

Scientific and Statistical Committee Economics Subcommittee Report on “Community Resilience Decision Tool Methodology”

June 2, 2026

The Scientific and Statistical Committee Economics Subcommittee (SSC-ES) held a webinar June 2, 2026, to review the draft Community Resilience Decision Tool Methodology for evaluating the resilience of West Coast fishing communities as part of a Community Resilience Decision Support Framework being developed under Council Special Project 2. The SSC Economics Subcommittee will report its recommendations to the full SSC, which in turn is scheduled to provide a report to the Pacific Fishery Management Council at the June 2026 meeting.

Section B.1: Presentation

Melissa Errend and Karma Norman (Northern Economics) presented the outcomes of stages 1-3 of a project that is aiming to improve the Council’s ability to measure and understand the impact of its decisions on U.S. West Coast fishing communities given the factors and conditions that are affecting the viability and persistence of these communities. Phases 1 and 2 involved the collection and synthesis of information on this topic and a gap analysis. A draft methodology to assess community resilience was developed in Stage 3 and will be reviewed during the June 2026 Council meeting when the Council and its advisory bodies will provide feedback on the methodology and input on case studies. The framework and application will be finalized in Phase 4 and delivered to the Council along with case studies in September of 2027. The subcommittee recognized that this was a single year project and that some of its suggestions may require more time and resources than are available. As such, the subcommittee (and the Northern Economics team) recognized that this work should be considered part of a longer-term process. The subcommittee noted that while this is not a research project, implementing some recommendations may require further study.

The decision tool is based on a conceptual model of what makes fishing communities resilient. It is predicated on the assumption that fishing communities that are less vulnerable are more likely to be resilient and proposes to use measurable and practical indicators of vulnerability that can be applied across West Coast communities. The decision tool could be used to assess a variety of stressors and shocks (e.g., climate change, market disruptions), but the subcommittee focused on the use of the tool to explore the community-related consequences of fishery regulatory changes. It was noted that the decision tool should be considered to be a “living document,” which will be expected to be flexible and to be modified over time. The tool will be designed for application on the West Coast but could be applied to other regions.

The synthesis of information and gap analysis was based on a literature review, interviews with stakeholders, input from an advisory team, and an overview of Council processes. It includes a summary of existing tools, metrics and indicators of vulnerability and resilience as well as an outline of some in-progress initiatives. Key observations from stages 1 and 2 of the project include that: (1) existing metrics reported in the California Current Ecosystem Status Report and previous research provide a strong foundation for evaluating community resilience; (2) there is a need for forward looking *ex-ante* analyses to predict future resilience as opposed to retrospective analyses; (3) more work is needed to understand adaptive capacity; (4) there is a need for more information

on infrastructure and community resilience, including social capital. The subcommittee agreed that the synthesis and gap document was comprehensive and agreed with the conclusion that there is a need for a tool that is forward-looking. The synthesis report also listed knowledge gaps such as a lack of indicators of adaptive capacity as well as the challenges associated with data confidentiality and the scale at which the decision tool should be applied (and hence that at which data need to be supplied and analyzed).

The decision tool aims to be flexible and practical in terms of its use of existing indicators and data sets. It is predicated on the assumption that resilience of fishing communities is related to vulnerability, which in turn is a function of the combined effects of exposure (stressors affecting the community), sensitivity (dependence of fishers and social vulnerability) and adaptive capacity (ability to change in response to stressors). Adaptive capacity conceptually reflects the combination of several dimensions (flexibility, assets, organization, learning, agency, and socio-cognitive factors) but this part of the methodology remains the least well developed in terms of indicators even though it is the most forward thinking of the three components of vulnerability.

Section C: Discussion

The subcommittee organized its discussion around the following four themes that the Council requested the SSC address at its June 2026 meeting:

1. Recommendations to ensure the methodology is applicable and useful across fisheries and fishing communities;
2. Suggestions for other data, metrics, or indicators to consider;
3. Desired balance between a narrative tool and an analytical tool;
4. Type of case study to apply the methodology and framework to (e.g., current Council action vs. retrospective action; fishery management plan amendment or specifications action).

