Community Resilience Decision Tool: Synthesis of Information & Gap Analysis

Final

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Abbreviations

ACS	American Community Survey
CC ESR	California Current Ecosystem Status Report
CDP	Census designated place
CEFI	Changing Ecosystems and Fisheries Initiative
COP	Council Operating Procedures
CSVI	Community Social Vulnerability Index
FMP	Fishery Management Plan
IFQ	Individual Fishing Quota
IO-PAC	Input/output Pacific fisheries model
MRIP	Marine Recreational Information Program
MSA	Magnuson Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NS8	National Standard 8
NWFSC	Northwest Fisheries Science Center
PFMC	Pacific Fishery Management Council
RSI	Relative stability index
SIA	Social Impact Assessment

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Executive Summary

The Pacific Fishery Management Council (PFMC or the Council) seeks to strengthen its ability to evaluate how its decisions affect West Coast fishing communities and to identify ways to bolster community resilience to both acute shocks and long-term change. To support this goal, Northern Economics conducted a synthesis and gap analysis of existing definitions, frameworks, indicators, and tools related to fishing community vulnerability, resilience, and adaptive capacity, with a focus on how these concepts can be operationalized within Council decision-making processes. This report summarizes the first two phases of the project: (1) review of current Council processes and existing analytical tools, and (2) identification of information gaps that impact the ability to develop a practical, decision-relevant Community Resilience Decision Tool.

Section 1. Introduction and Council Context

The report begins by situating community resilience within the Council's regulatory and non-regulatory processes, including fishery management plan (FMP) amendments, regulatory actions, ecosystem status reporting, and ad hoc analyses. Because most Council decisions require forward looking, or ex ante, evaluation of impacts under NEPA and the Magnuson-Stevens Act, the report emphasizes the need for approaches that can anticipate how proposed actions may affect fishing communities relative to the status quo. The section also establishes working definitions of fishing communities, resilience, vulnerability, and adaptive capacity, grounding them in existing statutory language, NMFS Social Impact Assessment guidance, and current Council practice.

Section 2. Literature Review on Vulnerability, Resilience, and Adaptive Capacity

Section 2 synthesizes academic and applied literature on fishing community vulnerability, resilience, and adaptive capacity, with particular emphasis on studies relevant to fishery management changes. The review highlights that most existing applications in U.S. fisheries rely on community-level vulnerability indicators, especially the Community Social Vulnerability Index (CSVI), while fewer studies empirically measure resilience outcomes or adaptive capacity. Recent work—including relative stability metrics, diversification analyses, and qualitative case studies—shows promise for advancing resilience analysis but remains uneven in coverage, spatial scale, and applicability for routine management decisions. The literature also underscores that adaptive capacity is multidimensional and difficult to measure consistently, particularly at the community scale.

Section 3. Community Resilience Attributes and Indicators for the West Coast

Section 3 reviews the primary indicators and analytical approaches currently used or are potentially available for evaluating fishing community outcomes on the West Coast. The CSVI, as updated through the California Current Ecosystem Status Report (CC ESR), remains the most widely used and standardized tool for characterizing fishing community vulnerability and engagement. However, while available indicators such as revenue diversification, participation networks, and relative

stability indices offer complementary perspectives on resilience but differ in spatial scale, temporal orientation, and readiness for ex ante application. The section also documents how West Coast fishing communities have been defined and analyzed historically, emphasizing place-based, port- or Census designated place (CDP)-level approaches consistent with National Standard 8 and longstanding Council practice.

Section 4. Interviews and Stakeholder Perspectives

Section 4 summarizes findings from interviews with NMFS staff, fishing industry representatives, community members, and academic experts. Interviewees broadly validated existing definitions and tools but emphasized several critical themes not fully captured in current indicators. Infrastructure, both its presence and accessibility, emerged as a central determinant of community resilience. Interviewees also highlighted cumulative and external stressors (e.g., ocean use conflicts, fuel costs, labor constraints), the importance of fishery-specific dynamics, and challenges associated with assessing resilience in large, diversified urban ports. Importantly, interviews revealed active, ongoing research efforts, particularly under NOAA's Changing Ecosystems and Fisheries Initiative (CEFI), that are directly relevant to this project and may substantially advance empirical understanding of resilience and adaptive capacity in the near term.

Section 5. Synthesis and Identified Gaps

The final section synthesizes findings across the literature review, indicator assessment, and interviews, and identifies key gaps that must be addressed to support a robust Community Resilience Decision Tool. While existing vulnerability-based approaches provide a strong foundation, there are clear limitations in their ability to predict resilience outcomes or capture adaptive capacity. Specific gaps include limited treatment of infrastructure, lack of clear thresholds or tipping points, insufficient information on unique fishery–community linkages, and persistent challenges related to data confidentiality and spatial scale. Addressing these gaps will require both strategic integration of ongoing research and careful consideration of feasibility within Council processes.

Overview of Key Findings

- **Strong alignment with ongoing CSVI and CEFI efforts:**
  In-progress projects, particularly updates to the CSVI and NOAA's CEFI research, have a strong bearing on this effort. Close coordination will be necessary to integrate emerging findings, empirical results, and analytical tools in ways that avoid duplication and ensure consistency across Council-facing products.

- **Ex ante analysis is central to Council decision-making needs:**
  The methodology developed under this project should prioritize forward-looking, ex ante evaluation of community impacts, consistent with NEPA, the Magnuson-Stevens Act, and Council practice. Retrospective resilience metrics may provide valuable context but indicators for this project are most useful when they can inform predictive assessments.

- **Existing place-based approaches provide a solid foundation:**
  Current approaches to defining West Coast fishing communities and assessing vulnerability, particularly CSVI, place-based CDPs, and CC ESR indicators, are appropriate starting points. These tools are well-established, transparent, and aligned with statutory requirements, making them suitable building blocks for a decision-support framework.

- **Substantial gaps remain, especially for adaptive capacity:**
  Significant data and conceptual gaps persist between predictive models of resilience impacts and the indicators needed to assess all dimensions of vulnerability, most notably adaptive capacity. Infrastructure, institutional access, leadership, and other adaptive traits are widely recognized as important but are not yet systematically measured or easily integrated into Council analyses.

Together, these findings suggest that a practical Community Resilience Decision Tool should build incrementally from existing vulnerability-based methods, integrate emerging empirical research where feasible, and explicitly acknowledge limitations, particularly around adaptive capacity, while identifying priority areas for future development.

