Agenda Item F.1.a
EWG Report 1
September 2023

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;

- Suggestions for potential workshop topics for fall/winter 2023 workshops to be conducted by The Nature Conservancy (TNC) and Council;
- Suggested next steps and timing for Initiative 4.

Additionally, the EWG will provide draft risk evaluation tables for sablefish and petrale sole for Council consideration and review in a supplemental report for the September meeting. The draft tables will also be a focus of our September 5 webinar and discussion of the draft tables would be particularly relevant to the Groundfish Management Team (GMT) and Groundfish Advisory Subpanel (GAP).

The EWG asks for the following guidance at this meeting:

- Review and provide guidance on Section 2 (species selection process), Appendix A (draft species selection criteria), and Appendix B (selection criteria applied to seven species).
- Review and comment on Section 3, FMP-specific timelines and on-ramps for ecosystem and climate information use in the harvest-setting processes for CPS, groundfish, and salmon. Provide advance guidance on what FMP-specific ecosystem and climate information might be appropriate to bring into the Council process in 2024. Comments on the accuracy of the ecosystem information on-ramps (red arrows in the figures) would be particularly helpful. Are there opportunities we are missing, for example?
- Review and comment on Appendix C (application of risk evaluation rubric to petrale sole and sablefish to be provided in a supplemental report), and provide guidance on whether the Council would like the EWG to explore further any of the examples of ecosystem information products described in Section 4.
- Provide guidance on how the draft risk evaluation tables for petrale sole and sablefish (see EWG supplemental report) could be used when finalizing harvest specification.

In addition to recommending that the Council provide the guidance requested above, **the EWG recommends that the Council:**

- Encourage and prioritize time for coordination meetings between the EWG and FMP-specific ABs through continued coordination between Council staff and AB chairs to schedule joint discussions at times suitable to different FMP processes.
- Task Council staff with sending the species selection criteria and process out for public review following the September 2023 meeting so that the EWG may provide final drafts for Council review and adoption at the March 2024 meeting.
- If the Council is interested in having the EWG evaluate additional species under the species selection criteria before March 2024, the EWG asks that the Council select no more than five additional species/stocks/groups for March 2024.
- Consider outstanding Climate and Communities Initiative tasks as potential TNC-Council workshop topics.

2. Process for Choosing Species/Stocks/Groups to Receive Ecosystem and Climate Information

Chapter 2 of the Fishery Ecosystem Plan discusses the Council's March-September meeting processes for addressing ecosystem agenda items. The EWG recommends continuing to follow that March-September process for formal Council-level ecosystem agenda items to choose new species/stocks/groups (hereafter "species") to receive ecosystem and climate information. For meetings between the EWG and FMP-specific ABs, we recommend continued coordination between Council staff and AB chairs to schedule joint discussions at times suitable to different FMP processes.

1. At each March meeting:
    a. *Species status report*: EWG reports to the Council on which species are currently receiving ecosystem and climate information as part of its report to the Council on the California Current Ecosystem Status Report.
    b. *Selection cycle for previously considered species closes*: Council solicits comments from its ABs on candidate species identified at the prior September Council meeting (see #2), considering the selection ratings (see #3), for the coming year and selects one or more species to recommend to NMFS for supplementing with ecosystem and climate information. Timelines for bringing new information into the different FMP processes are suggested below and will differ between FMPs.
    c. *Selection cycle for new species opens*: Council solicits comments from ABs on ongoing workload for integration of ecosystem/climate information into management processes, and solicits new candidate species suggestions from its ABs. (AB comments may be provided to Council under workload planning agenda items at March, April, or June meetings, depending on AB meeting schedules).
2. At each September meeting:
    a. Council selects candidate species based on input described in #1c above.
    b. Council assigns the relevant FMP ABs to work with the EWG on reviewing those species using the species selection criteria in Appendix A.
3. Between the September and the following March Council meeting, the EWG works with the relevant FMP ABs to apply the species selection criteria (Appendix A) to rate candidate species and presents the results (example species shown in Appendix B) at the March meeting.

This process would take a year from initial solicitation to Council recommendations for candidate species. Similar to the Council's stock assessment prioritization processes, the Council would be working with NMFS to narrow the list of candidate species and to recommend candidate species for ecosystem and climate information. Timing for bringing ecosystem and climate information on the chosen species into the harvest-setting processes for those species is discussed in Section 3, below.

In March 2023, the EWG provided draft selection criteria to identify and prioritize the Council-managed species groups or species with management processes that should next be supported with

ecosystem and climate information. Appendix A groups categories of recommended criteria together in a draft table to simplify future recommendations processes for the Council, taking into consideration recommendations provided by Council, ABs, and the public at the March 2023 Council meeting. **The EWG recommends that the Council send Appendix A out for public review following the September 2023 meeting and that the Council schedule final adoption of the species selection criteria for March 2024**.

Appendix B illustrates how the draft species selection criteria provided in Appendix A apply to seven example species/stocks: Pacific sardine, sablefish, petrale sole, North Pacific albacore, Pacific whiting (hake), bocaccio rockfish, and Klamath River Fall Chinook. In March 2023, the Council had asked the EWG to provide draft risk evaluation tables for four species in September 2023: petrale sole, sablefish, Pacific sardine, and Chinook salmon. As described in our June 2023 report:

- The CPS management process does not provide an opportunity to use a Pacific sardine risk table in fall 2023, and the CPS Management Team and Advisory Panel may prefer northern anchovy to Pacific sardine as a pilot species because it is more information-rich. However, Pacific sardine is included in Appendix B to illustrate how it might be considered under the species selection criteria.
- Based on the SSC's Ecosystem Subcommittee's discussions at its September 2022 meeting, the EWG recommends that salmon be reviewed at the stock/watershed level, not at the species level. We chose Klamath River Fall Chinook to illustrate how a salmon stock might be considered under the species selection criteria.
- North Pacific albacore and Pacific whiting (hake) are used as examples of how internationally-managed species could appear in a species-selection table.
- Bocaccio rockfish is used as an example of a southern rockfish species with a strong recreational fisheries emphasis.

