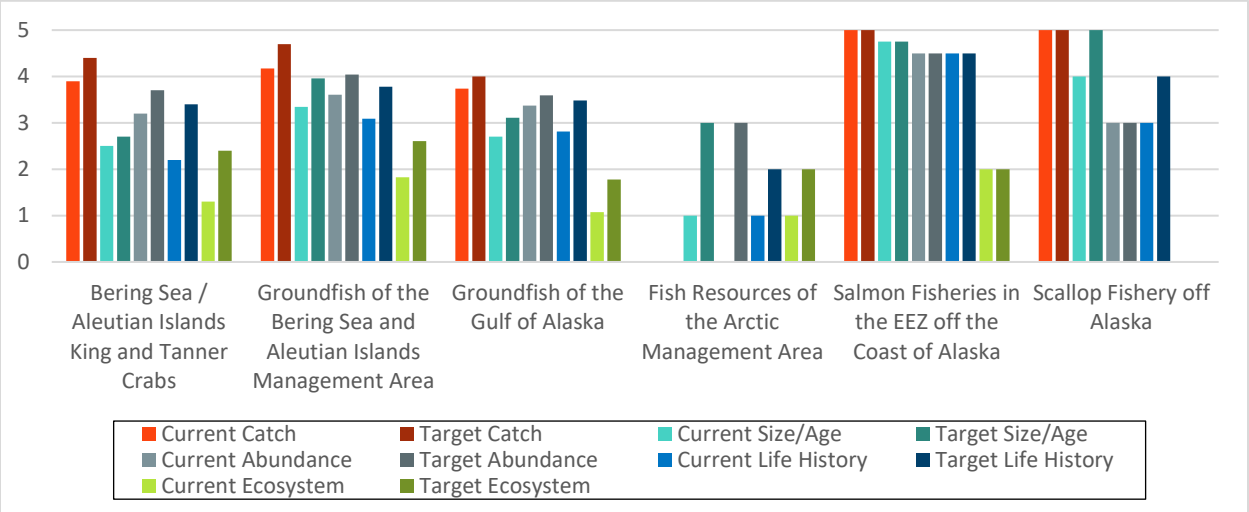

Figure 2. -- Comparison of current and target data input levels, averaged across Fishery Management Plan for stocks included in the Alaska stock assessment classification and gap analysis exercise (n = 69).

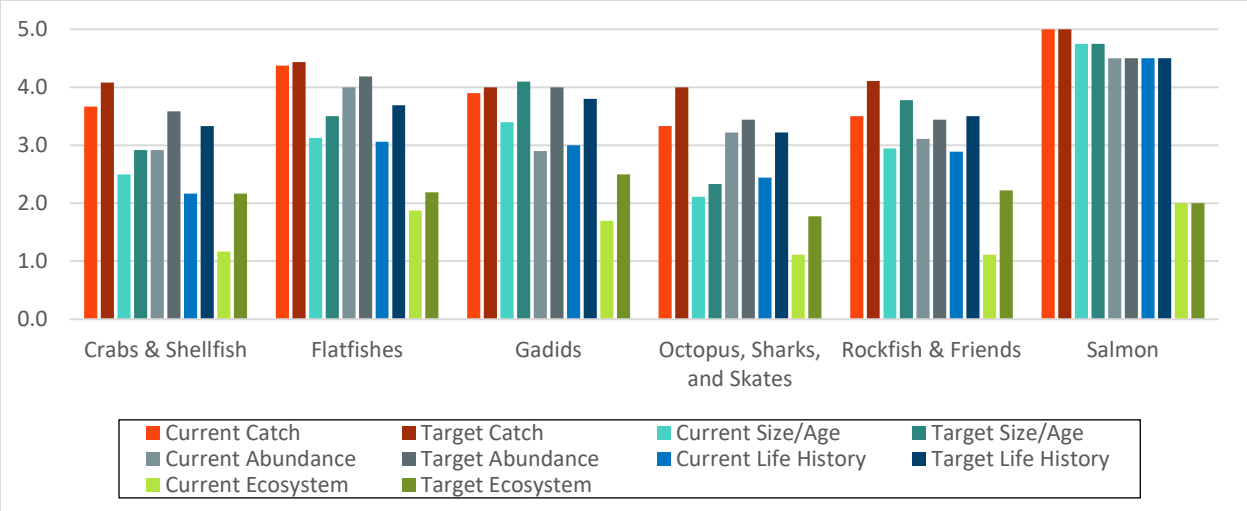

Figure 3. -- Comparison of current and target data input levels, averaged across taxonomic groupings for stocks included in the Alaska stock assessment classification and gap analysis exercise (n = 69). The grouping 'Rockfish & Friends' includes Sablefish and Atka Mackerel in addition to Scorpaenids.

Discussion and Future Directions

The results of the gap analysis for NPFMC stocks will be provided to the National Stock Assessment Program (NSAP) and eventually combined with the results of this activity from other regions to conduct a national data gap analysis. This exercise, completed using nationally consistent methods, will provide important quantitative information on data needs to support the stock assessment enterprise and feed into national planning activities (e.g., survey planning, updates to the Data Acquisition Plan). Results can also support regional strategic planning, such as identifying specific data needs for stock assessments. For instance in Alaska, we are using the ecosystem linkage information to identify stocks ready to initiate an ecosystem and socioeconomic profile (ESP), a standardized framework for testing ecosystem relationships within the stock assessment process. Data gaps for each attribute could be useful for identifying data needs by group (e.g., life history data for crab stocks) or across a wide variety of stocks (e.g., mechanistic ecosystem linkages) for activity planning or future research. Finally, the stock assessment author led collection of the current data levels developed as part of this process and subsequent tracking of progress toward the targets could be a starting point for organizing research priorities for all NPFMC stocks in a consistent and transparent fashion. This could help coordinate different research groups in their contributions to stock assessment and create a positive feedback loop with the stock assessment authors.

In future years, updating current assessment levels will be straightforward and occur in the Species Information System (SIS) database whenever new assessments (e.g., benchmark or operational) are completed. Targets, once established, will be reviewed periodically (e.g., every 5 years) but are expected to remain relatively stable over time. Notable changes in fishery or population conditions, such as major ecosystem shifts, market changes, development of new

fisheries, or emerging research, are likely to cause changes to existing targets. We also anticipate that this exercise and report will serve to guide future efforts for data classification in other regions.

