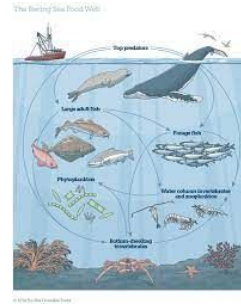# Ecosystem and Climate Initiative

Pilot risk tables for petrale sole and sablefish

FEP Initiative 4

- Review the incorporation of climate and ecosystem information into the Council's harvest-setting and fisheries management processes,
- Determine the need and appropriate timing for additional, FMP-specific ecosystem and climate information, and
- Where there is a need for additional ecosystem and climate information, develop clear pathways for it to be used in the setting of scientific uncertainty, harvest policy, and specific management actions.

Appendix C, Table C-1

ECOSYSTEM WORKGROUP REPORT ON THE ECOSYSTEM AND CLIMATE INFORMATION INITIATIVE

Contents

When the Ecosystem Workgroup (EWG) met via webinar on May 15 and 17, 2023, we shared new Ecosystem and Climate Information for Species, Fisheries, and Fishery Management Plans (Initiative 4) materials ideas in preparation for the Council's September meeting. We updated the Council on Initiative 4 at the Council's June 2023 meeting, where we received no change in guidance from the Council's March 2023 guidance on the initiative. The EWG will further brief Council advisory bodies (ABs) and the public during a September 5, 2023 webinar. Additional background on this initiative is available in EWG Report 1 and Report 2 from Agenda Item H.2.a, March 2023, and from the Council webpage for this initiative.

1. New Materials, Guidance Needed, and Recommendations

This report updates Initiative 4 materials with:

- Draft selection criteria and process for the Council to choose the future species/stocks/groups with management processes that should receive ecosystem and climate information;

- Example application of the selection criteria to seven species;

- Evaluation of timing and pathways where ecosystem and climate information can be incorporated into harvest setting processes under the coastal pelagic species (CPS), groundfish, and salmon fishery management plans (FMPs);

- A draft risk evaluation rubric to be used across all species, stocks, and species groups;

1

EWG tasks for the September Council meeting included:

- Species selection process
- Example application of selection criteria
- Evaluation of timing and pathways

Appendix C, Table C-1

ECOSYSTEM WORKGROUP REPORT ON THE ECOSYSTEM AND CLIMATE
INFORMATION INITIATIVE

Contents

> A draft risk evaluation rubric to be used across all species, stocks, and species groups.

Council on Initiative 4 at the Council's June 2023 meeting, where we received no change in guidance from the Council's March 2023 guidance on the initiative. The EWG will further brief Council advisory bodies (ABs) and the public during a September 5, 2023 webinar. Additional background on this initiative is available in EWG Report 1 and Report 2 from Agenda Item H.2.a, March 2023, and from the Council webpage for this initiative.

1. New Materials, Guidance Needed, and Recommendations

This report updates Initiative 4 materials with:

- Draft selection criteria and process for the Council to choose the future species/stocks/groups with management processes that should receive ecosystem and climate information;
- Example application of the selection criteria to seven species;
- Evaluation of timing and pathways where ecosystem and climate information can be incorporated into harvest setting processes under the coastal pelagic species (CPS), groundfish, and salmon fishery management plans (FMPs);
- A draft risk evaluation rubric to be used across all species, stocks, and species groups;

1

EWG Report 2: Tables C-2 and C-3

RISK EVALUATION TABLES FOR PETRALE SOLE AND SABLEFISH

This supplemental report contains the draft risk assessment tables for petrale sole (Table C-2) and sablefish (Table C-3). As discussed in Agenda Item F.1.a, EWG Report 1, these tables represent a pilot application of a risk assessment methodology adapted from the methods in use by the North Pacific Fishery Management Council. The purpose of these risk assessment tables is to provide climate and ecosystem information to the Pacific Fishery Management Council (Council) to supplement results of stock assessments (or if a stock assessment is not available) to help establish harvest reference points or other management measures.