1 Introduction

1.1 Purpose

The Pacific Fishery Management Council (henceforth referred to as PFMC or the Council) would like to increase its ability to evaluate the impacts of its processes and decisions on West Coast fishing communities and identify ways to bolster community resilience to shocks[1] and long-term changes. To support this, the Council has contracted with Northern Economics, Inc. to develop a decision support framework that supports the Council in fully considering how its management actions and recommendations affect the resilience of fishing-dependent and fishing-engaged communities in the face of variability of Council-managed resources. This report synthesizes the first two phases of the project: (1) assessing current Council decision-making processes and current available resources and tools and (2) identifying information gaps and resource needs. The information in this report aims to support the next two phases of the project: (3) developing new frameworks, tools, and/or analytical resources and (4) building out a decision support framework that the Council can apply to actions and processes. The goal of this report is to summarize and synthesize the current state of knowledge and tools related to fishing community resilience in order to identify any possible gaps and needs for developing the community resilience framework.

1.2 Report Structure

This report begins with an overview of council processes and consideration of socioeconomic information to understand how and when socioeconomic and fishing community information is currently considered. This is followed by an overview of key terms including proposed definitions for this project. Sections 2 and 3 focus on providing a review of information, data, and tools that are currently used or available to evaluate West Coast fishing community resilience. Section 4 provides a summary of interviews conducted to further understanding of the aforementioned topics and describes current attitudes, beliefs, and perceptions of these terms and metrics as well as tools that are in the process of being developed. Finally, Section 5 includes a summary and synthesis of findings, including a discussion of gaps in information or data that may be needed or desirable for inclusion in the final framework.

1.3 Description of Relevant of Council Processes and Procedures

To support the identification of relevant community resilience metrics, indicators and tools used to support Council decision-making processes, this project provides a brief overview of what these

[1] Here, a shock is defined as event that could disrupt or transform a social-ecological system (e.g., a fishing community); shocks may be environmental (such as a fishery disaster), economic (such as a recession), or regulatory in nature (such as a fishery management change).

processes are and describes relevant socioeconomic and community factors considered across different categories of decisions. In general, Council decision-making processes fall into two categories: regulatory and non-regulatory. Regulatory processes refer to decisions pursuant to adopting or changing fishery management measures. Non-regulatory processes generate information that may ultimately feed into regulatory processes, by exploring issues of concern, identifying priorities, or providing information needed for later management decisions. Here, we first summarize regulatory processes and then describe non-regulatory processes.

1.3.1 Regulatory Processes

Regulatory related processes of the Council primarily fall into three categories: 1) developing fishery management plans (FMPs); 2) FMP amendments; and 3) regulatory actions, which could include changes to federal regulations. Some actions taken by the Council can include both FMP and regulatory amendments. FMP amendments typically address more major shifts in management strategies and governing frameworks, including developing new federal regulations, while regulatory amendments modify federal regulations, such as harvest limits. The PFMC's Council Operating Procedures (COPs)[2] and Statement of Organizational Practices and Procedures[3] guide the process of developing fishery management plans, plan amendments, and regulatory amendments. Because FMP creation is uncommon, we focus here on reviewing relevant parts of FMP amendment and regulatory amendment processes, specifically how they consider information about socioeconomic and community outcomes.

1.3.1.1 FMP Development

The process of developing an FMP is described in the Magnuson Stevens Fishery Conservation and Management Act (MSA). The development of a fishery management plan is a complex process that involves multiple stakeholders across agencies and industry. The appropriate Council starts the entire process by identifying and justifying a conservation and management need,[4] gathering scientific, economic, and social data on the stock and communities associated with fishery of interest from panels, committees, and the public (16 U.S.C. §§1853-1854). Once the Council has gathered the information, it gives notice and submits a proposed action for National Marine Fisheries Service (NMFS) review, which initiates the input process from NMFS and the US Fish and Wildlife Service with regards to wildlife impacts and a review of the environmental impacts of the proposed action and to ensure compliance with all relevant laws and regulations, including the 10 National Standards, of which National Standard 8 (NS8) specifically requires fishery management actions to provide for sustained participation of fishing communities and to minimize economic impacts on them. Upon conclusion of the review of environmental impacts, a public notice is published that includes the draft

[2] *https://www.pcouncil.org/documents/2023/07/current-operating-procedures.pdf/*

[3] *https://www.pcouncil.org/documents/2019/09/sopps.pdf*

[4] Primarily stocks that are primarily caught in federal waters and are either overfished, subject to overfishing, or likely to be overfished or subject to overfishing, but may be based on other criteria. per the National Standard Guidelines (50 CFR 600.305)

proposal and its environmental impacts. The Council then hosts public hearings and gathers public comments. NMFS must then publish a notice of final action and address all public comments. At a specified time following the publication of the notice of the final action, the final action will take effect.

1.3.1.2 FMP Amendments

The COPs specify the process for pursuing an FMP amendment. Socioeconomic information may be considered and leveraged at any stage, including assessing the need for action, potential impacts from the proposed action, or developing potential amendment alternatives. Special meetings and modelling tools may also be developed to support the decision-making process. Then, the most significant opportunity for use of socioeconomic information, including community-level information, is through the development of analyses to evaluate social, economic, and community impacts resulting from various amendment alternatives in an Environmental Assessment or Environmental Impact Statement if required under the National Environmental Policy Act (NEPA). Impact analyses are also prepared pursuant to other relevant statutes, executive orders, or regulations, including the MSA. Analyses may be quantitative (using models or other numerically based tools) or be based on a qualitative description of the likely magnitude and direction of impacts, especially if quantitative analyses are not possible. Analyses are then reviewed by the Council's advisory bodies and the public to support identification of preliminary and/or final preferred alternatives. Thus, the nature and type of analyses that are used to evaluate community outcomes may have a large bearing on public and advisory body comments as well as ultimate Council decision-making.

1.3.1.3 Regulatory Amendments

Regulatory amendments/actions typically result from the management and activity cycles of the Council on set annual or biennial timeframes or for standalone actions (e.g., those identified by the groundfish workload and new management measure process). COP-9 outlines the management and activity cycles for each FMP. For example, for the Groundfish FMP, the biennial process includes three overlapping processes: 1) stock assessment, 2) harvest specifications and management measures, and 3) adoption of new and/or revised groundfish stock definitions. While much of the information considered along this process is biological in nature, socioeconomic and community information may be considered in several areas, including during the stock assessment and resultant science advisory processes, such as setting alternative harvest control rules (PFMC, 2020, 2024a). Other avenues for considering socioeconomic and community information are similar to FMP amendments, through the evaluation of impacts resulting from various management alternatives.