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Citations

Hollowed, A. B., K. Aydin, K. Blackhart, M. Dorn, D. Hanselman, J. Heifetz, S. Kasperski, S. Lowe, and K. Shotwell. 2016. Discussion Paper Stock Assessment Prioritization for the North Pacific Fishery Management Council: Methods and Scenarios. Report to North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, AK 99501. 17 p.

Lynch, P. D., R. D. Methot, and J. S. Link (eds.). 2018. Implementing a Next Generation Stock Assessment Enterprise. An Update to the NOAA Fisheries Stock Assessment Improvement Plan. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-183, 127 p. doi.org/10.25923/mg6k-kr33. Available online: https://repository.library.noaa.gov/view/noaa/27488.

Methot, R. D. (ed.). 2015. Prioritizing Fish Stock Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-152, 31 p. Available online: https://repository.library.noaa.gov/view/noaa/12874.

NMFS. 2001. Marine Fisheries Stock Assessment Improvement Plan. Report of the National Marine Fisheries Service National Task Force for Improving Fish Stock Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-56, 69 p. + 25 appendices. Available online: https://repository.library.noaa.gov/view/noaa/3261.

Appendix A: Alaska Stock Assessment Classification Data Collection Form

AFSC Stock Assessment Classification

This form will gather expert input on current and target levels for stock assessment data input attributes. This Stock Assessment Classification activity is an expansion of stock assessment prioritization and provides important information to identify regional gaps on a stock-by-stock and data-category-by-data-category basis. For additional details on Stock Assessment Classification, please see the 2018 Next Generation Stock Assessment Improvement Plan (NGSAIP; Chapter 10): https://spo.nmfs.noaa.gov/sites/default/files/TMSPO183.pdf.

Your responses will also help determine priority for conducting an Ecosystem and Socioeconomic Profile (ESP) at the Alaska Fisheries Science Center (AFSC).

For information on the AFSC stock/complex list for this activity including lead authors, please see the following sheet: https://docs.google.com/spreadsheets/d/18mzzbKq34ZRIZLeLsiMqi1s51JzQGvKHqevvgVOd3Qs/edit?usp=sharing

For additional definitions and descriptions to support completing this form, please see the activity summary document: https://docs.google.com/document/d/1HK98pTNfgDlY4fzaEw5nIpOplVHLQ6J92ezWZlzkMsI/edit?usp=sharing

For frequently asked questions and answers on this activity, please see the following document: https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing

Still have questions? Contact Kristan Blackhart (Kristan.Blackhart@noaa.gov, 206-302-2479) or Kalei Shotwell (Kalei.Shotwell@noaa.gov, 907-789-6056) for more help.

kalei.shotwell@noaa.gov Switch account Draft saved

* Required

Last Name *

Please provide your last name for reference

Your answer

First Name *

Please provide your first name for reference

Your answer

Email

Please enter your email for contact information

Your answer

Stock *

Please select stock or stock complex for this classification. This form should be filled out once for each individual stock/complex. Options are sorted regionally, then alphabetically based on SIS database (single stocks start with stock name followed by region, e.g., Atka mackerel - Bering Sea / Aleutian Islands; stocks complexes are preceded by the region name, e.g., Gulf of Alaska Other Rockfish Complex). For stock assignments, please see the AFSC Stock Assessment Classification List (https://docs.google.com/spreadsheets/d/18mzzbKq34ZRIZLeLsiMqi1s51JzQGvKHqevvgVOd3Qs/edit?usp=sharing).

Choose

Assessment Year *

Specify year of most the recent completed assessment (benchmark or full update). A benchmark means a CIE review was conducted during the assessment year.

Your answer

Current Catch Level *

Select the most appropriate category below based on the catch input data currently used in the assessment of this stock/complex. If statistical methods are used for the assessment (e.g., age-structured model), high or complete certainty is often assumed for catch data (level 5). However, if you adjust the model configuration for some uncertainty in catch (e.g., downweighted catch index), then you have some uncertainty in the catch data and could decrease a level (e.g., level 4).

- [ ] 0 = No quantitative catch data
- [ ] 1 = Some catch data, but major gaps for some fishery sectors or for historical periods such that their use in assessments is not supported
- [ ] 2 = Enough catch data establish magnitude of catch and trends in catch for a major fishery sector in order to apply a data-limited assessment method. This includes fisheries that are closed and it is known that negligible catch is occurring
- [ ] 3 = Catch data is generally available for all fishery sectors to support quantitative stock assessment, but some gaps exist such as low observer coverage, high levels of self-reported catch, weak information on discard mortality
- [ ] 4 = No data gaps substantially impede assessment, but catch is not without uncertainty (e.g., recreational catches estimated from surveys)
- [ ] 5 = Very complete knowledge of total catch

Author Target Catch Level *

Referring to the categories defined in the previous question, select the category you think is the most appropriate target for catch input data needed for assessment of this stock/complex

	0	1	2	3	4	5	
No quantitative catch data	○	○	○	○	○	○	Very complete knowledge of total catch

Author Target Catch Level Justification *

Provide a one sentence explanation for the selected target catch level in the previous question. Please see the FAQ document for example justifications (https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing).

Your answer

Catch Details *

Pick the option that best describes the effects of fishing on this stock/complex

- ○ Stock is not caught as target or bycatch in any fishery
- ○ Stock is subject to very minimal catch so that fishing-induced mortality most likely does not have measurable effects on stock dynamics
- ○ Stock is subject to fishing-induced mortality

Current Size_Age Composition Level *

Select the most appropriate category below based on the size or age composition data currently used in the assessment of this stock/complex. Please note that even if you have some of the information described in level 5 (e.g., ageing precision), you are not at a level 5 unless you also have very complete size AND age composition data.