The EWG emphasizes that we are **not** recommending that these example seven species/stocks become additional pilot species for this initiative. Starting in March 2024, the Council could begin the March-September selection cycle described above in this section to choose these or other species for evaluation in 2024 and beyond. Applying the Appendix A draft selection criteria to different species/stocks/groups is time-consuming and requires familiarity with species- and fisheries-specific literature and data. The species in Appendix A are all well-known in the Council process and are relatively data-rich compared to other species and stocks in their respective FMPs. If the Council is interested in having the EWG evaluate other species/stocks/groups under the species selection criteria before March 2024, the EWG asks that the Council select no more than 5 additional species/stocks/groups.

3. FMP-Specific Ecosystem and Climate Information On-Ramps in Harvest-Setting

The EWG received guidance at the March 2023 Council meeting from the different ABs on the timing and potential points of inclusion (on-ramps) for ecosystem/climate information into FMP-specific harvest setting processes for groundfish, CPS, and salmon. This guidance is illustrated in Figures 1-3 below. The goal of these schematics is to broadly depict harvest setting schedules in relation to the inclusion of ecosystem and climate information and identify the potential on-ramps

for this information to be used in each harvest setting process. **The EWG would particularly appreciate comments on whether the figures accurately reflect the potential on-ramps (illustrated with red arrows) for ecosystem and climate information within each FMP's schedule.**

For this process to be successful, all entities in the Council process should be involved and included in workload prioritization as these processes are formalized for Council consideration. As this initiative moves forward, roles and responsibilities for the Council, ABs, the SSC, and the Science Centers should be identified and formalized through revisions to harvest setting processes outlined in the FMP-specific Council Operating Procedures.

In this section, we provide further details on when additional ecosystem and climate information might be used in the groundfish management process. The risk assessment rubric in Appendix C and the forthcoming draft risk evaluation tables for petrale sole and sablefish are an example of an ecosystem information product modified from that used in the North Pacific Fishery Management Council process applied to two species managed in our Council process.

Groundfish example and groundfish FMP process:

At the March 2023 meeting, the Council supported the EWG's plan for its May 2023 meeting to discuss drafting risk evaluation tables for petrale sole and sablefish. The EWG asked the assessors for those species and other groundfish experts to attend our May 15 and 17, 2023, meeting, and was fortunate to have the assessors, biologists, ecological modelers, and other groundfish experts attend that meeting (Supplemental EWG Report 1, Agenda Item F.1.a, June 2023). During or following the Council's September meeting, the EWG would appreciate a chance to meet with the GMT and GAP to discuss the pilot risk tables for petrale and sablefish (to be provided in a supplemental report) in more detail. The goal of this meeting would be to refine the tables and timelines as necessary, clarify ABs' roles in the process, and discuss other potential mechanisms for inclusion of climate/ecosystem information into the groundfish management process.

As proposed by the SSC, the SSC-ES would meet (by webinar) between the September and November Council meetings to review September EWG reports, including pilot risk evaluation methodology application to petrale sole and sablefish (see Agenda Item C.8.a, Supplemental SSC Report 1, June 2023). Subcommittee recommendations from this meeting would be reviewed by the full SSC in November with recommendations provided to the Council.

We recognize that it may be difficult to bring new information products into the (current 2025-2026) biennial specifications process without more firm inter-AB plans for how the products could be used. Depending on how this EWG report is received in September, and on follow-up meetings with ABs, the EWG could report to the Council in March 2024 on an ongoing process to be applied in future groundfish harvest specifications cycles.

Even if the pilot risk assessment is not used in the current harvest specifications cycle, the EWG notes that one of the benefits recognized in the North Pacific was that the risk assessment process required ecosystem scientists and stock assessors to talk to each other. The May 2023 EWG webinar provides a clear example of such collaboration in the Council arena. Such a meeting could be institutionalized as part of a broader Council process to bring ecosystem/climate information

into groundfish management. This cannot be fully developed for the current specifications cycle but perhaps could be applied beginning with stock assessment prioritization for the 2027-2028 cycle (March 2024).

Figures 1 to 3 illustrate draft FMP-specific timelines and potential points in those processes when ecosystem and climate information might be used in the harvest-setting processes for CPS, groundfish, and salmon. The red arrows indicate potential on-ramps for ecosystem and climate information.