The application of this risk assessment methodology revealed a variety of considerations that need to be further explored to develop a robust tool that can be effectively used in management decision making. Overall, the me... ...contribute to an understanding of how stock dynamics, not explicitly consi... ...nt, may inform various management related considerations. T... ...(EWG) expects that these risk assessments wo... ...management decision processes (which can occ... ...tions (e.g., tied to stock management bou...) tak... ...nt a wide variety of ecological factors could be consi... ...drivers, changes in physical habitat, predators/prey/comp... ...indirect non-fishing effects (e.g., offshore wind facility development, c... ...tat modification), and range shifts. These current risk tables only include envi... ...drivers, but future risk tables could consider incorporating other ecosystem drivers like those listed above as they become available and as methods for determining risk associated with such factors are developed. Furthermore, an overall risk level assignment requires a weighting scheme to account for the relative magnitude of the effect of these factors on stock characteristics of concern. This weighting scheme is likely to be stock-specific and could be qualitative or quantitative. In addition, we are seeking guidance on what additional information should be included in the population dynamics and stock assessment columns.

While developing the risk assessment table... ...ole and sablefish, the EWG noted the need for dedicated time and effo... ...ssessment that provides actionable information... ...il conv... ...multi-disciplinary teams — ce... ...s, stock assessors, and physiologists, among ot... — ...to populate the risk assessment table and complete the risk assessment process. Such teams are needed because of the diversity of ecosystem and climate-related factors enumerated above, which demand the provision of comprehensive information relevant to the species being evaluated. These teams would be responsible for weighting the different types of information within and across the four categories delineated in the risk evaluation framework (see Table C-1 in EWG Report 1) and achieving consensus on risk classification for each category as well as the overall risk classification for the particular species/stock/fishery management plan. As part of such a process, the teams would document how a particular conclusion was reached (e.g., scoring according to the risk classification scheme), the underlying rationale, and other considerations related to their consensus (or lack thereof) on risk classifications. Terms of reference could be developed to guide such an effort and could build from
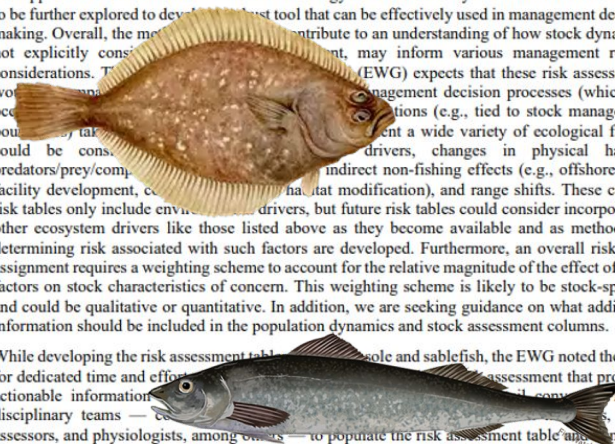
Taylor & Francis
Taylor & Francis Group

A risk table to address concerns external to stock assessments when developing fisheries harvest recommendations

Martin W. Dorn and Stephani G. Zador

Resource Ecology and Fisheries Management, Alaska Fisheries Science Center, Seattle, WA, USA
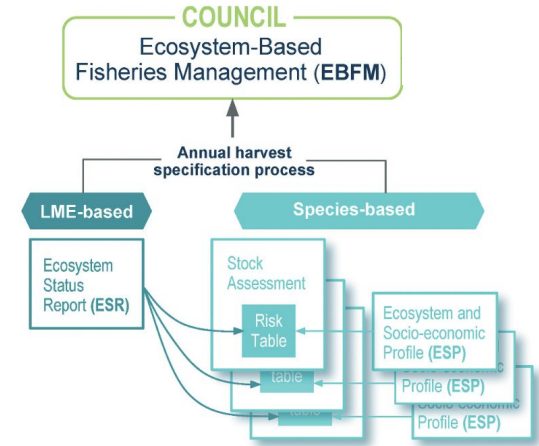
Team comprised of SA author, ESR rep, other scientists with doing relevant research draft risk table during assessment cycle (full, updates) → Lead SA make final decision on all risk levels → Lead SA presents risk table to GF plan team, SSC, ABs, and the NPFMC during the assessment review → Make recommendation on ABC (lower, no change) to SCC who makes decision on ABC