- [ ] 0 = No composition data collected
- [ ] 1 = Some size or age composition data has been collected, but major gaps in coverage, and not used in stock assessment
- [ ] 2 = Enough size or age composition data has been collected to enable data-limited assessment approaches
- [ ] 3 = Enough size or age composition data is collected over a sufficient time series to be informative in age/size structured assessment models
- [ ] 4 = Enough age composition data has been collected over a sufficient time series to enable assessments methods that need age composition data from the fishery
- [ ] 5 = Very complete age and size composition data, including, as needed on stock-specific basis, knowledge of ageing precision, spatial patterns or other issues

Author Target Size_Age Composition Level *

Referring to the categories defined in the previous question, select the category you think is the most appropriate target for size or age composition input data needed for assessment of this stock/complex

	0	1	2	3	4	5	
No composition data collected	○	○	○	○	○	○	Very complete size_age composition data

Author Target Size_Age Composition Level Justification *

Provide a one sentence explanation for the selected target size or age composition level in the previous question. Please see the FAQ document for example justifications (https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing).

Your answer

Size_Age Details *

Pick the option that best describes recruitment variability for this stock/complex. For this question recruitment variability is defined as the standard deviation of log (recruitment) for age-structured stocks or a qualitative estimate of interannual variability in abundance for data-limited stocks (1 = low, 2= moderate, 3 = high amount of variability).

- ◯ Age-structured: standard deviation of log (recruitment) is greater than 0.9
- ◯ Age-structured: standard deviation of log (recruitment) is less than 0.3
- ◯ Not age-structured: high amount of interannual variability in abundance (3 on a scale of 1 to 3)
- ◯ Not age-structured: low amount of interannual variability in abundance (1 on a scale of 1 to 3)
- ◯ All other stocks that do not fit any of the above choices (e.g., standard deviation of log (recruitment) <0.9 or >0.3, interannual variability in abundance = 2)
- ◯ Unknown

Current Abundance Level *

Select the most appropriate category below based on the abundance input data currently used in the assessment of this stock/complex. Please note the difference between level 4 and 5 is relative abundance versus absolute abundance. To have estimates of absolute abundance (level 5) you would need tag-recapture information or would need independent confirmation ("calibrated" not "standardized") on the estimate of catchability or selectivity for the fishery-independent survey.

- [ ] 0 = No indicator of stock abundance or trend in stock abundance over time
- [ ] 1 = Fishery-dependent catch rates (CPUE) are available, but high uncertainty about their standardization over time; or expert opinion on degree of stock depletion over time
- [ ] 2 = Fishery-dependent catch rates (CPUE) are sufficiently standardized to enable their use in full assessments; data from fishery-independent sources are not available or sufficient to estimate abundance trends
- [ ] 3 = Limited fishery-independent survey(s) provide estimates of relative abundance; however, the temporal or spatial coverage of the stock is limited or the sampling variability is high
- [ ] 4 = Complete fishery-independent survey(s) provide estimates of relative abundance, and the survey(s) cover a large proportion of the spatial extent of the stock with several years of tracking at a level of precision that supports assessments
- [ ] 5 = Calibrated fishery-independent survey(s) or tag-recapture provide estimates of absolute abundance

Author Target Abundance Level *

Referring to the categories defined in the previous question, select the category you think is the most appropriate target for abundance input data needed for assessment of this stock/complex

	0	1	2	3	4	5	
No indicator of stock abundance	○	○	○	○	○	○	Absolute abundance

Author Target Abundance Level Justification *

Provide a one sentence explanation for the selected target abundance level in the previous question. Please see the FAQ document for example justifications (https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing).

Your answer

Abundance Details *

Are absolute abundance estimates based on calibrated fishery-independent survey(s) or tag-recapture information feasible for this stock?

- ◯ Yes
- ◯ No

Current Life History Level *

Select the most appropriate category below based on the life history input data currently used in the assessment of this stock/complex

- ☐ 0 = No life history data
- ☐ 1 = Estimates of most life history factors not based on empirical data; instead derived using proxies, meta-analyses, borrowed from other species, or without scientific basis
- ☐ 2 = Estimates of some life history factors based on stock-specific empirical data, but at least one derived using life history proxies, meta-analyses, borrowed from other species, or without scientific basis. Generally supports data-poor assessments that use life history information
- ☐ 3 = Estimates of most life history factors based on stock-specific empirical data
- ☐ 4 = Data are sufficient to track changes over time in at least growth
- ☐ 5 = No major gaps in life history knowledge, including detailed stock structure, spatial and temporal patterns in natural mortality, growth and reproductive biology

Author Target Life History Level *

Referring to the categories defined in the previous question, select the category you think is the most appropriate target for life history input data needed for assessment of this stock/complex

	0	1	2	3	4	5	
No life history data	○	○	○	○	○	○	No major gaps in life history knowledge

Author Target Life History Level Justification *

Provide a one sentence explanation for the selected target life history level in the previous question. Please see the FAQ document for example justifications (https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing).

Your answer

Current Ecosystem Linkage Level *

Select the most appropriate category below based on the highest level of ecosystem linkage currently incorporated in the assessment of this stock/complex. There are follow-up questions below to provide additional information on any ecosystem linkages currently incorporated in the assessment - please provide information for each level applicable up to and including the Current Ecosystem Linkage Level you select here. For example, if you select 4 in this question, then you may answer any following question up through "Selected Ecosystem Linkage Level 4".

- [ ] 0 = No linkage to ecosystem dynamic or consideration of ecosystem properties (environment, climate, habitat, predator-prey, etc.) in configuring the assessment (i.e., equilibrium conditions assumed for ecosystem)
- [ ] 1 = Ecosystem-based hypotheses inform the assessment model structure (e.g., defining the stock boundaries and/or spatial or temporal features) and/or are used for processing assessment inputs (e.g., abundance index), but no explicit linkage to any ecosystem drivers (environment, climate, habitat, predator-prey, etc.)
- [ ] 2 = The assessment includes some form of variability or effect to explicitly account for unidentified ecosystem dynamic(s) (e.g., time/space "regimes", random variation, or other approaches to changing features without direct inclusion of ecosystem data)
- [ ] 3 = One or more assessment features is linked to a dynamic (i.e., data) from at least one of the following categories: environment, climate, habitat, predator-prey data (e.g., covariate)
- [ ] 4 = The assessment model is linked to at least one ecosystem dynamic, and one or more process studies directly support the manner in which environmental, climate, habitat, and/or predator-prey dynamics are incorporated (e.g., consumption rates measured and covariate informed by results)
- [ ] 5 = The assessment approach is configured to be coupled or linked with an ecosystem process (e.g., multispecies, coupled biophsyical, climate-linked models)

Selected Ecosystem Linkage Level 0 - Ecosystem Considered

Were ecosystem properties considered sometime during the assessment process (e.g., sensitivity runs, survey design, etc.) or management process (informed ABC), but just not included in the final assessment model or model structure? If yes, then respond "Other" and add additional details on the nature of the ecosystem consideration.