1.3.2 Non-Regulatory Processes

While regulatory-related processes represent the core of the Council's decisions, socioeconomic and community information may be used in other places indirectly to support the identification of fishery management issues, the tools used to evaluate socioeconomic and community outcomes, and the

development of regulatory actions and alternatives. Below is a set of non-regulatory processes where socioeconomic and community information is being or may be utilized:

- Fishery Ecosystem Plans
- Periodically Updated Informational Reports
    - E.g., California Current Ecosystem Status Report (CC ESR), Stock Assessment and Fishery Evaluation reports
- Ad-Hoc Research or Reports
    - E.g., Phase 2 Trawl Cost of Management Report (PFMC, 2024b)
- Methodology Reviews (COP-15, 25, 26)
- Management Performance Reviews (catch share program and allocation reviews [COP-27])
- Council workload priority setting
- Research and data needs
- Council Comment letters
    - In writing comment letters to federal or state agencies, the Council has often cited impacts to coastal communities. Most recently, PFMC letters on offshore wind energy development describe potential socioeconomic impacts from such development.[5] *https://www.pcouncil.org/correspondence-2/*
- Essential Fish Habitat Authorities
    - Councils provide comments and recommendations to federal and state agencies when their actions may affect essential fish habitat. When a Council determines that an action would substantially affect the habitat of anadromous fish, Councils 'shall' comment and make recommendations to the Secretary and any Federal or State agency...." (see MSA 305(b)(3)(B)
- Cross-cutting Committees and Initiatives:
    - E.g., Climate Scenario Planning, Climate and Communities Initiative**,** Climate-Informed Fisheries Management Initiative**,** Supporting Fishery and Fishing Community Resilience Initiative

1.4 Definitions and Key Terms

Fishing communities, resilience, and adaptive capacity are all key terms for this project; however, each does not have one single definition. Therefore, here, we briefly review definitions for each term,

[5] *https://www.pcouncil.org/documents/2023/11/november-2023-letter-to-boem-governor-kotek-on-pfmc-comments-on-draft-wind-energy-areas.pdf/*

related to the project's goals and purpose, and propose a definition for the project's use to ensure shared understanding of these terms.

1.4.1 Defining a Fishing Community

Communities can be defined in many different ways and fishing communities are no different. For example, fishing communities may be conceived as connected networks among fishing community members that exist in port and on land, across a shared sector or based on a shared fishing grounds on the water (Clay and Olson, 2008; K. S. Martin and Hall-Arber, 2008; Zador et al., 2017). However, a place-based approach to communities is the most common and consistent with a generalized approach to defining communities found in the literature across non-fishing contexts (Charnley et al., 2008; Welland and Cossham, 2019).

In this work, we generally rely on the place-based definition of fishing communities that is rooted in the MSA and current practices for evaluating the effects of fishery management measures on fishing communities,[6] but also acknowledge where alternate definitions of fishing communities may be appropriate to consider. The focus on place-based definitions of community is due in part to how federal fisheries management legislation has defined fishing communities. The MSA defines fishing communities as:

> …substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community.

Under NS8, there is a requirement to minimize economic impacts on fishing communities and to maintain participation of fishing communities in fisheries. As described in Clay and Olson (2008), NS8 requires fishing communities to be place-based and dependent on fishing to some degree, which has shaped the construction of related indicators and metrics designed to evaluate social and community impacts on communities resulting from fishery management measures (e.g., Jepson and Colburn, 2013). Additionally, the guidelines produced by NMFS for Social Impact Assessments (SIAs), state that for a community to be considered a "fishing community", four elements must be considered (NMFS, 2007):

> (a) a fishing community occupies a geographic location, and (b) a fishing community includes some or all of the groups of participants, and (c) a fishing community is substantially dependent on harvesting or processing of fishery resources to meet social and economic needs, and/or (d) a fishing community is substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs.

[6] https://media.fisheries.noaa.gov/dam-migration/01-111-02.pdf

Communities that may be reasonably considered as fishing communities (Jepson and Colburn, 2013; Sepez, 2007) are typically highly engaged in commercial and/or recreational fishing. This translates into higher numbers of vessels, permits, and general fisheries participation, a higher number of processors or other shoreside businesses tied to commercial fishing, or higher volumes and value of landings in these communities compared to other coastal communities. While some coastal communities other than those which measure as "highly engaged" in commercial fishing may also participate in various fisheries, they are not substantially connected to fishing such that they are important to a specific fishery or fisheries overall, nor do commercial fisheries loom as large in terms of the community's overall economic and social structure. Accordingly, these less fishing-engaged communities may not require or express the same level or kind of resilience as more highly engaged communities. Communities less engaged or reliant on commercial fishing, according to measures grounded in vessel, landing, and permit numbers, are home to fishermen who self-report greater reliance on non-fishery income sources (Norman et al., 2022).

While fishing communities as considered relevant to fishery management actions are place-based, it should be noted that there is not a consistent geographical scale or unit by which fishing communities are defined. Across regions, including the West Coast, US fisheries management has examined potential fishing regulatory impacts based upon the geographic scale of the census-designated place (CDP), home port or landing port, or at the larger port-group or regional scale (Colburn et al., 2016; Leonard and Watson, 2011). However, as noted in the SIA guidelines, smaller spatial scales such as neighborhoods or areas within ports or CDPs where fishing activities and industries are concentrated may qualify as fishing communities, which may be important for cities where fishing activities may be a small relative share of overall economic activity (NMFS, 2007).

1.4.2 Defining Resilience

Generally, resilience is defined as the ability of a system to withstand, recover from, and adapt to disturbances. Resilience in the context of a community may be viewed as the functioning of a community after a disturbance when compared to prior to and during the disturbance and the factors affecting community functioning (Ackerman et al., 2025). While conceptually resilience appears straightforward, generalizable, measurable, and quantitative definitions of resilience are harder to identify because of important questions about scope and scale, including resilience "of what" and "to what" (Carpenter et al., 2001).

Here, we assume that we are primarily concerned with ex-ante evaluations of resilience impacts, specifically resulting from potential fishery management changes under consideration by the Council (see Section 1.3: *Description of Relevant of Council Processes and Procedures*). Furthermore, it is necessary to ground our working definition of resilience in spatial and temporal scales that are relevant for fisheries management decision making. As a result, framing of resilience impacts should mirror how impacts are analyzed and evaluated under NEPA and the MSA, which considers impacts relative to the status quo (what the system would look like without the action) and characterizes the scale and duration of impacts (e.g., localized or widespread, or short-term or long-term). Under

NEPA, cumulative impacts (including other reasonably foreseeable management actions) are also considered.