NPFMC sablefish risk table ABC considerations

Assessment Related Considerations

(Lead: SA author)

In summary, given the large quantities of data, the high quality of data, and general agreement in recent population trends in the sablefish indices, there were no major concerns about the data used in the sablefish assessment. The variety of data sources available for sablefish tend to show general agreement regarding population growth, and the proposed model is able to adequately fit all available data. Moreover, retrospective patterns and recruitment estimation difficulties associated with previous sablefish models (i.e., model *16.5*) have been greatly reduced. Although there is uncertainty in the magnitude of recent year classes, particularly the 2017, 2018, and 2019 year classes, there are no major assessment related concerns for sablefish at this time. **Therefore, we rated the assessment related concern as 'level 1 – normal'.**

Population Dynamics Considerations

(Lead: SA author)

Overall, productivity remains high. Thus, what was originally identified as an anomalous and unprecedented 2014 year class during the 2017 assessment appears to be a proven, consistent, and encouraging trend. Despite uncertainty associated with estimating the size of recent year classes and the lack of older, fully mature fish, large year classes (e.g., 2014 and 2016) are helping to expand the age structure and will likely reach fully mature ages at relatively high abundance. Thus, population trends are generally positive and indicate continued growth of the population. **Hence, we rate the population dynamics as a 'level 1 – normal'.**

Environmental and Ecosystem Considerations

(Lead: Ecosystem scientist)

Overall, environmental and ecosystem indicators suggest generally warming, above average, water temperatures across Alaska (though still below average at depth in the BS), which could be favorable for survival of young sablefish. Foraging conditions for young sablefish appears above average, though adult condition continued to decrease indicating below average prey availability for adults (or continued competition among and within large recent sablefish year classes). Competition and predation did not demonstrate any strong changes from 2021, and were generally neutral, though increased overlap in the BS with Pacific cod (due to a more southerly distribution of cod) may lead to increased competition. Given that no major concerns are apparent for sablefish, the **environmental and ecosystem category was rated '1 – Normal'.**

2022 Assessment of Sablefish stock in Alaska

Taylor & Francis
Taylor & Francis Group

A risk table to address concerns external to stock assessments when developing fisheries harvest recommendations

Martin W. Dorn and Stephani G. Zador

Resource Ecology and Fisheries Management, Alaska Fisheries Science Center, Seattle, WA, USA
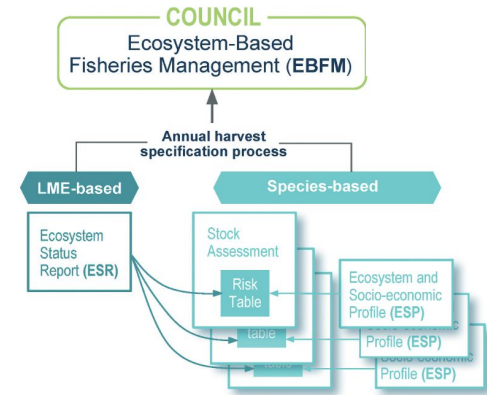
- Not meant to be a comprehensive evaluation, provides info that might inform ABC

- Formalizes and documents the process for a reduction of ABC and if contextual information is used to inform this decision

- Provides transparency in a consistent framework

- Normalizes discussions between stock assessors and ecosystem scientists

Draft PFMC risk evaluation rubric

Content for these two columns to be provided during stock assessment development and review.

Low concern

High concern

	Environmental/ecosystem considerations	Assessment model-related uncertainty considerations	Population dynamics considerations
Level 1: Above or better than normal	Some indicators show the system supporting greater abundance or increased habitat area.	Below-average uncertainty/very few unresolved issues in assessment, no or few data conflicts.	Stock trends are above normal for the stock; recent recruitment is above normal range.
Level 2: Normal	No apparent environmental/ecosystem concerns.	Typical to moderately increased uncertainty/minor unresolved issues or data conflicts in assessment.	Stock trends are typical for the stock; recent recruitment is within normal range.
Level 3: Substantially increased concerns	Some indicators show adverse signals but the pattern is not consistent across all indicators.	Substantially increased assessment uncertainty/ unresolved issues, or data conflicts.	Stock trends are unusual; abundance increasing or decreasing faster than has been seen recently, or recruitment pattern is atypical.
Level 4: Major Concern	Most indicators showing consistent adverse signals a) across the same trophic level, and/or b) up or down trophic levels (i.e., predators and prey of stock).	Major problems with the stock assessment, poor fits to data, major data conflicts, high level of uncertainty, strong retrospective bias.	Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns.