- [ ] No
- [ ] Other: _____

Selected Ecosystem Linkage Level 1 - Ecosystem Hypothesis

What ecosystem-based hypothesis informed the assessment model structure (e.g., defining the stock boundaries, and/or spatial or temporal features), or was used for processing assessment inputs (e.g., accounting for whale depredation in the abundance index)?

Your answer

Selected Ecosystem Linkage Level 2 - Ecosystem Dynamic

Was the variability included as a regime shift (e.g., use regime shift for calculation of equilibrium recruitment), random variation (e.g., include random variation in recruitment equations), or other approach? Please select from the following options or provide more detail in Other.

- [ ] Regime shift
- [ ] Random variation
- [ ] Other: _____

Selected Ecosystem Linkage Level 3 - Ecosystem Dynamic

How are ecosystem data linked to the assessment process or model feature(s) and what ecosystem data affect the assessment or projections?

Your answer

Selected Ecosystem Linkage Level 4 - Ecosystem Dynamic

How are ecosystem data linked to the assessment process or model feature(s) and what ecosystem data affect the assessment or projections? Also, what process study or studies directly support the manner in which the ecosystem data are incorporated?

Your answer

Selected Ecosystem Linkage Level 5 - Ecosystem Dynamic

How was the model coupled or linked to an ecosystem process? This level describes coupled models where there is dynamic feedback between the stock assessment and the ecosystem process (e.g., if the CEATTLE model was operational, the dynamics of arrowtooth affect the dynamics of pollock simultaneously). Please select from the following options or provide more detail in Other.

- [ ] Multispecies model
- [ ] Coupled biophysical model
- [ ] Other:

Inform Current Management Decision

Did any of the current ecosystem linkages described above inform a management decision (e.g., change in spatial allocation, an ABC reduction, a shift in gear type, inform model configuration)? If yes, then respond "Other" and add additional details on the nature of the management decision.

- [ ] No
- [ ] Other: _____

Ecosystem Category

Please select the ecosystem property/properties that was/were considered, hypothesized, or used as an ecosystem dynamic (e.g., data) for the ecosystem linkage(s). Choose all that apply. Please see the activity summary sheet (https://docs.google.com/document/d/1HK98pTNfgDlY4fzaEw5nIpOplVHLQ6J92ezWZlzkMsI/edit?usp=sharing) for more details. If you would like to provide additional information on the ecosystem categories, select 'Other'.

- [ ] Environment
- [ ] Climate
- [ ] Habitat
- [ ] Predator-prey
- [ ] Other: _____

Assessment Process

What assessment process or model feature(s) was/were explored, informed, or linked by the ecosystem dynamic(s) (e.g., data)? Choose all that apply. If selecting 'Other', please provide additional details.

- [ ] Mortality
- [ ] Growth and/or Consumption
- [ ] Recruitment
- [ ] Maturity and/or Fecundity
- [ ] Selectivity and/or Catchability
- [ ] Stock structure and/or Distribution
- [ ] Other: _____

Author Target Ecosystem Linkage Level *

Select the category below that you think is an appropriate target for the ecosystem linkage level needed for assessment of this stock/complex

- [ ] 0 = No linkage to ecosystem dynamic or consideration of ecosystem properties (environment, climate, habitat, predator-prey, etc.) in configuring the assessment (i.e., equilibrium conditions assumed for ecosystem)
- [ ] 1 = Ecosystem-based hypotheses inform the assessment model structure (e.g., defining the stock boundaries and/or spatial or temporal features) and/or are used for processing assessment inputs (e.g., abundance index), but no explicit linkage to any ecosystem drivers (environment, climate, habitat, predator-prey, etc.)
- [ ] 2 = The assessment includes some form of variability or effect to explicitly account for unidentified ecosystem dynamic(s) (e.g., time/space "regimes", random variation, or other approaches to changing features without direct inclusion of ecosystem data)
- [ ] 3 = One or more assessment features is linked to a dynamic (i.e., data) from at least one of the following categories: environment, climate, habitat, predator-prey data (e.g., covariate)
- [ ] 4 = The assessment model is linked to at least one ecosystem dynamic, and one or more process studies directly support the manner in which environmental, climate, habitat, and/or predator-prey dynamics are incorporated (e.g., consumption rates measured and covariate informed by results)
- [ ] 5 = The assessment approach is configured to be coupled or linked with an ecosystem process (e.g., multispecies, coupled biophsyical, climate-linked models)

Author Target Ecosystem Linkage Level Justification *

Provide a one sentence explanation for the selected target ecosystem linkage level in the previous question. Please see the FAQ document for example justifications (https://docs.google.com/document/d/1YVPaJqo-njafsmlS1f0FA1WeG1tDeMIBwQNVDYEJCsY/edit?usp=sharing).

Your answer

Inform Target Management Decision

Given your selected target ecosystem linkage in the previous question, would that target inform a management decision (e.g., change in spatial allocation, an ABC reduction, a shift in gear type, inform model configuration)? If yes, then respond "Other" and add additional details on the nature of the target management decision.

- [ ] No
- [ ] Other: _____

Ecosystem Linkage Details - Habitat *

- ○ Stock relies on a particular habitat niche that is sensitive to ecosystem change during one or more life stages (e.g., anadromous species)
- ○ Stock is thought to easily adapt to changes in physical properties of the ecosystem
- ○ All other stocks that do not fit the first two choices (e.g., do not have a particular habitat niche or are not thought to easily adapt to changes in physical properties of the ecosystem)
- ○ Unknown

Ecosystem Linkage Details - Model *

- ○ Current assessment model exhibits issues that may be appropriately addressed by including ecosystem dynamics (e.g., retrospective or residual patterns)
- ○ All other stocks that do not fit the previous choice (e.g., do not exhibit model issues that may be addressed by including ecosystem dynamics)
- ○ Unknown

A copy of your responses will be emailed to the address you provided.