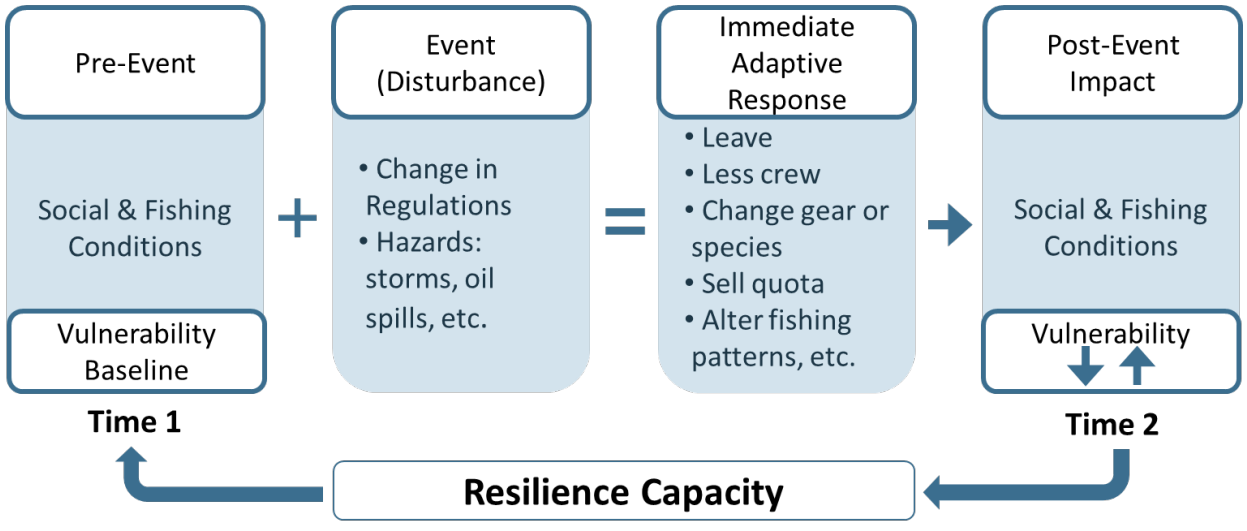
Therefore, an evaluation of resilience in this context means an evaluation of short-term and long-term effects to the fishing community, which in turn relies on the ability to assess the vulnerability of fishing communities to impacts, including what factors or features may increase or decrease impacts, including their potential ability to adapt to the impact, also called 'adaptive capacity'. Both of these other two related concepts are discussed below.

1.4.2.1 Resilience and vulnerability

Resilience and vulnerability of fishing communities are related concepts (Figure 1) with many different interpretations and definitions across the literature and are further expanded upon in the next section. Resilience, as previously defined, is the ability of the fishing community to resist or recover from change stemming from various shocks. Vulnerability is typically defined as the burden of risk in a community to a potential hazard of interest (Jepson and Colburn, 2013), or the susceptibility to change resulting from shocks. Generally, it is held that resilience and vulnerability are inversely related. A fishing community that is more vulnerable may be less resilient, and if a community's vulnerability can be decreased, it may become more resilient. In the case of fishing communities, vulnerability to a shock, which may be environmental or regulatory, may change over time, for example, based on changes to infrastructure (Seara et al., 2016; Selden et al., 2024).

Ultimately, vulnerability and resilience describe how people within a community cope with stressors and shocks.

Figure 1. Flowchart of Vulnerability, Resilience, and Adaptive Capacity



Source: Adapted from climate.gov

1.4.2.2 Resilience and adaptive capacity

Resilience and adaptive capacity are also intertwined concepts, where adaptive capacity is often considered a type of resilience. Adaptive capacity is the ability of a fishing community to adjust to shocks (Jepson and Colburn, 2013; Seara et al., 2016). This capacity is typically governed by the availability of resources such as financial or institutional, as well as the community's ability to access those resources in the context of the hazard or shock of interest (Seara et al., 2016). While there have been numerous approaches to defining dimensions or components of adaptive capacity, there is not a standard measure that includes consistent variables (Whitney et al., 2017).

2 Review of Fishing Community Vulnerability, Resilience, and Adaptive Capacity Literature

In this section, we briefly review available literature on fishing community vulnerability, resilience, and adaptive capacity, to better understand how each has been explored broadly, especially with respect to fishery management changes. This section also includes a summary of what is known about how various fishery management actions can affect community resilience. Section 3 focuses on building on this review to identify a suite of available metrics, indicators, and tools that may be used to support evaluations of community resilience impacts on the West Coast.

2.1 Fishing Community Vulnerability

Golden et al (2024b) describe how the vulnerability of fishing communities, specifically to climate change, is determined by the nature of the stressors or impacts that a community may face (exposure), how much they depend on affected resources (sensitivity), and their ability to adjust to shocks to make transformative change (adaptive capacity). Assessments of fishing community vulnerability, especially in relation to fishery management changes, have generally utilized the community level measures of vulnerability developed by Jepson and Colburn (2013) and are more fully described in Section 3. Jepson and Colburn (2013) adapted a prior index method (Cutter et al., 2003) by adding community measures specific to commercial and recreational fishing and coupled these fishing reliance measures with general measures of demographic and social vulnerability. The assumption underlying these vulnerability measures is that communities with higher measures of both socio-demographic vulnerability and fishing engagement may be more disrupted by commercial fishing shocks of regulatory, economic, or ecological origin (Colburn et al., 2016; Jacob et al., 2013; Norman et al., 2022).

However, as noted in Jepson and Colburn (2013), this approach has several important assumptions and limitations. Firstly, the relationship between the indicators of fishing community vulnerability are largely theoretical, and methods connecting vulnerability and shocks more directly to communities have historically been absent (Colburn et al., 2016). Empirical evaluations of vulnerability and resilience have been the focus of recent work (Speir et al., 2023; Mamula et al. 2025).

Secondly, vulnerability is usually established for the whole of the community rather than participants in the fishing industry specifically, and ongoing empirical work has focused on linking these measures at the scale of the community to the fishermen themselves, who may represent only a portion of the community's population and socioeconomic base (Holland et al., 2020; Norman et al., 2022). Earlier efforts had similarly sought to ground-truth the community measures for fishermen specifically (Jacob et al., 2013). Notably, in the previous body of NMFS work, these measures have not been empirically evaluated in a comprehensive way that predicts community responses to

change based upon their demographic characteristics and social make-up (i.e., their "social vulnerability"). Therefore, a nascent effort within NMFS seeks to both rename and reconsider these Community Social Vulnerability Index (CSVI) measures alongside alternative and additional measures. In this emergent work, these CSVI measures may describe the extant "status" of West Coast fishing communities, as opposed to defensibly measuring and describing their "vulnerability" (explored more in Sections 3 and 4).

Nevertheless, it has been generally assumed that fishing communities with high measures of social vulnerability and fishing dependence may experience greater impacts from fisheries management changes compared to those with lower levels of those metrics (Moore et al., 2019). For example, on the West Coast, vulnerability measures have been included in a discussion of decision alternatives for allowable bycatch for yelloweye rockfish (PFMC, 2020). This assumption also underlies the approach to exogenous community shocks that are environmental as opposed to regulatory. Importantly, marine ecological shocks may impact fisheries and communities and be subsequently addressed by necessary management responses, which may further impact communities in varied ways.