Some considerations for PFMC risk evaluation

- Oceanographic drivers, changes in habitat, food web dynamics, direct and indirect non-fishing effects (offshore wind facility development), range shifts

Some considerations for PFMC risk evaluation

- Oceanographic drivers, changes in habitat, food web dynamics, direct and indirect non-fishing effects (offshore wind facility development), range shifts

- Overall risk level assignment requires a weighting scheme to account for the relative magnitude of the effect of the factors on stocks

Some considerations for PFMC risk evaluation

- Oceanographic drivers, changes in habitat, food web dynamics, direct and indirect non-fishing effects (offshore wind facility development), range shifts

- Overall risk level assignment requires a weighting scheme to account for the relative magnitude of the effect of the factors on stocks

- Dedicated time and effort and a structured process to complete a risk assessment, multi-disciplinary teams

- Achieve consensus, document how a particular conclusion was reached, the underlying rationale

How might we use information from risk tables?

- Stock assessment prioritization

- Scientific uncertainty buffer in stock assessment (sigma)

- Management uncertainty / risk tolerance (P* buffer) – leading to changes in harvest policy

- Influence how the penalty function gets applied for the age of the assessment.

- In-season adjustments

Council/ABs feedback

- GMT/GAP, CPSMT/CPSAS: Will work with EWG on timelines and on ramps for incorporating climate and ecosystem information in management process; emphasized use of risk tables for assessment prioritization

Council/ABs feedback

- GMT/GAP, CPSMT/CPSAS: Will work with EWG on timelines and on ramps for incorporating climate and ecosystem information in management process; emphasized use of risk tables for assessment prioritization

- CPSMT: Clarify how Level 1 determination differs from Level 2 in informing risk in the decision-making process outside of stock assessments; what factors would lead to possible increase in harvest allowances?

Council/ABs feedback

- GMT/GAP, CPSMT/CPSAS: Will work with EWG on timelines and on ramps for incorporating climate and ecosystem information in management process; emphasized use of risk tables for assessment prioritization

- CPSMT: Clarify how Level 1 determination differs from Level 2 in informing risk in the decision-making process outside of stock assessments; what factors would lead to possible increase in harvest allowances?

- GAP: Recommends retrospective analysis to test readiness of process

Council/ABs feedback

- GMT/GAP, CPSMT/CPSAS: Will work with EWG on timelines and on ramps for incorporating climate and ecosystem information in management process; emphasized use of risk tables for assessment prioritization

- CPSMT: Clarify how Level 1 determination differs from Level 2 in informing risk in the decision-making process outside of stock assessments; what factors would lead to possible increase in harvest allowances?

- GAP: Recommends retrospective analysis to test readiness of process

- EAS: Risk tables are an opportunity to use "skipper science" and incorporate fishermen's on-the-water experience

Council/ABs feedback

- GMT/GAP, CPSMT/CPSAS: Will work with EWG on timelines and on ramps for incorporating climate and ecosystem information in management process; emphasized use of risk tables for assessment prioritization

- CPSMT: Clarify how Level 1 determination differs from Level 2 in informing risk in the decision-making process outside of stock assessments; what factors would lead to possible increase in harvest allowances?

- GAP: Recommends retrospective analysis to test readiness of process

- EAS: Risk tables are an opportunity to use "skipper science" and incorporate fishermen's on-the-water experience

- Council: SSC-ES to review rubric, pilot applications, whether to be used this cycle and workload

Questions to think about with respect to risk tables

- Can pilot risk tables be used in this specifications cycle?
  - If yes, how?
  - If not, how could they be used in the future?
  - What might that process look like?
  - Who develops risk tables? How will the info be shared (e.g. AFSC)?
- What else could be included in the pilot tables? What's missing?
  - E.g. Present info that captures conditions during specific life stages
- Are the categories appropriate?
- How would we weight different factors included within and across the columns?