Submit Page 1 of 1 Clear form

Appendix B: AFSC Stock Assessment Classification Summary Document

Purpose

A major focus of the 2018 Next Generation Stock Assessment Improvement Plan (NGSAIP, https://spo.nmfs.noaa.gov/sites/default/files/TMSPO183.pdf) is developing a portfolio of "right-sized" assessments. To evaluate priorities for conducting assessments at frequencies and levels most appropriate to each stock, the National Marine Fisheries Service (NOAA Fisheries) needs a consistent approach to tracking and classifying assessments. The NGSAIP details an updated stock assessment classification system that includes five data input attributes. This system allows us to track the current status of the stock assessment enterprise and to establish targets for each stock's assessment. By comparing current status to targets, we can identify regional stock assessment gaps on a stock-by-stock and data-category-by-data-category basis. This provides an important planning tool to inform strategic decisions for stock assessments, and track performance of the stock assessment enterprise. It also gives NOAA Fisheries a strong business case to justify continued investment in stock assessments.

Current Assessment Levels

The current levels describe how comprehensively each assessment has been conducted according to the five data input attributes. Responses for current levels should be based on information that was actually used in the assessment. If additional data are available but has not been incorporated into the assessment yet, please select the level that reflects data used in the current assessment configuration. If a stock is unassessed, select the level of data available and likely to be used in an assessment. In future years, updating current assessment levels will be straightforward and occur in the Species Information System (SIS) database whenever new assessments (e.g., benchmark or full update) are completed.

Target Assessment Levels

It is not necessary to conduct the most data-rich, ecosystem-linked assessments for every stock every year. Management advice for stable stocks benefits little from frequent reassessment. Conducting data-intensive assessments of minor stocks may not be worth the effort when such stocks can be reasonably managed using more moderate approaches. Establishing reasonable targets is essential to ensure efficient use of assessment and management resources. When setting targets, experts should think critically about assessment and management needs for the stock and the data requirements to meet those needs.

Targets, once established, will be reviewed periodically (e.g., every 5 years) but are expected to remain relatively stable over time. Notable changes in fishery or population conditions, such as major ecosystem shifts, market changes, development of new fisheries, or emerging research, are likely to cause changes to existing targets.

Catch Input Data

This attribute describes the availability/need for data describing fishing removals on the stock. Some things to consider when selecting target levels for this attribute:

- Assessments using traditional statistical methods often assume high or complete certainty in the understanding of fishery removals
- More limited catch monitoring may be sufficient for stocks that are subject to little or no fishing

Size/Age Composition Input Data

This attribute describes the availability/need for data describing the size and/or age structure of the stock. Age data that has been collected but not yet validated, and does not yet allow an age-structured assessment for the stock, should not be included when selecting the current level but may be important when considering targets. Some other things to consider when selecting target levels for this attribute:

- Assessments that include composition data produce more complete descriptions of the effects of fishing on populations and may improve the ability to estimate natural mortality when estimated within the model
- Collection and processing of size/age data requires significant resources and may not be worth the effort for lower value stocks

Abundance Input Data

This attribute describes the availability/need for indices describing estimates of the abundance or biomass of the stock. Some things to consider when selecting target levels for this attribute:

- Abundance trends are useful indicators of stock dynamics for baseline monitoring for unassessed stocks
- Fishery catch rates alone can lead to biased conclusions about abundance and stock dynamics

Life History Input Data

This attribute describes the availability/need for data describing a stock's biology and life history, such as natural mortality, growth, reproduction, and stock structure. Some things to consider when selecting target levels for this attribute:

- Detailed biological information isolates fishing impacts on a stock and improves assessment precision and accuracy
- Less important stocks may be successfully managed with less complete life history data

Ecosystem Linkages

This attribute describes the extent to which an assessment considers or incorporates ecosystem dynamics. Based on what current level you select, you will be asked to provide more information related to the stock's current level and any applicable levels up to that current level (e.g., if you select Level 4 as your current level, you may answer any following question up through Level 4). In addition to information on current level of ecosystem linkage, there are additional questions

related to how and what type of ecosystem dynamic information is considered in the assessment process. Some things to consider when selecting target levels for this attribute:

- Ecosystem dynamics (e.g., environment [e.g., temperature, salinity, etc.], climate [e.g., PDO, NAO, etc.], habitat, predator-prey relationships) may be considered at multiple phases in the assessment or management process (e.g., sensitivity runs, survey design, informing ABC, etc.)
- Ecosystem dynamics may be linked to a variety of processes in the assessment (e.g., mortality, growth, recruitment, fecundity, catchability, stock structure/connectivity)
- Including ecosystem dynamics in the assessment model does not always improve management advice
- Using ecosystem in empirical approaches to guide management decisions may be more appropriate for some stocks
- Some stocks may not have evidence or data available suggesting stock/fishery dynamics are tightly coupled with a variable ecosystem feature

Appendix C: AFSC Stock Assessment Classification FAQs

GENERAL QUESTIONS

1. How are the stocks broken out for the AFSC Stock Assessment Classification List? It seems that the stocks are broken out by Tiers within complexes but not for Tier 5/6.

   We are following a stock list based on how the assessments are conducted (keeping in mind this is a national exercise), and how they are then reported into the Species Information System. The stocks listed are separated out more by the modeling capability than the real data availability, because in the lower Tiers (4 to 5 to 6) there are just less and less data. Generally, the stocks that have a Tier 3/4 are pulled out from complexes and stocks in a Tier 5/6 are kept together. For example, skates have a Tier 3 with Tier 5/6 and they just pull out the Tier 3 and keep the 5/6 together in the rest of the complex. When you answer the questions for a complex or group of stocks (e.g., remainder of stocks after the indicator is considered separately) that is a combination of Tier 5/6, answer the questions based on stocks with the most data available.