As another example, a great deal of focus on US West Coast community vulnerability measures and impacts surrounds the 2015–2016 marine heatwave and its associated major harmful algal bloom event. The toxic domoic acid produced by a large and sustained bloom of *pseudo-nitzschia* resulted in several important closures for the West Coast's Dungeness crab fishery, which required analyses of community vulnerability and impacts (Fisher et al., 2021; Jardine et al., 2020; Moore et al., 2019, 2020, 2024; Ritzman et al., 2018), including some which made an explicit effort to address resilience and adaptive capacity in the context of this substantial shock (Free et al., 2023; Liu et al., 2023; Moore et al., 2020).

2.2 Fishing Community Resilience

Examining the resilience of a fishing community specifically requires a broad examination of impacts to the fishing industry and its associated communities from shocks that could come in different forms (e.g., natural disasters, market shifts, management changes, etc.). Furthermore, assessing resilience necessitates not only understanding the impact resulting from a shock, but what factors or features work to attenuate, mitigate, or offset impacts; or conversely, what factors or conditions worsen impacts. In this work, the focus is management shocks to the system, so we focus on literature examining these types of shocks in particular.

Speir et al. (2023) propose a specific relative stability index to evaluate port level shocks, including both ecological and fishery management shocks to West Coast fishing communities. The foundational resilience analysis which informed the relative stability index had been used on economic shocks previously (R. Martin et al., 2016), but it was adapted and measured with the Input/output Pacific fisheries model (IO-PAC) using fishery revenue by fishery, gear and permit at the IO-PAC port level

and compared with coastwide revenue (Speir et al. 2023). While the approach of Speir et al. (2023) simplifies resilience to a metric based entirely on revenue, it nevertheless represents an improvement upon prior US West Coast fishing communities analyses which generally rely on vulnerability measures (Norman et al., 2022) to track and evaluate the responses of these measures to management changes and other disruptions (as opposed to evaluations like in Perng et al., 2023).

Specifically on the West Coast, Ackerman et al. (2025) outlined five factors influencing resilience and suggested that there are differing levels of resilience. Using Oregon coastal fishing communities as a case study, these factors of resilience were represented by presence of: foundational assets; community livability; capacity for effective action; community cohesion, engagement, and support; and salience of external stressors (Ackerman et al., 2025). In addition to different levels of resilience, others have suggested that resilience should not be confined to community-specific measures alone, but should be connected to industry sectors, with a particular focus on seafood processing (Cramer et al., 2023). While fishing communities feature vessel owner/operators and vessel support businesses that may or may not exhibit resilience in response to industry disruptions, Cramer et al. (2023) posit that the seafood processing work force is an important and often overlooked part of fishing community resilience.

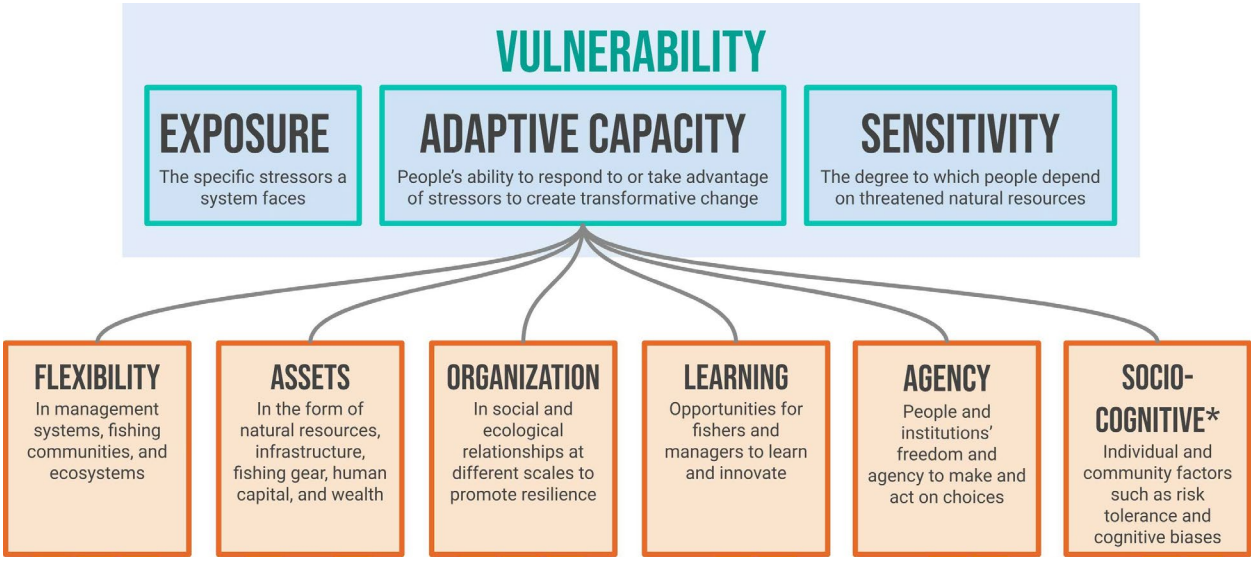
Some efforts to address potential community resilience impacts resulting from climate change within US fisheries have focused on only some of these core conceptions and definitions, not necessarily synthesizing them in the context of long term resilience (Colburn et al., 2016; Koehn et al., 2022), Others have focused more exclusively on fishermen separately from the whole of the community (Yandle et al., 2020), or turned their focus to particular fisheries and their catch income diversification (Quezada et al., 2024) and the tendency for community fisheries revenues to bounce back to a norm in response to some disruptive environmental or regulatory event (Speir et al., 2023). Nevertheless, the place-based approach to US fishing communities, which leans on snapshot vulnerability measures as foundational in examining community resilience and adaptive capacity, may present the approach most amenable to such a synthesis.

2.3 Fishing Community Adaptive Capacity

As discussed previously, adaptive capacity is defined here as the ability of a fishing community to adjust to shocks (Jepson and Colburn, 2013; Seara et al., 2016). This capacity is typically governed by the availability of resources (e.g., financial or institutional) as well as the community's ability to access those resources in the context of the hazard or shock of interest (Seara et al., 2016). Golden et al., 2024a summarize six domains of adaptive capacity that have been described in the literature for social-ecological systems: flexibility, assets, organization, learning, agency, and socio-cognitive (Figure 2). Specifically, ***flexibility*** refers to flexibility in management and governance, fishing communities, and ecosystems; ***assets*** include natural resources, infrastructure, fishing gear, human capital and wealth; ***organization*** refers to how social and ecological relationships at different scales promote resilience, including effective leadership, ecological connectivity, and social capital;

learning incudes opportunities for fishermen and managers to innovate; ***agency*** refers to the freedom to make and act on choices; and while less common, ***socio-cognitive*** constructs refers to concepts such as risk tolerance and cognitive biases. While there have been numerous approaches to measuring adaptive capacity, there is not a standard measure that includes consistent variables (Whitney et al., 2017).