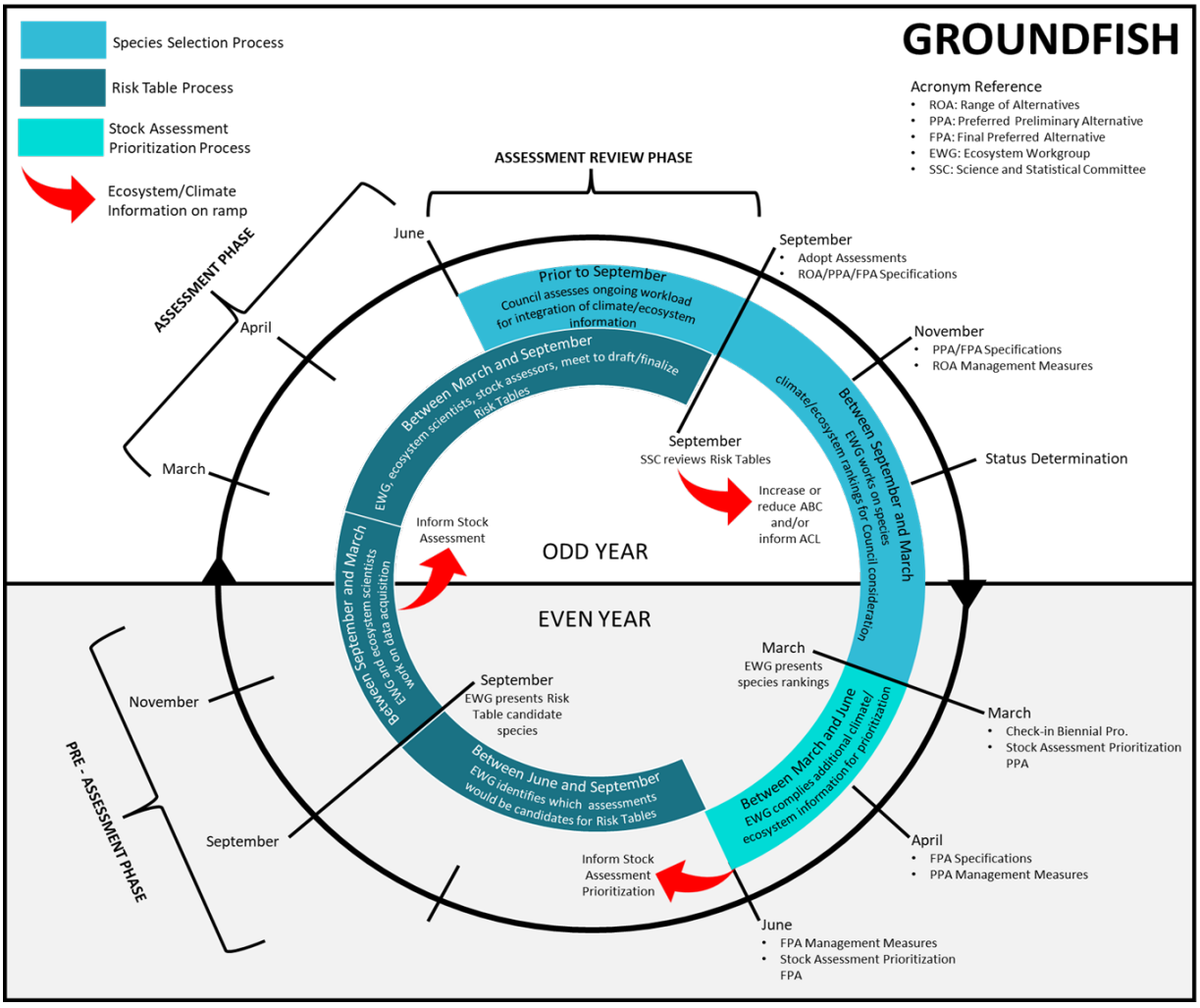

Figure 1: Groundfish harvest setting process highlighting the timing and potential on-ramps for ecosystem/climate information.

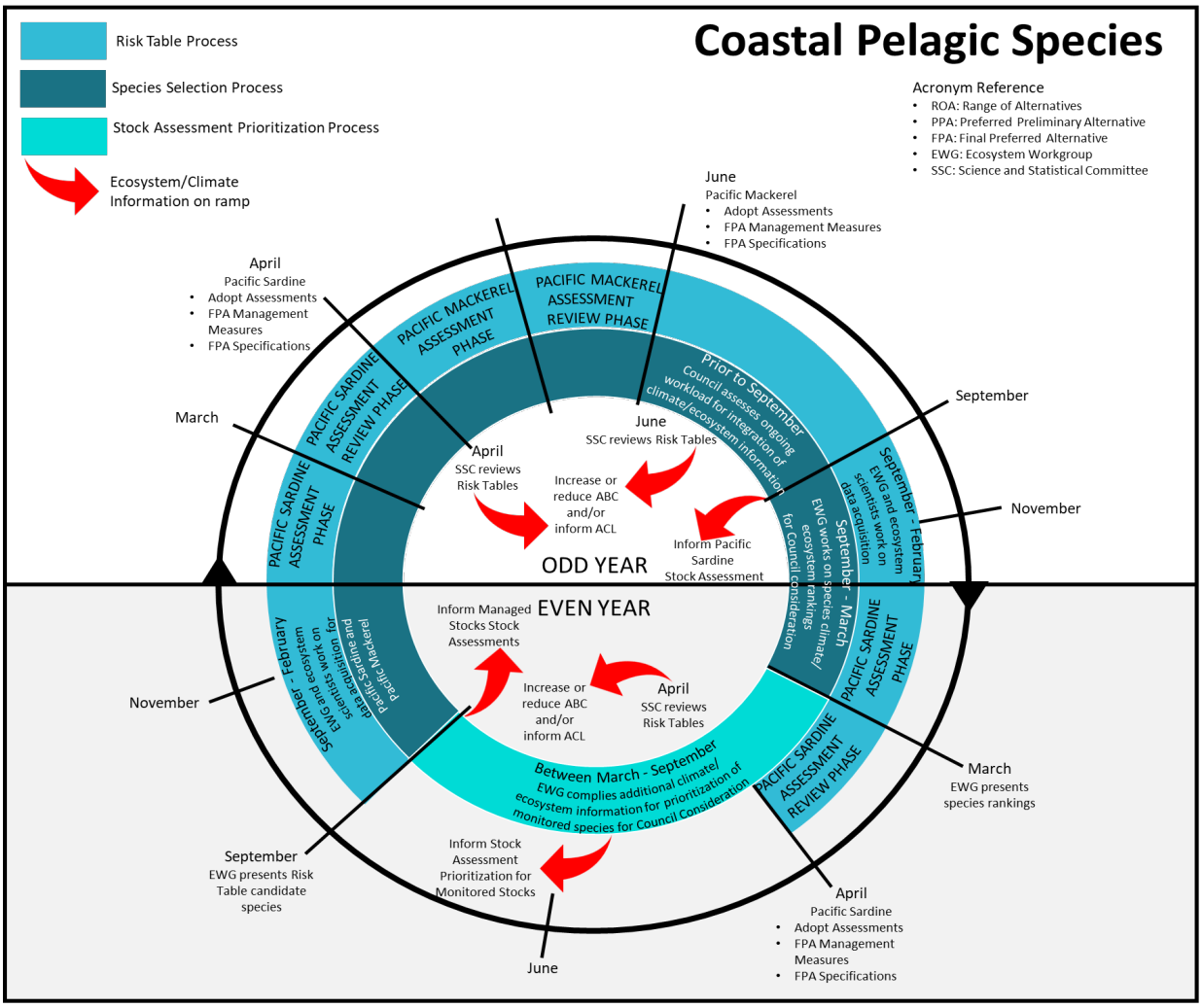

Figure 2: CPS harvest setting process highlighting the timing and potential on-ramps for ecosystem/climate information.