2. What does "separated ABC" mean in the stock list spreadsheet? This is not what ultimately is recommended.

   This indicates there are separate ABCs listed in the SAFE document, because in most cases it was an age-structured model derived ABC that was separated (two tables) from the Tier 5 or 6 ABCs even though they ultimately were combined for the recommendation.

3. In general, does "assessment" refer to the combined assessment activities reflected in the respective SAFE report chapter, or just the model/method upon which the harvest specifications were based?

   "Assessment" refers to the model configuration and methods used to set the harvest specifications.

4. What does "benchmark" mean in the Assessment Year question?

   "Benchmark" now means "CIE review conducted during the assessment year."

5. Some of the wording for the different data levels seems strange. Can we change this to be more applicable to our region?

   The data level definitions were developed for the NGSAIP and reviewed and accepted by each of the regions and the FMCs. We can try to clarify with specifics to Alaska assessments and management but cannot change the form. Please see additional responses below.

6. How do we think about setting targets in general?

   Follow the suggestions in the activity summary sheet and the definition of target. These are somewhat subjective, but keep in mind the word "reasonable" in the definition.

CATCH LEVELS

1. How do we decide between a Level 4 or 5 since there are likely always going to be some level of uncertainty in catch information (e.g., potentially increasing discards for sablefish)?

   This does seem to be a bit of a region-specific question as I think most of our stocks qualify as very complete knowledge of the total catch. I would say to answer this based on your model configuration of catch. If catch is estimated without uncertainty in the model or given high precision in the likelihood, then you have a very complete knowledge of the total catch and are a Level 5. If you downweight the catch or have time blocks of lower weighting due to changes in data collection, then you have some uncertainty and should probably be a Level 4. Other factors that might weigh into this decision are the following:

   1. *There is a directed fishery on the stock (likely you are at a Level 5 then).*
   2. *There is very good reporting on bycatch fishery (e.g., Thornyheads, Level 5).*
   3. *Catch is based on landings only with no extrapolation from observer data (at least a Level 4, possibly Level 5 if you are directed and tracked closely).*
   4. *Level of reporting has improved dramatically in current data collection even though some historic catches have uncertainty (e.g., Dusky Rockfish, Level 5).*
   5. *Catch consists of more than a single species and there is concern about disproportionate harvest for one of the species (e.g., Rougheye/Blackspotted Rockfish, Level 4).*
   6. *Discard mortality rate is a concern for the stock, but is well estimated and discards are counted (e.g., some crab stocks, Level 5).*

2. If we have a high target level of catch data now (e.g., Level 5), but we anticipate some uncertainty in the future (e.g., potentially increasing discards for Sablefish), do we select a lower target catch level (e.g., Level 4)

   You should select a target level based on what is needed to adequately assess and manage the stock. It is possible that a target level could ultimately be above what is necessary and a target might need to be changed. Taking the example with sablefish, if the current catch level is at a Level 5 because that is what is needed for the assessment, then the target should be a Level 5. If discards increase in the future causing uncertainty (current catch level would reduce to Level 4), that would be an indication of a gap in data collection for this stock. At that point regional decision makers would need to weigh the increased uncertainty against other data gaps to decide if it is a priority to put more effort into tracking those discards to reduce uncertainty in sablefish catch.

3. What is meant by the word “discard mortality” in the Level 3 description? Is that referring to "discard mortality rate" or simply "discards"?

   The intent of the examples for this level is to describe situations that would cause gaps in the catch data. Our interpretation is this is about discards and not a discard mortality rate since these descriptions are intended as national guidance and there are many areas in the Nation where the amount of discards is not known (e.g., areas with no observers). If you do know something about discard mortality rate (which is fairly rare, but crab stocks have this), then you would select a Level 4 because you have information about discards but have some

uncertainty in the catch data due to the concern over discard mortality rate. This is beyond the normal level of uncertainty over the catch data just because we do not know EVERYTHING on catch.

4. How do you justify your catch target level choices?

   Example rationale responses:

   1. *For GOA Rougheye/Blackspotted Rockfish, target was Level 5 (up from current Level 4) because the stock is considered a choke stock and we have concern over the disproportionate harvest of Blackspotted or Rougheye Rockfish in the fishery.*
   2. *For BSAI Sharks, target was Level 2 (same as current) because this is a low priority complex and addressing issues in the observer data (e.g., size biases) either cannot be done or will not be elevated to be done.*
   3. *For GOA Other Rockfish, target was Level 3 (same as current) because catch data are generally available, but low coverage in eastern GOA and unsure how electronic monitoring comes into play yet.*
   4. *For Northern Rockfish, target was same as current (5), directed fishery.*
   5. *For POP, target was same as current (5), directed fishery.*
   6. *For Sablefish, target was selected at 5, which is the same as its current level, sablefish is a high commercial value, high demand stock.*

SIZE/AGE COMPOSITION LEVELS

1. Some of the Level 5 information for size/age composition level data can be gathered without having complete age/size composition data (e.g., knowledge of ageing precision). How are we supposed to score the stock if we have some Level 5 information?

   For these data levels, think of them generally as cumulatively increasing. Therefore, data would have to pass the qualifications of the Levels 0 through 4 to be able to reach a Level 5. As it is written, the important part of Level 5 is to have "very complete age and size composition data." The ageing precision is listed under "as needed." So, if you have information on ageing precision, but do not have enough size/age composition data collected to enable age composition from the fishery, then you have not passed a Level 4 and would therefore select a Level 3 for your stock. Also, if you have an abundance of size composition data to potentially estimate spatial patterns but do not have the equivalent in age composition data, then you could not be at a Level 5 as this level states "very complete age and size composition data."

2. What is meant by recruitment variability for age-structured assessments in the Size_Age Details question? This needs to be fairly unambiguous so that the answers are based on the same calculation. Change "coefficient of recruitment variability" to either "CV of recruitment," "recruitment coefficient of variation," "standard deviation of log(recruitment)," or something else that is fairly unambiguous.

   For age-structured models, recruitment variability is the "standard deviation of log (recruitment)." This is not the estimate (or fixed value) for sigma r. We have added this clarification to the question description and answers.