Pilot stocks

- Petrale sole and sablefish
- Chosen because both have assessments or assessment updates being conducted in 2023 and are science-ready.
- Sablefish added later to EI4 and assessment docket in part due to information from 2023 ESR on strong incoming year class
- EWG held meeting in May with engaged participation by stakeholders, GMT members, and stock assessors, ecologists, and other scientists.
- In addition to risk tables, groundfish experts emphasized potential for climate information to inform assessment prioritization
- We have not explored development of risk tables for stocks in other FMPs, but they would likely be quite different

Petrale sole

Environmental/ecosystem considerations: We evaluated the influence of oceanographic drivers of petrale sole recruitment exclusively for this draft risk table. While potentially important to petrale sole population dynamics, the influence of predators, prey, competitors, habitat, and non-fisheries human activities, (such as offshore wind development) were not assessed during this evaluation.

An environmental index found that degree days during the pelagic juvenile phase and long-shore transport during the larval stage were the best predictors of recruitment variability (Appendix of Taylor et al., 2023). The index predicts near-average recruitment in 2019-2022, but a very strong year class in 2023, on par with the peak recruitment observed from 2006-2008 that led to the stock's rebuilding. An index of juvenile petrale sole from the West Coast Groundfish Bottom Trawl Survey did not identify a strong 2022 year class, which is consistent with the environmental index.

A sensitivity of the 2023 assessment model to inclusion of the environmental index indicated higher recruitment estimates in the most recent few years, which translated into slightly higher estimates of spawning depletion (0.415 vs 0.336 in the base model) and the OFL.

A three-year La Niña endedin the spring of 2023 and an El Niño began impacting the CCE in the summer 2023. Over the past several years large MHWs have also occurred during the summer, making for warm conditions despite being in a La Niña. These types of environmental conditions have not been observed in past years and thus at present it is not certain what impacts this will have on petrale sole populations but may facilitate stronger recruitment. Additionally, it is important to monitor local environmental conditions such as hypoxia because coastal environmental conditions may be different in the future during La Niña/El Niño. Further, climate-induced changes in growth are important to consider and monitor over time, as growth alterations can affect various ecological processes, including reproduction and recruitment, as well as management reference points (Stawitz et al. 2019)

The Climate Vulnerability Assessment (McClure et al. 2023) suggests petrale sole are highly exposed and moderately sensitive to climate change, with an overall CVA rank of moderate.

EWG Recommendation: Level 1: Above or better than normal

Petrale sole

Assessment considerations: <mark>Petrale sole is a data-rich stock with a variety of data sources providing consistent information on stock trajectories over the years and no major conflicts among data sources.</mark> The 2023 model estimates are similar to those from previous assessments (even after the model structure was substantially simplified within the 2023 assessment). All sensitivity model runs explored as a part of the 2023 assessment also resulted in very similar trajectories.

Studies on stock structure and movement of petrale sole indicate transboundary movement of petrale sole (adults and pelagic juveniles, Cruz et al. 2023) between U.S. and Canadian waters. However, the 2023 assessment results apply only to the area off the U.S. West Coast.

STAT Recommendation: Level 1: Above or better than normal

Population dynamics considerations: The stock dynamics are driven by infrequent above average recruitment events, generally followed by several years of low recruitment that together drive fluctuations in the spawning biomass. The fishery for petrale sole is sustained by the large, infrequent year classes.

Recruitment estimates in the most recent few years, during which the youngest cohorts are not well-selected by surveys or fisheries, are uncertain.

<mark>The status of the stock is estimated to be above the target reference point of 0.25. However, the biomass is estimated to be declining due to below-average and then uncertain recruitment in recent years.</mark>

STAT Recommendation: Level 2: Normal

Sablefish

Environmental/ecosystem considerations: We evaluated the influence of oceanographic drivers of sablefish recruitment exclusively for this draft risk table. While potentially important to sablefish population dynamics, the influence of predators, prey, competitors, habitat, and non-fisheries human activities (such as offshore wind development) were not assessed during this evaluation.