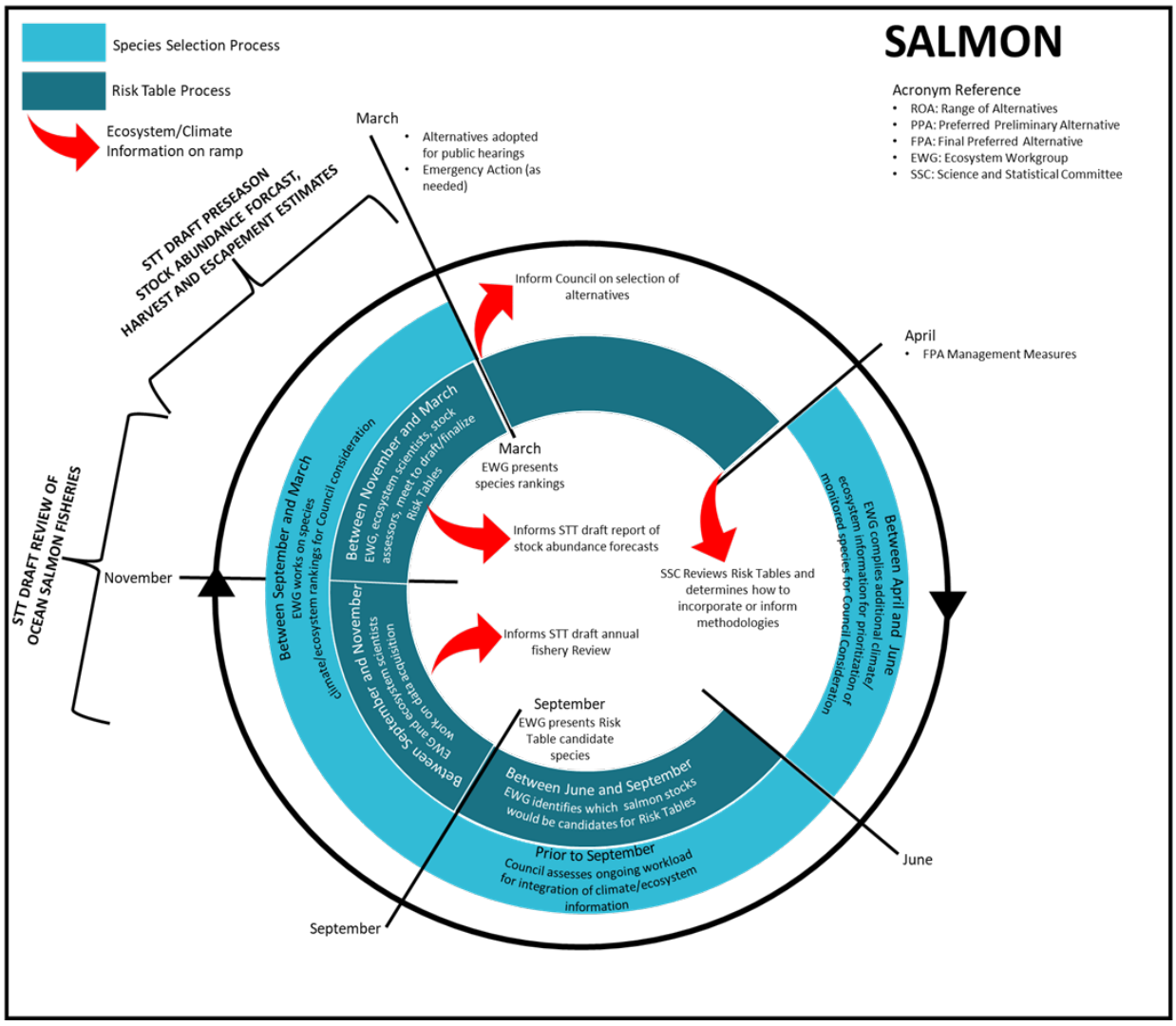

Figure 3: Salmon harvest setting process highlighting the timing and potential on-ramps for ecosystem/climate information.

4. The Pilot Risk Assessment Methodology (Appendix C) and other Ecosystem Information Products

Through Initiative 4, the Council has begun to explore risk assessment and risk evaluation tables similar to those used in the NPFMC for Gulf of Alaska pollock (Dorn and Zador 2020,[1] Monnahan et al. 2021[2]). The main objective here is to provide information to the Council that can help with

[1] Dorn, M. W., and S. G. Zador. 2020. A risk table to address concerns external to stock assessments when developing fisheries harvest recommendations. Ecosystem Health and Sustainability 6:1813634.

[2] Monnahan, C. C., Dorn, M. W., Deary, A. L., Ferriss, B. E., Fissel, B. E., Honkalehto, T., Jones, D.T., Zador, S. 2021. Assessment of the Walleye Pollock Stock in the Gulf of Alaska. Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska. North Pacific Fishery Management Council, 1007.

harvest-setting decisions. For example, environmental conditions can influence recruitment strength and can thus help forecast near term population dynamics or can lead to redistribution that can make species more or less available for fisheries or fisheries surveys.

Appendix C contains Table C-1, the risk classification matrix for evaluating different species, stocks, or groups. The EWG plans to provide a supplemental report with Tables C-2 and C-3, which will illustrate how the risk classification matrix applies to petrale sole and sablefish, respectively. In response to a Council recommendation from March 2023, we have modified the NPFMC's example risk classification table to add a row to our draft risk assessment table that acknowledges that environmental conditions can be better than normal in some years, not just different degrees of worse than normal. We are not, however, recommending the more recent NPFMC approach of waiting for the risk tables to consider fishery performance. Instead, we recommend that the Council continue with its current approach of addressing that information earlier in the process by including this type of information in stock assessment executive summaries, and also by considering a range of social and economic concerns in the early species selection stage of the process – see Appendix A. As discussed in Section 3, further work is needed on how these products can be integrated into the groundfish harvest specifications process, and other FMP-related processes such as stock assessment prioritization.