The subcommittee notes that much of its discussion was based on decisions that have not yet been made about the Council's objectives and expectations for the tool. In particular, the appropriate balance between a narrative and an analytical approach, and the level of investment required to build and maintain the tool, depend on how the Council proposes to use the tool and on the stage in the decision-making process at which it will be used. The subcommittee encourages the Council to provide clearer guidance on these objectives prior to embarking on Phase 4 of the project.

1. Recommendations to ensure the methodology is applicable and useful across fisheries and fishing communities

The primary objective of the draft framework is to evaluate the resilience of fishing communities using a framework and a set of indicators that describe community vulnerability, which is assumed to be an indicator/predictor of resilience. The subcommittee noted that the definition of resilience provided in the draft methodology is general, and ways to measure it (which would be required for validating its relationship with vulnerability indicators) are not specified. It will be important in Phase 4 to clearly identify measurable indicators of resilience that can be used for validation.

The subcommittee discussed the importance of deciding on a consistent spatial scale for the tool before significant development proceeds. Many of the relevant datasets (e.g., fish ticket data, permit records, social vulnerability indices) differ not only in their spatial scale but also in their

unit of observation (e.g., vessel, permit holder, census place, county, port group). Integrating such datasets can be challenging, as each scale imposes different confidentiality restrictions. There will also need to be decisions about how to aggregate data or metrics. For example, a port group revenue diversification indicator might be based on fishery revenue at the port group level or might be calculated as an average of diversification scores for vessels with landings to that port group. The subcommittee recommends that a single (or at least preferred) scale of analysis be identified early in Phase 4 so that the datasets needed to operationalize the tool can be assembled and maintained in a consistent, usable form. This would make future applications of the tool more efficient and consistent, and would reduce the burden on analysts when the tool is applied to specific management actions.

The subcommittee also emphasized that the current methodology would benefit from greater attention to how the three components of vulnerability (exposure, sensitivity, and adaptive capacity) are integrated into outputs that inform decision-making. At present, the framework identifies indicators for each component but does not specify how to combine or summarize them. For example, a community with high exposure, high sensitivity, and low adaptive capacity is clearly vulnerable. But what about a community with high exposure, low sensitivity, and high adaptive capacity? The implications of these types of differences might be explored in case studies. While a tool that provides a single metric of vulnerability to a particular disturbance would be useful, the Council is familiar with using the results of analysis tools (e.g., MSEs and rebuilding analyses) that provide multiple metrics, so creating a single output metric need not be the focus for the tool development. The subcommittee notes that integration is an important gap to address as the project moves into Phase 4.

Similarly, the subcommittee recommends careful consideration of how indicators are reported. The level of some indicators may not be meaningful in isolation; what matters is their trend over time or their value relative to a reference group or baseline, and in particular how they may change in the future given the stressors. The analytical team should be explicit about which indicators are interpretable on their own and which require normalization or benchmarking to be meaningful.

The subcommittee noted that there was little discussion of uncertainty, both in terms of vulnerability metrics and in terms of how well they predict resilience. The analytical team acknowledged the importance of understanding and incorporating uncertainty. Ways to characterize uncertainty should be explored in Phase 4.

Finally, the subcommittee notes that the tool should be designed with flexibility in mind. This is because a single rigid framework is unlikely to be applicable across all contexts given the diversity of fisheries and management actions that the Council oversees, ranging from broad ecosystem-level decisions to more targeted harvest specification changes. The tool should provide a core set of indicators and methods while leaving room for analysts to make adjustments appropriate to the fishery and management action in question.

2. Suggestions for other data, metrics, or indicators to consider

The subcommittee discussed the importance of integrating the current set of proposed indicators and cautioned against expanding the set of indicators further before a workable approach to synthesis has been developed.

That said, the subcommittee endorsed the inclusion of port and community infrastructure as an indicator of adaptive capacity. Infrastructure is an important determinant of a community's ability to respond to management changes, and changes in infrastructure, particularly loss of it, are also critical to understanding resilience in retrospective case studies. The subcommittee notes that relevant data are already being collected through ongoing efforts, including the West Coast Fisheries Participation Survey and a national NMFS Seafood Human Capital and Infrastructure Project that is developing a geospatial database with infrastructure and human capital information. The subcommittee encourages the project team to draw on these existing (and developing) data sources.