3. In the Size_Age Details recruitment variability question, it seems odd to have options for CV < 0.3, CV > 0.9, but nothing for 0.3 < CV < 0.9 unless these are truly supposed to fall into the final level ("All other stocks..."). If the latter is the case, maybe it would be good for the description of that level to include something like, "(e.g., 0.3 < CV(recruitment) < 0.9)" so that authors will not think that this is not just an oversight.

   We have changed the options for this question because of the confusion on what to do if the answer was unknown or fit between the two options for either an age-structured or not age-structured stock. The "All other stocks" option is meant for the in between condition of < 0.9 or > 0.3. We have added that in the examples to the answer. We have also added an "Unknown" category for situations when the information is simply too sparse to make a call.

4. In the Size_Age Details question on recruitment variability, can there be an option that one sees large change in abundance from year to year but likely because of a survey effect?

   In this case you could select the "All other stocks…" option or the "Unknown" option because you may either think the survey does not sample your stock well and have auxiliary information that the stock is more stable or you simply do not have a good survey of this stock and the variability is unknown.

5. How do you justify your target level choices?

   Example rationale responses:

   1. *For GOA Rougheye/Blackspotted Rockfish, target was Level 4 (same as current Level 4) because this stock is very difficult to age. It is not a target stock, we do not harvest over 50% of the ABC, and we currently have fairly even spatial coverage for age samples for this stock complex. We do not yet have the capabilities for a two-stock model.*
   2. *For BSAI Sharks, target was Level 2 (up from Level 1) because ongoing projects may be able to inform the assessment and better utilize data limited methods.*
   3. *For GOA Other Rockfish, target was Level 2 (up from Level 1) because recent projects will be incorporated into the next assessment and DLMs will be investigated within the next five years.*
   4. *For Northern Rockfish, target was 4, same as current level of 4 given the difficulties of survey sampling in Northern Rockfish habitat as well as high sampling variability.*
   5. *For POP, target was 5, greater than the current level of 4. Recent changes in sampling may contribute to better spatial coverage in future surveys.*
   6. *For Sablefish, target was 5 as opposed to the current level of 4. The age samples are adequate but there is a target of a tag integrated spatial model that would benefit greatly from larger age sample sizes.*

ABUNDANCE LEVELS

1. Could you emphasize relative versus absolute abundance level for 4 and 5?

   We cannot change the description of the levels but we have added this to the description of the current abundance level question. Also, the abundance levels should be interpreted from an assessment (not survey) perspective. Answer these based on how the information is being used in the assessment. For example, if you have an acoustic survey that estimates absolute abundance through a geostatistical model (e.g., kriging), but the assessment model uses this survey as a relative abundance index (i.e., the assessment estimates catchability (q) based on other information and does not use any information from the survey as a prior on q), this would be Level 4, not 5, because of how it is actually being used, not what is theoretically available to be used.

2. What does "calibrated" mean in the abundance Level 5 description? One could argue that the bottom trawl survey is calibrated and so all stocks with an abundance index from the trawl survey are a Level 5.

   Calibrated here refers to an independent confirmation of catchability or selectivity for the fishery-independent survey (e.g., ROV doing visual counts to calibrate the bottom trawl). This is different from standardization that ensures that the same gear, vessels, and survey design are used from survey to survey. The important point here is that you answer based on how the information for abundance is being used in the assessment.

3. The SSC has determined that absolute abundance estimates are available for all stocks/complexes other than those managed under Tier 6. Is this question intended just to identify which assessments are managed under Tier 6?

   This question is intended to determine which stocks could have a Level 5 designation for abundance level which means they have a "calibrated fishery-independent survey(s) or tag-recapture" that provides estimates of absolute abundance. This is not intended to identify which assessments are managed under Tier 6. We have clarified this question. It is important to remember that the levels for this classification were written to be general enough to apply nationally, but clarification by region will be an important part of this process. Our survey biomass estimates, while estimated as an absolute abundance, are really an absolute of abundance of fish available to the trawl survey.

4. How do you justify your target level choices?

   Example rationale responses:
   1. *For GOA Rougheye/Blackspotted Rockfish, target was Level 4 (same as current Level 4) because we currently use two surveys in the assessment model that adequately cover the spatial distribution of the stock complex. There are no calibrated surveys for Rougheye/Blackspotted Rockfish and we have limited success in tag-recapture due to barotrauma of this deep-water species.*
   2. *For BSAI Sharks, target was Level 2 (up from Level 1) because we should be able to develop standardized fishery-dependent CPUE and utilize fishery-independent data sources in the next 5 years.*

3. *For GOA Other Rockfish, target was Level 3 (same as current level) because these species are generally poorly sampled by surveys, spatial variability is high and the surveys do not always cover spatial range of the stocks.*
4. *For Northern Rockfish, target was 4, higher than the current level of 3, because if the untrawlable grounds survey gets going it will aid greatly in expanding the coverage of northern distribution.*
5. *For POP, target was equal to current level of 4. Recently sampling variability has been relatively low, the distribution of POP is pretty well covered. Future efforts to refine the abundance index (e.g. include acoustic or fishery-dependent information) would not make it a 'calibrated' index.*
6. *For Sablefish, target was the same as current Level 4. Multiple relative abundance indices exist and doing a "calibrated survey" would likely not be worth the additional effort if possible. Mark-recapture estimates could be made but have not been to date.*

LIFE HISTORY LEVELS

1. Under "Current Life History Level," what is the difference between "at least one" being based on something other than stock-specific empirical data (level 2) and "most" being based on stock-specific empirical data (level 3)?

   For Level 2, you are using at least one life history factor that is not stock-specific (e.g. borrowed from other species, life history proxy, meta-analyses, etc.). For Level 3, you are no longer using life history information that is not specific to your stock. The word "most" was included in the Level 3 description because you simply might not have all the life history information for your stock.