There are a variety of other ways the EWG could further explore the use of ecosystem information in harvest setting processes. For example, the Northwest and Southwest Fisheries Science Centers have been presenting and refining salmon indicators for several years through the salmon stoplight tables used in the annual ecosystem status report and elsewhere. Stoplight tables do not explicitly assess risk in support of decision making. However, if through the proposed species selection process the Council were to choose a salmon stock, the EWG would be prepared to further develop the stoplight methodology to link it more explicitly to harvest setting decisions. In addition to stoplight tables, stock assessors have added brief one-page summaries to recent Pacific whiting (hake), petrale sole, and black rockfish assessments, and those summaries could be supplemented with ecosystem information. A third option to consider comes from NMFS's national Stock Assessment Improvement Plan, which suggests a two-page summary of stock-specific and ecosystem information (Lynch et al. 2018). These two-page summaries are similar to a suggestion made in 2011 by the Science Centers in an early report from the California Current Integrated Ecosystem Assessment. Regardless of which approach the Council favors for receiving future FMP-specific ecosystem information, we will need to explore on-ramps in the decision-making process to use that information (See Section 3) if that information is to affect Council decisions.

5. Workshop Topic Suggestions for TNC

In response to Council requests for suggested topics for a workshop sponsored by The Nature Conservancy and the Council in support of this initiative, we suggest the workshop steering committee consider:

- Applying Appendix A species selection criteria to new species/stocks/groups;
- Developing recommendations for including ecosystem and climate information in the management process for data poor species/stocks/groups (species without Category 1 stock assessments);

- Exploring innovative onramps for bringing ecosystem information into the fishery management process;
- Developing strategies for increasing the resiliency of our managed stocks and fisheries beyond harvest-setting processes;
- Exploring Council decision-making and NMFS review and regulatory processes to suggest ways to make those more dynamic to respond to rapidly changing environmental conditions.

The EWG also reported on incomplete follow-up tasks from the Climate and Communities Initiative (CCI) in March 2023 (Agenda Item G.6.a., Supplemental EWG Report 1) and that task list may provide additional workshop ideas.

6. Next Steps

For September 2023 and beyond, work on this initiative could proceed as follows, and will likely evolve depending on decisions made at this and subsequent Council meetings.

September– November 2023:

- EWG provides an online briefing on the contents of this report to interested AB members and the public (September 5).
- EWG consults with the GAP and GMT to revise the draft petrale sole and sablefish risk tables prior to review by the SSC Ecosystem Subcommittee, and to discuss whether there are other ecosystem information products that may be more useful in the groundfish management process (after September Council meeting).
- SSC Ecosystem Subcommittee reviews Initiative 4 materials (September-October).
- EWG consults with the CPSAS, CPSMT, SAS, and STT to discuss management processes and appropriate ecosystem information products for those species and management processes (prior to the March 2024 Council meeting).
- At its September meeting, the Council reviews the draft petrale sole and sablefish risk tables and determines whether the final risk tables can be delivered in support of groundfish agenda items in November 2023. The EWG also seeks SSC input on its review and use of the pilot risk tables, noting that such a review would involve members of both of the Ecosystem and Groundfish subcommittees and be conducted for Council consideration prior to the November meeting.

November 2023 – March 2024:

- EWG revises and updates future species selection criteria based on guidance from public review and presents a revised draft under the March 2024 initiative update.
- EWG revises and updates draft ecosystem/climate information on-ramp processes shown in Figures 1-3 and recommends ecosystem and climate information products relevant to the processes for CPS, groundfish, and salmon under the March 2024 initiative update.
- Depending on the Council's September 2023 guidance, EWG revises draft risk tables, including the addition of a clear framework for climate and ecosystem information to consider in evaluating risk, or drafts alternative ecosystem and climate information products for Council consideration in March 2024.

March 2024:

- Council and advisory bodies test future species selection criteria process and make recommendations for species or species groups to be added to those receiving ecosystem and climate information reports, taking into account the FMP schedules appropriate to the selected species.
- Council reviews draft ecosystem/climate information on-ramp processes to ensure that ecosystem and climate information may be used in near-term harvest setting processes for CPS, groundfish, and salmon.

April 2024 - September 2024:

- EWG revises and updates future species selection criteria process, finalizing for Council review and adoption in September 2024.
- EWG works with Centers' staff to draft additional ecosystem and climate information reports for species or species groups recommended by the Council in March 2024.
- EWG revises draft ecosystem/climate information on-ramp processes as directed by the Council in March 2024.

September 2024: Council adopts final process for selecting future species or species groups to have ecosystem and climate information products, such as risk evaluation tables, developed for them. Council adopts final ecosystem/climate information on-ramp processes for CPS, groundfish, and salmon. Council finalizes initiative and makes any needed near-term adjustments to its advisory body schedules for considering ecosystem and climate information.

Appendix A: Selection Criteria for Choosing Species/Stocks/Groups to Receive Ecosystem and Climate Information

Criterion	Prerequisites	High	Medium	Low	Reference(s)
Council authority					
This criterion asks about the extent to which the Council has authority over the species/stock/group under review.	Harvest levels for the species/stock/group are set by the Council, or management measures (whether to control targeted catch or bycatch) are set for the species/stock/group by the Council. Highest priority should be given to MSA-managed species/stocks, or to species/stocks taken in fisheries that require consultations under the ESA or MMPA.	The Council develops harvest limits and management measures for the portion of the species/stock/group population taken within the US West Coast EEZ.	The Council sets management measures, including bycatch minimization measures, for the portion of the species/stock/group population taken within the US West Coast EEZ.	West Coast species of interest to the PFMC, but not managed by the PFMC.	PFMC Fishery Management Plans.