Figure 2. Vulnerability and Adaptive Capacity Framework from Golden et al. (2024a)



Note: reproduced with permission from Golden et al. (2024a)

As an example, adaptive capacity may be examined in the shore-based environment of the whole community. Broad-based efforts to establish domains and measures of human well-being at the scale of the community are in part designed to develop this approach to adaptive capacity (Breslow et al., 2016, 2017; Charnley et al., 2017). Maintenance of human well-being within a community via adaptive capacity may mean, in some cases, that adaptation represents fundamental transformation. With sufficient institutional or other resources, some fishing communities may adapt to frequent economic and ecological shocks by developing tourism-centered economies (Chiang and Cronon, 2008), although this may occur subject to contestation and conflict (Hall, 2021) due in part to commercial fishermen's sociocultural attachment to fishing livelihoods (Holland et al., 2020).

One means of adapting to a disruptive shock within a particular fishery lies in the capacity of a fisherman, vessel, or community to participate in other fisheries. Commercial fishery diversification has been the subject of a great deal of research, including on the US West Coast, where it is associated with greater income stability across commercial fishing (Holland et al., 2017; Kasperski and Holland, 2013) and within particular fisheries (Quezada et al., 2024). In response to the disruptive marine heatwaves and harmful algal bloom of the 2014–2016 period, which impacted the generally lucrative Dungeness crab fishery in addition to affecting the sardine and market squid fisheries (Free et al., 2023), some research suggested that access to alternative fisheries was an important part of adaptive

capacity at the vessel level (Fisher et al., 2021). Participation in alternate fisheries was identified as one component of adaptive capacity in addition to increased vessel mobility (Fisher et al., 2021, p. 20; Liu et al., 2023). Because vessel mobility around fishing grounds represents an adaptive strategy in response to a particular fisheries shock (Fisher et al., 2021; Liu et al., 2023; Samhouri et al., 2019), vessel size may be a part of fishermen's adaptive capacity based on the associations between vessel size and vessel mobility (Jardine et al., 2020).

Elements of adaptive capacity may also be analyzed in terms of additional nuance. Fishery diversification, for example, may not allow for adaptation in and of itself. Even as "fishermen with the gear and knowledge base to vary the species they target may be better prepared to adapt to changing environmental conditions in comparison to those who consistently target a single species" (Selden et al., 2024), this may still depend on the nature of the diversity of within the fishing portfolio (Aguilera et al., 2015; Cline et al., 2017). A portfolio which features fish species that respond differently to exogenous shocks may be necessary to fully realize the adaptive capacity of diversification. Selden et al. (2024) further identify nuanced relationships between catch diversity, catch flexibility and fishing mobility.

Adaptive capacity may also be analyzed in sociocultural and economic contexts obtained through fieldwork and qualitative data collection. Fieldwork, for example, highlighted the emergence of cumulative stressors in West Coast communities, which extended beyond climate-induced ocean conditions and included social and economic realities such as labor availability (Drakopulos and Poe, 2023). Fishermen in the Northeastern US as well as the Caribbean, for example, perceived more limited adaptive capacity as a result of having experienced more intense past shocks (e.g., natural disasters), suggesting that impacts could similarly have a compounding effect over time (Seara et al., 2016, 2020). Relatedly, fieldwork among Oregon fishermen establishes a link between adaptive capacity and demographic trends such as aging captains and crew and reduced recruitment into the industry (Haugen et al., 2021).

Indeed, attention to the components of adaptive capacity highlights the importance of the specifics of management actions fishing communities may face. The nature of the disruption in fishing necessitated by a management action may be fishery-specific or may be specific to fishing grounds or fishing gear. The impacts of each of these actions allows for different potential adaptations and would require different data sources in order to assess adaptive capacity (Reimer et al., 2025; Whitney et al., 2017).

2.4 Management Actions that Promote Community Resilience

There is limited literature on specific management actions that would promote community resilience, especially since much of the literature is more framed on the converse (i.e., qualities or features of communities or fisheries that mitigate or exacerbate impacts from fishery management actions). However, there is some investigation of actions that may exacerbate community impacts

and/or limit community resilience and other factors to explore when considering management actions. These factors can be as broad as how outcomes are integrated into the management system to as specific as addressing an issue that may only concern a single fishery.

Overall, dramatic, sudden, and/or unpredictable changes have been discussed in the literature as being highly consequential for fisheries and fishing communities. From fishery closures to large decreases in fishing allocations, dramatic management changes are often deemed necessary to meet fundamental fishery management objectives to prevent overfishing and protect stocks; however, for resource-dependent communities (those with the highest exposure to impacts), such changes may not only have short-term social and economic impacts, but also make them more vulnerable to other impacts or cross tipping points (and thereby decrease their overall resilience).

Diversification has emerged as an important concept for resilient fishing communities, where higher levels of fishery diversification may be important in times of fishery management or environmental changes (Speir et al., 2023). Richerson and Holland (2017) found that salmon fishermen with low fishery diversification were more likely to stop fishing (temporarily or permanently) rather than move to other fisheries in the event of closures of major salmon fisheries. In addition to fishery diversification, other economic diversification may also be important for stability and resilience. Kim and Reimer (2025) illustrate that for fishing communities in Alaska, balanced diversification across fishery and non-fishery sectors was important for stabilizing income over time. Livelihood diversification of fishermen may also be important for individual stability, but may result in tradeoffs for fishing communities, where processors and other fishery support businesses may rely on having sufficient levels of fishing activity across years to remain in business.

Fishery management policies that support diversification may be effective strategies to support increased resilience. There is evidence that catch share management may reduce diversification of individual fishing vessels (Holland et al., 2017), which may be decreasing resilience of individuals and fishing communities to a suite of environmental and economic shocks in recent years (Holland et al., 2025). On the West Coast, the impact of catch shares on fishery income diversification is described as uncertain (Holland et al., 2017) or, based on qualitative data, potentially positive (Russell et al., 2018). This is in contrast to other regions, where qualitative data suggest catch shares may reduce diversification by reducing entry-level opportunities into the suite of otherwise available fisheries (Carothers, 2015). Additionally, opportunities to diversify fishing opportunities are increasingly limited, due to the vast majority of US fisheries being managed under some form of limited entry, and the high costs of entry into these fisheries. Instability in environmental and economic outcomes may furthere create barriers to entry due to the perceived or actual financial risks, prompting recent research to investigate how new insurance schemes may help (Hobday et al., 2025; Ocean Science Trust, 2025). However, an important caveat is that understanding of the linkages and interactions between individual and community-level diversification is relatively underdeveloped.