2. How do you justify your target level choices?

   Example rationale responses:
   1. *For GOA Rougheye/Blackspotted Rockfish, target was Level 4 (same as current Level 4) because currently we have enough information from size/age data to track growth over time for the complex. In the future, we may also have some new information regarding growth of the two stocks (with genetic identification) from successive bottom trawl surveys that is soon to be published. We also have potential for identifying the two stocks via otolith morphology which could get at stock differences in growth over time from fishery and bottom trawl survey age compositions.*
   2. *For BSAI Sharks, target was Level 2 (up from Level 1) because ongoing research should inform on some life history parameters, but many will still be borrowed for use in DLMs*
   3. *For GOA Other Rockfish, target was Level 2 (same as current) because many of the species still use borrowed life history parameters.*
   4. *For Northern Rockfish, target was 4, greater than the current level of 3. Recent changes to sampling protocol on survey may enable better understanding of certain life-history characteristics*
   5. *For POP, target was the same as the current level of 4. See sablefish answer.*

6. *For Sablefish, target was 4 as was the current level. Data is likely sufficient for current management, although having estimates of all those life history parameters with time-varying qualities would be nice.*

ECOSYSTEM LINKAGE LEVELS

1. Under "Current Ecosystem Linkage Level," does the random variation listed in Level 2 include random variation in recruitment? I am guessing the answer is, "No."

   Yes – including random variation in recruitment is a way of accounting for unidentified process error, which can certainly be due to ecosystem influences (we devote a lot of time to figuring out mechanisms for understanding this error). Additionally, for all the age-structured assessments we use the time block from 1977 to present to represent the equilibrium level of recruitment in the calculation of the B40% reference point. This is to account for the 1977 regime shift impacts and so any stock that is an age-structured assessment in our region would at least be at current ecosystem Level 2.

2. What are the differences between Levels 1 and 2 in the "Current Ecosystem Linkage Level"?

   An example of a Level 1 would be how whale depredation is accounted for in generating the longline survey and fishery estimates for the Sablefish assessment. So the ecosystem information is informative outside the model configuration. An example of a Level 2 can be seen in any age-structured assessment in that we use the regime shift for the calculation of equilibrium recruitment or we include random variation in the recruitment estimates to account for process error.

3. Under "Current Ecosystem Linkage Level," replace "a dynamic (i.e., data)" with "data."

   We cannot change the description, but yes, linking to a dynamic generally means linking to ecosystem data. However, the "dynamic" term may have been necessary to be more general and allow for those cases when data was not explicitly used. For example, an equation was altered for different parameter estimates based on an ecosystem hypothesis (e.g., GOA Pacific Cod natural mortality block).

4. Under "Current Ecosystem Linkage Level," I am having trouble thinking of a case in which a model that qualifies under Levels 3 or 4 would not automatically qualify under Level 5.

   The difference between Level 3 and 4 is that in Level 4 at least one process study supports the use of the ecosystem dynamic (e.g., covariate) in the model. Level 5 would be more complicated than a Level 3 or 4 in that the model is not just using a covariate that could be an output from an ecosystem model but rather is coupled to an ecosystem model such that both are updated at the same time and the output of one feeds into the other.

5. Under "Current Ecosystem Linkage Level," in the follow-up to Level 5, it appears to be assumed that the coupling/linking actually took place, but in the description of Level 5 itself, it appears that only the potential for coupling/linking is required.

This appears to be referring to the use of the word "approach" in the description of a Level 5 linkage. To qualify as a Level 5, the stock assessment model configuration is actually (not potentially) coupled or linked to an ecosystem process (i.e., one updates the other). Possibly the "approach" terminology is to allow for situations where the methodology to link the stock assessment and the ecosystem assessment models is not traditional. An example of this might be when using biophysical output from say an individual based model (IBM) coupled to a ROMS/NPZ model. The ROMS/NPZ is run prior to the IBM and does not adjust due to any input from say a stock assessment model. But the IBM results could change when coupled to the stock assessment model. Generally, the Level 5 ecosystem linkage is reserved for the more complicated coupled models where there is dynamic feedback between the ecosystem model and the stock assessment model. In a multispecies setting, such as CEATTLE if it was operational, the dynamics of Arrowtooth affect the dynamics of Pollock simultaneously.

6. What does the "environment" mean in the "Ecosystem category" question? To my mind "Environment" includes any of the other options.

   In this case, the environment category generally means the physical environment (e.g. temperature, salinity, nutrients, etc.). This issue might be where to put the phytoplankton, if say chlorophyll a estimates of production were used or productivity estimates. I would say that if you use phytoplankton information, you would check "Environment" and if you use anything of a higher trophic level (e.g., zooplankton to fish, birds, mammals, etc.) you would check "Predator-Prey". These categories were based on the NGSAIP, but we also allow you to specify in "Other" if you would like to provide more information.

7. Assessment process: "Growth / consumption"... I can imagine cases where growth data are examined without dealing with consumption; did you mean to be that restrictive?

   No, we did not mean to be restrictive here. This was meant to be inclusive, as in examining impacts on growth and/or consumption. We adjusted the form to show this.

8. What does "All other stocks" mean for the additional ecosystem questions at the end of the form? Can you use it for a "No", "Don't Know", or "Unknown" answer?

   The "All other stocks" was meant to be the go to answer for anything that did not satisfy the previous two choices. This has caused much confusion, so we are adding an "Unknown" category and specifying what the "all other stocks" implies. For example, "All other stocks that do not have a particular habitat niche or thought to easily adapt to physical properties of the ecosystem."

9. How do you justify your target level choices?

Example rationale responses:

1. *For GOA Rougheye/Blackspotted Rockfish, target was Level 2 (same as current Level 2) because potentially there is new information on maturity from process studies that suggest that there is substantial skip spawning in Blackspotted Rockfish, but there might be some need for verification of this study as there was concern on the species identification. Potentially we could explore linking ecosystem data (e.g., temperature index) to stock assessment processes with respect to skip spawning but that would be beyond a 5-year horizon.*
2. *For BSAI Sharks, target was Level 1 (same as current); it is unlikely that ecosystem linkage research will be conducted in the next 5 years for this data-limited assessment.*
3. *For GOA Other Rockfish, target was Level 1 (same as current), this is a low-priority complex, with limited environmental linkage information, environmental variability will not be worked into the assessment in the next 5 years.*
4. *For Sablefish, target level was 4 which is the same as current, the current level uses whale depredation mortality as a model input, another input that would be good is a mechanistic recruitment covariate.*

U.S. Secretary of Commerce
Gina M. Raimondo

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