Criterion	Prerequisites	High	Medium	Low	Reference(s)
Scientific considerations					
This criterion asks about the data richness and science readiness of the information available for the species/stock/group under review. Does the data for this species/stock/group have broad spatial coverage? Are continuous time series of data available for this species/stock/group? Is scientific information available for this species/stock/group theoretically sound and does it respond predictably and with sufficient sensitivity to changes in a specific ecosystem key attribute?	Availability of climate and ecosystem information relevant to the species/stock/group has broad spatial coverage including most or all of the spatial management unit, and/or is based on samples collected on multiple occasions, preferably without substantial time-gaps between sampling. Scientific, peer-reviewed findings demonstrate that climate and ecosystem information provides a theoretically-sound basis for changes in the abundance and/or distribution of a stock or stock complex Climate and ecosystem information provides unambiguous response to variation in the key attribute(s) of the stock or stock complex they are intended to measure, in a theoretically- or empirically-expected direction.	Data collected over most or the entire domain of the species/stock/group and/or for 10+ years. Three or more peer-reviewed or PFMC publications provide consistent findings in support	Data collected over less than half of the domain of the species/stock/group, and data collected regularly, possibly not annually, and for 5+ years Less than three peer-reviewed or PFMC publications, or expert opinion, provide limited support.	Data collected over a small part of the domain of the species/stock/group, and data collected irregularly (less than every 3 years) with no minimum amount of sampling. No peer-reviewed evidence, evidence against, or conflicting support.	Kershner et al. 2011

Criterion	Prerequisites	High	Medium	Low	Reference(s)
Ecological considerations					
This criterion asks about the effects of the physical environment on the species/stock/group under review and about the role of the species/stock/group within the ecosystem, particularly trophic connections.	Species/stock group abundance or distribution is exposed to and biologically sensitive to near-term climate variability or long-term climate change. Criterion should be reviewed taking into account the resiliency of the species/stock/group to changes in the physical environment and its adaptive capacity to respond to these new conditions. Species/stock group is known to be trophically connected to multiple predators as prey, important prey for a predatory species of concern (e.g. ESA-listed), or an important predator foraging on multiple important prey species.	Very high or high likelihood	Moderate likelihood	Low likelihood	Crozier et al. 2019 McClure et al. 2023

Criterion	Prerequisites	High	Medium	Low	Reference(s)
Social and Economic Considerations					
This criterion asks: whether the species/stock/group under review is likely to be culturally or economically important to vulnerable or dependent fishing communities; whether fisheries for the species/stock/group are likely to have been operating with relatively consistent management measures, gear use, and landings timings and locations in recent years; and, about whether the species/stock/group or its fisheries are likely to be affected by competing non-fishing ocean uses.	Fisheries for the species/stock/group are known to include ceremonial or subsistence fisheries. Either landed by commercial fisheries or supports recreational fisheries trips in communities known to be fishing -dependent, economically vulnerable, or both. Fisheries for the species/stock/group are known or suspected to overlap with other ocean use areas such as offshore wind energy development.	Very high or high likelihood	Moderate likelihood	Low likelihood	https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities and attached data viewer.

Appendix A References

Crozier, L. G., McClure, M. M., Beechie, T., Bograd, S. J., Boughton, D. A., Carr, M., Cooney, T. D., Dunham, J. B., Greene, C. M., Haltuch, M. A., Hazen, E. L., Holzer, D. M., Huff, D. D., Johnson, R. C., Jordan, C. E., Kaplan, I. C., Lindley, S. T., Mantua, N. J., Moyle, P. B., … Willis-Norton, E. (2019). Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. PLoS One, 14(7), e0217711. https://doi.org/10.1371/journal.pone.0217711

Kershner, J., J. F. Samhouri, C. A. James, and P. S. Levin. 2011. Selecting Indicator Portfolios for Marine Species and Food Webs: A Puget Sound Case Study. PLoS ONE 6:e25248.

McClure MM, Haltuch MA, Willis-Norton E, Huff DD, Hazen EL, Crozier LG, Jacox MG, Nelson MW, Andrews KS, Barnett LAK, Berger AM, Beyer S, Bizzarro J, Boughton D, Cope JM, Carr M, Dewar H, Dick E, Dorval E, Dunham J, Gertseva V, Greene CM, Gustafson RG, Hamel OS, Harvey CJ, Henderson MJ, Jordan CE, Kaplan IC, Lindley ST, Mantua NJ, Matson SE, Monk MH, Moyle P, Nicol C, Pohl J, Rykaczewski RR, Samhouri JF, Sogard S, Tolimieri N, Wallace J, Wetzel C and Bograd SJ.2023. Vulnerability to climate change of managed stocks in the California Current large marine ecosystem. Front. Mar. Sci. 10:1103767. doi: 10.3389/fmars.2023.1103767.

Appendix B: Applying Selection Criteria to Sample Species/Stocks/Groups

Selection Criteria Summary

	Council Authority	Scientific Considerations	Ecological Considerations	Social and Economic Considerations
Sardine	High	High, mixed	High	Med
Sablefish	High	High	Med	High
Petrale Sole	High	Med-High	Med	Low
Albacore	Med-Low	High, mixed	High	High
Pacific Whiting/ Hake	Med-High	High	High	High
Bocaccio Southern Stock	High	High	High	High
Klamath fall Chinook	High	High	High	High

Council authority Criteria: This criterion asks about the extent to which the Council has authority over the species/stock/group under review.

- Species or stocks with a ***High*** level of Council authority are Fishery Management Unit (FMU) species with harvest levels and management measures set by the Council.
- Species or stocks with a ***Medium*** level of Council authority may have harvest levels set by multi-national science or management organizations, but have management measures set by the Council.
- Species with a ***Low*** level of Council authority may or may not be FMU species, and are managed with little guidance or restrictions set within the Council process.

Sardine	**High** FMU species with harvest levels and management measures set by the Council
Sablefish	**High** FMU species with harvest levels and management measures set by the Council.
Petrale Sole	**High** FMU species with harvest levels and management measures set by the Council.
Albacore	**Medium-Low** Open access fishery. No fishery restrictions until/unless internationally set limits are reached. Other HMS stocks may rate higher.
Pacific Whiting/ Hake	**Medium-High** Harvest levels are set under US/Canada agreement, but Council sets management measures for the US West Coast. Largest West Coast fishery by volume and is managed for bycatch interactions, which are infrequent but can be meaningful because of overall fishery volume (Free et al. 2023).
Bocaccio Southern Stock	**High** FMU species with harvest levels and management measures set by the Council.
Klamath fall Chinook	**High** FMU species/stock with harvest levels and management measures set by the Council. Serves as the proxy stock that is the basis for the biological opinion for ocean fisheries affecting threatened California Coastal Chinook.