The 2023 Ecosystem Status Report indicates that the abundance of age-0 sablefish in pelagic surveys of the northern California Current ecosystem returned to average in 2021 and 2022, following anomalously high abundance in 2020. This dramatic increase in young fish was also seen in the bottom trawl survey used in the stock assessment. Overall, these data suggest potential improvement in stock status in coming years due to this strong year class.

Over the past three years, environmental conditions in the California Current have been largely warmer than average even with the backdrop of a prolonged La Niña event, which provided favorable recruitment conditions and likely contributed to the strong year classes we are currently seeing. However, we are currently transitioning to an El Niño that is forecast to intensify this fall/winter. During El Niño events that impact the California Current Ecosystem, upwelling is generally weaker (Jacox et al 2015), and northern copepod populations are generally lower. This has the potential to negatively impact sablefish recruitment. Furthermore, historical tagging data from adult sablefish showed that El Niño conditions have a significant negative effect on sablefish growth off the U.S. west coast (Kimura et al. 1998).

The Climate Vulnerability Assessment (McClure et al. 2023) suggests sablefish are highly exposed and moderately sensitive to climate change, with an overall rank of moderate.

EWG Recommendation: Level 2: Normal

Sablefish

Assessment considerations: The assessment of U.S. West Coast sablefish is fit to length data from the discarded fish in the commercial fishery and whole catch in the West Coast Groundfish Bottom Trawl Survey, as well as age data from all available sources. Additional length data are excluded from the assessment because they, sometimes, provide conflicting information about growth given that sablefish are relatively fast growing but can live to over 100 years of age. The productivity of the stock and how it responds to fishing is uncertain due to confounding of natural mortality, absolute stock size, and stock-recruit steepness.

The model is also fit to an environmental index of sea-level height to help inform recruitment starting in 1925. The index improved model predictions as compared to catch-only models (Tolimieri and Haltuch 2023). However, the index does not provide a lot of additional information in the full assessment relative to the age data because the survey catches age-0 fish. The index is particularly valuable when empirical data cannot be collected via surveys.

STAT Recommendation: Level 2: Normal

Population dynamics considerations: Recruitment is estimated to be highly variable with estimates of above average year classes approximately every 5-10 years. The most recent large recruitment event in 2020 also carried forward to 2021 and leads to all explorations of the assessment model indicating that the population is above the management target and currently increasing. These recruitment events are estimated to be greater than any other recruitment across the modeled period. However, the scale of the population is highly uncertain and will not be better informed until there is a larger contrast in the time series of biomass since 2003, the start year of the most recent survey.

STAT Recommendation: Level 1: Above or better than normal

Thank you!
Further questions/comments?

Council guidance on Initiative 4

- **Defer consideration of the species selection process** and method described in EWG Report 1, section 2 and Appendix A.
- Directed the **EWG to continue work on identifying on-ramps for providing ecosystem information in management processes**, as presented in EWG Report 1, Figures 1-3, based on input from advisory bodies.
- Directed its SSC, through its Ecosystem Subcommittee, to review the risk assessment rubric and application to petrale sole and sablefish (Table C-1 in EWG Report 1 and Tables C-2 and C-3 in Supplemental EWG Report 2) and report to the full SSC at its November meeting..
- **Endorsed joint meetings between the EWG and the GMT, GAP** before the November Council meeting, preferably to occur during the GMT's October 16-20 online meeting. This could help the advisory bodies to formulate any recommendations with respect to the use of the risk assessments as part of the November harvest specifications decision. The EWG is also **encouraged to meet with the CPS FMP advisory bodies** over the fall and winter to discuss tools and processes for integrating ecosystem information into the respective FMP management processes.
- Provided advice on the content of the **proposed TNC-PFMC workshops** described in public comment. The Council recommended that the workshops be a **forum for a broad look at the Council's fishery management processes and the provision of ecosystem information**.