Understanding how diversification affects community-level outcomes depends on a higher level of information about all fisheries based out of, or landing in, the community and the decisions of all harvesters and associated businesses in the face of change, including vessels, crew, processors, and fishery support businesses. Broadly, there is a recognition that creators of policies and management actions do not consistently understand the context in which they are applied and, therefore, the impacts of those policies or management actions. Some researchers assert that decision-makers may assume that fisherman will adjust to any regulatory changes made to remain within the fishery without a greater understanding of the fishermen's and community's capacity and willingness to change and adapt (Clay and Olson, 2008). Similarly, policies that are developed and applied at a national or state level may lead to greater stress among communities that are facing more immediate threats (Ackerman et al., 2025), which leads to a need for researchers and policy-makers to understand more local trends and community dynamics for effective decisions (Cramer et al., 2023).

Articles about West Coast fisheries from news outlets and journals can offer insight into actions that could improve the resilience of some fisheries. An issue that is being felt across many fisheries at this time is termed the "graying of the fleet," which implies that many of the participants are aging without younger fishermen joining the fleet to replace them and maintain the fishery. One article suggests that implementing policies that support new and specifically younger fishermen entering a fishery would be beneficial to more than just that fishery (Cramer et al., 2018). Another issue that faces fishermen, particularly in California, is regulatory closures of the crab fishery (Belli, 2025) and the salmon fishery (Gilden, 2025). While these closures have had a substantial impact on small boat fleets (Gilden, 2025), some suggestions have been made to adapt including implementation of new technology such as pop-up crab fishing gear to limit fishing line interactions with marine life (Belli, 2025).

3 Community Resilience: Attributes and Indicators for the West Coast

This section focuses on additional information about theoretical frameworks, indicators, and tools that may be available and relevant for the community resilience decision framework to leverage. We first describe the framework and analytical methods that have been developed to support evaluations of fishery management impacts on fishing communities and then in the following subsection provide more information on all theoretical resilience framework metrics, indicators, and tools that may be readily available and applicable for this work focused on the West Coast.

3.1 Current Fishery Management Analyses of Community Impacts

As previously discussed, current fishery management analyses of community impacts are primarily guided by the MSA, National Standards, and NMFS policy guidance for conducting SIAs (NMFS, 2007). As a result, these analyses focus on identifying fishing communities as those that are "substantially dependent on or substantially engaged in the harvest or processing of fishery resources" (per the MSA definition, discussed in Section 1). Thus, dependence and engagement are two conceptual approaches linking commercial fishing to individual communities that have been developed for evaluations of fishing community impacts under the MSA.

Dependence of a community on commercial fisheries was developed as a quantitative indicator in one NOAA technical memorandum, and accounted for both a community's involvement in fishing and the community's population (Norman et al., 2007). Engagement, in the same approach, was measured as a comparison of that community's participation in a fishery or fisheries to the overall participation in that same fishery or set of fisheries (Norman et al., 2007). The quantitative development of these two conceptual approaches relied on a Data Envelopment Analysis method and the associated indicators have been used in various publications on West Coast and North Pacific fishing communities (Sepez, 2007). A larger, national-scale community evaluation index, built from a different multi-dimensional scaling method, was ultimately developed by NMFS and put forward by Jepson and Colburn (2013). The resultant Community Social Vulnerability Index (CSVI) is described in detail below. Often, quantitative indicators developed through both methods require consistent data that may be limited in their availability between different communities, while others are relatively publicly available through the US Census Bureau and data requests through government agencies. Similarly, the indicators are reported alongside qualitative or ethnographic information that is developed from knowledge of the community's history and evolving characteristics (Jacob et al., 2013; Norman et al., 2007; Sepez et al., 2006). Nonetheless, understanding this information provides a glimpse into the community and the larger intra-community network that has supported the fishing industry.

3.1.1 Community Social Vulnerability Index

The CSVI was developed by NMFS to support fisheries SIAs and to ensure that the social and community impacts of fishery management changes could be consistently evaluated across US federally managed fisheries (Jepson and Colburn, 2013). With some *ad hoc* exceptions (Colburn et al., 2016), communities were defined by a CDP determination in counties that had some connection with the ocean, whether through coastline river, bay, or estuary. The index is comprised of 14 individual indices based on secondary data primarily from the US Census Bureau and dealer/fish ticket and permit data collected by the states and maintained by NMFS.

In its original form, the CSVI project (Jepson and Colburn, 2013) analyzed data from nearly 3,000 coastal communities in 19 states, from Maine to Texas, using factor analyses to create a set of 14 indices of social vulnerability and fishing dependence. Social vulnerability indices for communities include variables such as housing characteristics, changes to housing costs, poverty and social assistance use, population demographics, and labor force characteristics. Gentrification indices are composed of variables that include retirement population characteristics, population density, cost of living, rental vacancy rates, and proportion of homes that are vacant. Commercial fishing engagement was measured using the total numbers of active permits, pounds and value of landings, and the number of dealers. Recreational fishing engagement was estimated using community names from the Marine Recreational Information Program (MRIP) site survey of fishing pressure by total fishing trips by mode (private boat, charter boat, and shore fishing). Reliance was calculated using the per capita calculations of the same metrics for both commercial and recreational activities with the addition of the percentage employed in agriculture, forestry, and fishing for commercial fishing reliance. The availability of the secondary data on which the index is built have supported the CSVI's use for SIAs and other purposes in fishery management regions across the United States. The indices used in these analyses are shown in Table 1 below.

Table 1. CSVI Index and Variables (Jepson and Colburn 2013)

Grouping	Index	Variable	Source
Social Vulnerability Indices	Personal Disruption Index	Percent unemployed	US Census Bureau American Community Survey (ACS)
		Crime index	CLResearch Website http://www.clrsearch.com)
		Percent with no diploma	US Census Bureau ACS
		Percent in poverty	US Census Bureau ACS
		Percent females separated	US Census Bureau ACS
	Population Composition Index	Percent white alone	US Census Bureau ACS
		Percent female single headed households	US Census Bureau ACS
		Percent population age 0-5	US Census Bureau ACS
		Percent that speak English less than well	US Census Bureau ACS
	Poverty Index	Percent receiving assistance	US Census Bureau ACS
		Percent of families below poverty level	US Census Bureau ACS
		Percent over 65 in poverty	US Census Bureau ACS
		Percent under 18 in poverty	US Census Bureau ACS