Scientific considerations: This criterion asks about the data richness and science readiness of the information available for the species/stock/group under review.

- Does the data for this species/stock/group have broad spatial coverage, including most or all of the spatial management unit? Are continuous time series of data available for this species/stock/group? What surveys, if any, are used to collect data for this species/stock group?
- Is scientific information available for this species/stock/group theoretically sound and does it respond predictably and with sufficient sensitivity to changes in a specific ecosystem key attribute?

Sardine	**High but Mixed** Despite almost a century of research, it has been difficult to understand the true mechanistic drivers for the stock dynamics. At the turn of the 21st century, we felt we had a solid understanding that the sardine population did well when the ocean was warm (Chavez et al. 2003). However, we've just experienced the warmest decade (2013-2023) in the North Pacific and sardines remain very low. There are questions regarding stock structure that may confound our understanding of environmental relationships. We are operating under the assumption that there are northern and southern stocks of sardine in U.S. waters, but this notion is being questioned. In addition, it was recently discovered that Japanese sardine (*Sardinella zunasi*) are present in the California Current Large Marine Ecosystem but the abundance of this species and the nature of its interaction with Pacific sardine is unknown. Notably, Japanese and Pacific sardines are indistinguishable morphologically; the presence of genetic analysis.ɔ was found with
Sablefish	**High** Sablefish is regularly assessed and their adult population is relatively well sampled. This species is widely distributed along the North American coast as one genetically mixed population. More pre-recruit information is needed on this species, but it is one of the few West Coast species with a species-specific analysis of recruitment links to oceanographic drivers (Tolimieri et al. 2018) that also led to the development of an environmental recruitment index for the stock assessment (Tolimieri and Haltuch 2023).
Petrale Sole	**High-Medium** Petrale sole is regularly assessed and their adult population is relatively well sampled. Large amount of age and length data spanning multiple generations. Less pre-recruit/juvenile information than sablefish. One of the few West Coast species with a species-specific analysis of recruitment links to oceanographic drivers (Haltuch et al. 2020), and identified driving mechanisms between spawning and juvenile settlement regions (Santa Cruz et al. 2023).

Albacore	**High but mixed** This is a Pacific Ocean basin species that is seasonally present in the CCE. While scientific information on the status and ecosystem role of this species is relatively good for HMS, it is on a different scale from "good" information for more regional fish stocks. Future Seas has ramped up basinwide albacore research, including providing more information about connections between climate variability and prey availability to albacore within the CCE (Muhling et al. 2019).
Pacific Whiting/ Hake	**High** Species is regularly assessed with many generations of data (Berger et al. 2023). Possibly the most data-rich assessment on the West Coast, and includes variability in growth and recruitment. This is a relatively short-lived species, which means that science has tracked and monitored changes to many generations of the stock over time. Lots of research into mechanisms of population variability. Species with highly variable recruitment that may be connected to climate variability (Jacobsen et al. 2021, Vestfals et al. 2023). Pacific whiting/hake is subject to a binational adult survey every other year, with the possibility of annual surveys if it is combined with the coastal pelagics survey.
Bocaccio Southern Stock	**High** There is robust information on larval, recruit (pelagic juvenile), and adult stages from NOAA surveys. There is also a rich, mechanistic understanding of recruitment drivers (Schroeder et al. 2019). Specifically, recruit abundance is higher in years when gestating adults are exposed to Pacific sub-Arctic water. Larvae are also in better condition when their parents were exposed to CCE water (Fennie et al. under revision). Between Schroeder et al. (2019), Tolimieri et al. (2005), and now Fennie et al. (under revision), we have a good handle on the drivers of population dynamics of bocaccio in the CCE.
Klamath fall Chinook	**High** This stock has been relatively highly studied and there is good scientific information available on this stock for both ocean distribution and freshwater habitat. (Satterthwaite et al. 2014, Crozier et al. 2019, O'Farrell and Satterthwaite 2021, Crozier and Siegel 2023). Freshwater escapement & juvenile monitoring programs: CDFW Fisheries Branch Anadromous Assessment Unit; USFWS Arcata Fish Health Monitoring, Trap Catch Summaries. Serves as the proxy stock that is the basis for the biological opinion for ocean fisheries affecting threatened California Coastal Chinook.

Ecological considerations: This criterion asks about the effects of the environment on the species/stock/group under review and about the role of the species/stock/group within the ecosystem, particularly trophic connections.

- Species/stock group abundance or distribution is exposed to and biologically sensitive to near-term climate variability or long-term climate change (based on climate vulnerability assessment [CVA] in McClure et al. 2023 or Crozier et al. 2019).
- Criterion should be reviewed taking into account the resiliency of the species/stock/group to changes in the physical environment and its adaptive capacity to respond to these new conditions.
- Species/stock group is known to be trophically connected to multiple predators as prey, important prey for a predatory species of concern (e.g. ESA-listed), or an important predator foraging on multiple important prey species.

See Appendix A, page 3.

Sardine	**High** Sardines are a known high value/energy low trophic level prey species (McClatchie et al. 2016, Koenigstein et al. 2022). Overall CVA Rank: Low.
Sablefish	**Medium** Dissolved oxygen affects the spatial distribution of sablefish (Essington et al. 2022) and the coastwide abundance and distribution of sablefish is projected to change in response to long-term warming and reduced oxygen concentrations (Liu et al. 2023). Sablefish is a mid-trophic level species that consumes forage fishes (Koehn et al. 2016) and potentially juvenile salmon (Sturdevant et al. 2011). Recent work indicates that warmer temperatures drive increased spatial overlap among juvenile sablefish and salmon in the NCC and that sablefish may have a competitive advantage over salmon (Daly et al. in prep.) Overall CVA Rank: Moderate.
Petrale Sole	**Medium** Mid-trophic level species. There has been work done on spatial/temporal patterns in habitat and growth but not linked to climate or ecosystem indicators yet (Gertseva et al. 2017, Tolimieri et al. 2020). Overall CVA Rank: Moderate.