The subcommittee discussed diversification indices as a promising quantitative indicator of adaptive capacity that has been shown to be predictive of future interannual revenue variation and fishery participation (Kasperski and Holland, 2013; Richerson and Holland, 2017; Abbott et al., 2022), and noted several considerations relevant to their implementation:

- *Ex ante* measures based on permit portfolios are conceptually attractive, but implementing them at the community level requires linking vessels to permit holders' residences, a step that entails data quality (and confidentiality) challenges.
- *Ex post* diversification measures (e.g., Shannon or Simpson indices of fishing revenue across species or fishery groups) are relatively straightforward to construct from fish ticket data and have been shown to be highly correlated with *ex ante* measures based on permit holdings and also predictive of future revenue variation. Given data constraints, *ex post* measures may be sufficient for practical purposes.
- Network-based metrics could offer a complementary approach by characterizing the connectedness or centrality of communities within fishery participation networks. Recent work by Fisher et al. (2021) has shown that these metrics have the potential to predict community responses to climate shocks and warrant consideration as indicators of adaptive capacity.

The subcommittee also noted that measures of resilience are required for validating the tool. The relative stability index (Speir et al. 2023) provides one example of an outcome-oriented measure based on fishing revenues, though the subcommittee recognizes that resilience is broader than revenue stability and that additional outcome measures should be considered. Other possibilities include interannual variation in revenue and changes in or persistence of infrastructure, employment, and number of vessels participating. Measures of social and cultural resilience should also be considered. It will be useful to evaluate and crosswalk whether and how various vulnerability measures relate to different resilience measures if multiple metrics are used to define and measure resilience as well as vulnerability. Ideally this would be done with methods that can test for causality, but at least correlative analyses should be undertaken where possible.

3. Desired balance between a narrative tool and an analytical tool

The subcommittee discussed at length the appropriate balance between a narrative and an analytical approach. A fully analytical tool would be capable of making *ex ante* predictions using mechanistic or statistical relationships between management actions and vulnerability indicators. However, the subcommittee concluded that such a tool is unlikely to be feasible within the

timeframe and resources of the current project, and that the conceptual foundation needed for this approach does not yet exist for many of the indicators proposed in the methodology.

The subcommittee concluded that a narrative tool, but one based on quantitative indicators, is more feasible and can accommodate a broader range of management scenarios, allowing analysts to describe the exposure, sensitivity, and adaptive capacity of affected communities without necessarily reducing all indicators to a single output. The subcommittee noted that this approach is not without precedent: the Council is already accustomed to working with tools, such as management strategy evaluations, that produce multiple indicators that decision-makers and stakeholders integrate and weigh themselves rather than receiving a single summary metric. A narrative tool organized around the three components of vulnerability could function similarly. As noted earlier, preparing and maintaining a database of indicators and the appropriate scale will be necessary to support the efficient application of a narrative tool.

The subcommittee emphasized that a narrative approach should also be validated to ensure that the proposed indicators are predictive of vulnerability and resilience. The subcommittee recommends that the project team develop explicit outcome measures of community resilience to evaluate the tool's predictive power. Vulnerability indicators should then be validated through retrospective case studies, demonstrating that the tool works in cases where we observe the impact on communities (see below).

4. Type of case study to apply the methodology and framework

The subcommittee discussed the appropriate type of case study to apply the methodology and framework to in Phase 4. The subcommittee recommends that the case study be retrospective rather than based on a current Council action. Applying the tool to an ongoing action would not allow validation, since the action's outcomes would not yet be observable. A retrospective case study, by contrast, allows the project team to "replay history:" the indicators can be computed using data available prior to the action, and the results can be compared against what actually happened to the affected communities. This approach would allow the team to assess whether the indicators would have detected meaningful differences in community vulnerability across the alternatives considered, what information the tool would have provided to the Council that was not otherwise available, and whether the indicators proved to be predictive of actual community outcomes following the action.