Albacore	**High** Albacore is a highly migratory high trophic order predator that tracks their prey through the California Current Ecosystem. Albacore diet varies with climate variability (Muhling et al. 2019, Muhling et al. 2022), which can affect the fisheries that track and target albacore (Smith et al. 2023). Albacore diet analyses are here: (Hardy et al. *in press* F&F) - Gleiber et al. *in review* Ecol Ind.) – stomach samples also have been included in the IEA ESR Overall CVA Rank: Moderate.
Pacific Whiting/ Hake	**High** Very high biomass species, key mid-trophic species (Koehn et al. 2016). Recent work indicates that Pacific hake and Chinook salmon share foraging areas and prey species, particularly during periods of low productivity (Wells et al. 2023). Migratory patterns and extent of migration changes with ocean conditions, so distribution changes need to be incorporated into assessment and management (Malick et al. 2020, Jacobsen et al. 2021, Jacobsen et al. 2022). Largest West Coast fishery by volume and is managed for bycatch interactions, which are infrequent but can be meaningful because of overall fishery volume (Free et al. 2023). Overall CVA Rank: Low.
Bocaccio Southern Stock	**High** Pelagic juvenile rockfishes are important prey for some birds (Santora et al. 2014) and marine mammals (McClatchie et al. 2016). However, they are part of the broader assemblage of pelagic juvenile rockfishes and the importance of bocaccio relative to other rockfish is not known. When the stock is high, they are an extremely important benthic apex predator. Recruitment responses clearly to changes in the physical environment. Relative to other apex predator rockfishes (e.g., cowcod *S. levis*), they are capable of producing giant recruitment classes that mature quickly. Overall CVA Rank: Moderate.
Klamath fall Chinook	**High** This stock plays an important role in nutrient transfer from ocean to freshwater, and they are a food source for a wide variety of birds and mammals. Like other salmonid populations of the northeastern Pacific, this stock is likely to shift distribution in response to a warming climate (Satterthwaite et al. 2014, Shelton et al. 2018, Shelton et al. 2020). Information on current adult distributions may be available through coded-wire tag data. Due to recent Klamath River dam removal, this particular salmon stock will likely be subject to near-term and uncertain fluctuations in abundance, distribution, and fisheries and habitat management. Overall CVA Rank: High.

Social and Economic Considerations: This criterion asks:

- if the species/stock/group is regularly subject to allocation issues
- whether the species/stock/group under review is likely to be culturally or economically important to vulnerable or dependent fishing communities
- whether fisheries for the species/stock/group are likely to have been operating with relatively consistent management measures, gear use, and landings timings and locations in recent years
- whether the species/stock/group or its fisheries are likely to be affected by competing non-fishing ocean uses, particularly offshore wind.

See Appendix A, page 4.

Sardine	**Medium** Coastwide allocation; issues have been minimal but could rise in the future with changing climate; No sectoral allocation issues. Low level of potential interaction with offshore wind installations, although population may be affected by wind installations if turbines themselves affect upwelling processes and larval movement. Could be affected by offshore aquaculture installations, but could also benefit from offshore aquaculture industry if sardine can be sold as feed to fish farms. Primarily high-volume fishery with high social and economic value. When population is high, the fishery is also of high value across all three states; highly important to ports with historic landings (Free et al. 2023). Low volume live bait fishery with high economic importance to Southern California recreational fisheries.
Sablefish	**High** Tribal/non-tribal allocations, trawl/fixed gear allocations, sub-sector allocations within fixed gear, geographic area allocations. High potential for trawl fisheries to be affected by offshore wind installations. High value species landed in many ports; therefore, relatively high importance to many fishing communities
Petrale Sole	**Low** Petrale sole is almost exclusively taken by the groundfish trawl fishery and there are no within-sector allocations of this species. High likelihood of interaction with offshore wind through trawl fisheries.

Albacore	**High** Albacore is open access, which means few allocation concerns and that fishery provides resiliency to coastal communities when there are restrictions in crab and salmon fisheries (Frawley et al. 2021). Offshore wind turbines are highly likely to be placed where albacore fisheries tend to occur – high wind areas and desired bottom placement overlap with fishery. Open access flexibility in albacore fishery's management makes this fishery highly valuable to ports experiencing climate- or other changes in availability of other stocks to fisheries.
Pacific Whiting/ Hake	**High** Highly allocated stock: Tribal/non-tribal commercial fisheries allocation; non-tribal commercial allocation between shoreside, catcher-processor, and mothership sectors. Although bycatch is low in these fisheries by volume, the overall volume of the fishery is so high that bycatch avoidance can drive management, particularly for incidental take of Chinook salmon, darkblotched rockfish, dogfish, shortbelly rockfish and other species. Bycatch rates and species composition may be driven by climate variability (Sabal et al. 2023). Likely to be significant interactions with offshore wind industry because wind turbines are likely to be placed in offshore areas where Pacific whiting fisheries are known to occur. Primarily a high-volume fishery with high social and economic value in sectors and ports where it has historically been taken or landed.
Bocaccio Southern Stock	**High** Bocaccio are an extremely important commercial and recreational fishery in California (Field et al. 2010).
Klamath fall Chinook	**High** This stock is important to tribal fisheries, and to non-tribal commercial and recreational fisheries in dependent fishing communities. Although fishing activity for this stock may not be directly affected by offshore energy installations, ocean fisheries occur in a high wind area and there may be onshore conflicts for available harbor resources. Due to recent Klamath River dam removal, this particular salmon stock will likely be subject to near-term and uncertain fluctuations in abundance, distribution, and fisheries and habitat management.

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Appendix C: Risk Classification Table

Table C-1: Risk classification rubric for environmental/ecosystem considerations, assessment, and population dynamics.

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

	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.