The subcommittee suggests that the retrospective case study draw on communities that varied across the three components of vulnerability so that the tool's ability to differentiate among communities with different profiles can be evaluated. Two actions were identified as potentially suitable for this purpose:

- The yelloweye rockfish rebuilding plan
- The sablefish gear switching action

The subcommittee notes that these two examples span different types of management actions and that examining both could help demonstrate the tool's flexibility across different regulatory contexts. The choice of case studies is up to the Council and the analytical team, but the

subcommittee recommends prioritizing an action for which sufficient post-implementation data exist to support a meaningful validation of the tool's predictive capabilities. It would also be useful to consider a case study focused on an action in an FMP other than groundfish, potentially salmon or coastal pelagic species.

Appendix A. References

Abbott, J.E., Y. Sakai, D.S. Holland 2022. Species, space, and time: a quarter-century of fishers' diversification strategies on the US West Coast. *Fish and Fisheries* 24:93-110.

Fisher, M.C., Moore, S.K., Jardine, S.L., Watson, J.R. and Samhouri, J.F., 2021. Climate shock effects and mediation in fisheries. *Proceedings of the National Academy of Sciences*, 118(2), p.e2014379117.

Kasperski, S. and D.S. Holland 2013. Income Diversification and Risk for Fishermen. *Proceedings of the National Academy of Science*. 100(6):2076-2081.

Richerson, K. and D.S. Holland 2017. Quantifying and predicting responses to a West Coast salmon fishery closure. *ICES Journal of Marine Science* 74(9):2364-2378.

Speir, C., Phillips, A., Mamula, A. and Norman, K., 2023. A measure of port-level resilience to shocks in commercial fisheries. *Marine Policy*, 151, p.105575.

Appendix B. SSC Economics Subcommittee Members in Attendance

Dr. Dan Holland, NMFS Northwest Fisheries Science Center, Seattle, WA (SSC EC Chair)

Dr. Michael Hinton, San Diego, CA

Dr. André Punt, University of Washington, Seattle, WA

Dr. Matt Reimer, University of California Davis

Dr. Cisco Werner, Silver Spring, MD

Appendix C. Summary Observations and Recommendations

Category	Recommendations/Observations
Overarching Recommendation to the PFMC	The Council is encouraged to provide clearer guidance on its objectives and expectations for the tools to be developed.
Recommendations on Methodology Applicability	Identify measurable indicators of resilience that can be used for validation.
	Identify a single (or at least preferred) spatial scale of analysis.
	Clarify how the three components of vulnerability (exposure, sensitivity, and adaptive capacity) can be integrated into outputs that inform decision-making.
	Give careful consideration to how indicators are reported. The team should be explicit about which indicators are interpretable on their own and which require normalization or benchmarking to be meaningful.
	Explore methods characterizing uncertainty.
	The tool should be designed with built-in flexibility and provide a core set of indicators and methods while leaving room for analysts to make adjustments to fishery and management actions.
Suggestions for Other Data, Metrics, or Indicators	Integrating the current set of proposed indicators is important. Be cautious about further expanding the set of indicators before a workable approach to synthesis has been developed.
	Relevant data on infrastructure are already being collected through ongoing efforts - the analytical team should draw on these existing (and developing) data sources.
	Diversification indices are promising quantitative indicators of adaptive capacity and have been shown to be predictive of future revenue variation for individuals and port groups.
	Measures of resilience are required for validating the tool. The relative stability index provides one example but others should be considered including measures of social and cultural resilience.
	A fully analytical tool is unlikely to be feasible within the timeframe and resources of the current project.

Balance between a narrative tool and an analytical tool	A narrative tool based on quantitative indicators is more feasible and can accommodate a broader range of management scenarios, allowing analysts to describe exposure, sensitivity, and adaptive capacity
	Any narrative approach should also be validated to ensure that the proposed indicators are predictive of vulnerability and resilience. The project team should develop explicit outcome measures of community resilience to evaluate the tool's predictive power.
Case Studies	Case studies should be retrospective, rather than based on current Council actions, so they can be used for validation. Case studies should focus on action for which sufficient post-implementation data exist to support a meaningful validation of the tool's predictive capabilities
	Case studies should include communities that varied across the three components of vulnerability.
	Two actions identified as potentially suitable for case studies are: <ul style="list-style-type: none"> ● The yelloweye rockfish rebuilding plan ● The sablefish gear switching action