Grouping	Index	Variable	Source
	Labor Force Structure Index	Percent females employed	US Census Bureau ACS
		Percent population in the labor force	US Census Bureau ACS
		Percent of class of worker self employed	US Census Bureau ACS
		Percent population receiving social security	US Census Bureau ACS
	Housing Characteristics Index	Median rent in dollars	US Census Bureau ACS
		Median mortgage in dollars	US Census Bureau ACS
		Median number of rooms	US Census Bureau ACS
		Percent mobile homes	US Census Bureau ACS
	Housing Disruptions Index	Percent change in mortgage	US Census Bureau ACS
		Percent change in home values	US Census Bureau ACS
		Percent of owners monthly costs 35% of income	US Census Bureau ACS
Gentrification Indices	Retiree Migration Index	Households with one or more over 65	US Census Bureau ACS
		Percent population receiving social security	US Census Bureau ACS
		Percent receiving retirement income	US Census Bureau ACS
		Percent in labor force	US Census Bureau ACS
	Urban Sprawl Index	Population Density	US Census Bureau ACS
		Nearest city w/50k population in miles	Neighborhood guides (www.moving.com)
		Cost of living index	CLResearch Website (http://www.clrsearch.com)
		Median home value	US Census Bureau ACS
	Natural Amenities Index	Rental vacancy rate	US Census Bureau ACS
		Percent homes vacant	US Census Bureau ACS
		Boat launches per 1,000 persons	MRIP
		Percent water cover	Census Tiger Files Places Shape Files
Fishing Engagement and Reliance Index	Recreational Fishing Reliance Index	Recreational fishing mode charter per capita	MRIP
		Recreational fishing mode private per capita	MRIP
		Recreational fishing mode shore per capita	MRIP
	Recreational Fishing engagement Index	Recreational Charter Fishing Pressure (# of trips)	MRIP
		Recreational Private Fishing Pressure (# of trips)	MRIP
		Recreational Shore Fishing Pressure (# of trips)	MRIP
	Commercial Fishing Reliance Index	Value of landings per capita	NOAA Fisheries
		Number of commercial fishing permits per capita	NOAA Fisheries
		Dealers with landings per capita	NOAA Fisheries
		Percent of population in agriculture, forestry, and fishing	US Census Bureau ACS
	Commercial Fishing	Value of landings	NOAA Fisheries
		Number of commercial fishing permits	NOAA Fisheries
		Dealers with Landings	NOAA Fisheries

Grouping	Index	Variable	Source
	Engagement Index	Pounds of Landings	NOAA Fisheries
Diversity Index	Shannon Diversity Index	Occupational Diversity and Mean by Community	US Census Bureau ACS

Source: Jepson and Colburn (2013)

The CSVI approach has been adapted specifically for the West Coast and is updated on an annual basis in conjunction with the California Current Ecosystem Status Report, or CC ESR (Leising et al., 2024). Here, a multiple factor analysis was applied to the national CSVI indices to tailor the index for the West Coast, which allows for coastal community vulnerability analysis and community comparisons. These indices also provide policy-makers information about social impact assessment needs for a range of fisheries-oriented management and environmental change scenarios. Community vulnerability to changes in fishing conditions is calculated in terms of engagement, reliance, or a combination of the two. For these assessments, the commercial fishing indices and methods were developed from the CSVI approach (illustrated in Jepson and Colburn (2013)). While the recreational fishing indices are produced using CSVI methods adopted across regions, the West Coast utilized distinct variables following from Lewis-Smith and Norman (2024), as discussed below.

This West Coast index for recreational fishing engagement and reliance was further adapted by Lewis-Smith and Norman, 2024, which followed the Jepson and Colburn (2013) method and includes data collected through the census and in coordination with federal and state agencies and local businesses. The recreational fishing indices were developed on the scale of the CDP with components selected to build an engagement index based on economic activity related to recreational fishing and a reliance index related to engagement per capita. Charter permit numbers at both the federal and state level were collected along with associated addresses as well as recreational license data. Historic business data were purchased from ESRI and filtered for "Fishing Tackle Dealers" and "Operating Marinas," which were filtered for business addresses that were within 5 kilometers of the NOAA West Coast shoreline shapefile. These data were compiled into the associated CDP with Census data on population for per capita calculations. The social vulnerability indicators used were labor force structure, housing characteristics, poverty, population composition, and personal disruption. While accounting for impacts from the COVID-19 pandemic, an analysis using these measures found that engagement decreased following the pandemic and that communities with higher engagement measures were less vulnerable than communities with higher reliance measures. This adapted method supports a national approach to evaluating the recreational fishing sector in place-based communities while ameliorating sustainable fisheries governance in these communities.

In addition, the CSVI approach has also been updated and tailored for individual West Coast fisheries. The 2017 review of the West Coast Groundfish Trawl Catch Share program created an engagement index specific to the shorebased Individual Fishing Quota (IFQ) fishery and identified changes in dependence and vulnerability to communities that were highly engaged in that fishery (PFMC and NMFS, 2017). The indices that were used to measure engagement focused on how involved each

community is within the shorebased IFQ program and did not include per capita measures which reflect the reliance on or importance of a fishery to the community. The index of engagement specific to the shorebased IFQ fishery included the pounds and value of shoreside trawl sector landings, the number of first receivers/processors associated with those landings, and the number of Quota Share permits within a community. The variables were analyzed and classified into highly engaged, moderately engaged, or low engagement in the shorebased groundfish IFQ fishery even if the community only had a single variable with data related to the IFQ program. The review found that communities that were highly engaged with the shorebased groundfish IFQ program for all years through 2013 were generally less vulnerable than those that were highly engaged for fewer years.

One common comment from the literature is that communities defined by land-based characteristics are not necessarily the same as communities that exist when those same people work at/go to sea. Accordingly, an approach that defines communities based on shared fishing grounds and activity at sea has been explored and developed in the literature associated with fishing community analysis (St. Martin and Hall-Arber, 2008; St. Martin and Olson, 2017). St. Martin's "communities-at-sea" approach has been particularly valuable in interdisciplinary analyses that seek to consider community impacts and responses to species distribution shifts (Papaioannou et al., 2021; Samhouri et al., 2024; Selden et al., 2024). Nevertheless, the NMFS approach generally has examined fishing communities on land, as ports of landing, according to language clarifying National Standard 8 within the MSA (Clay and Olson, 2008). Relatedly, the SIA guidelines indicate that groups of fishermen or fisheries dispersed through a region and not "based" in a geographic place should not be considered fishing communities since they should be covered by other impact assessments.

3.2 Available Resilience Frameworks, Metrics, and Indicators

Metrics and indicators that may be available for this project to leverage are a combination of those that are available nationally or have been developed specifically for the West Coast, such as those provided in the CC ESR. SIA guidelines (NMFS, 2007) provide standards that could be considered for each metric: relevance, significance of the impact, availability of associated data, efficiency of the use of that variable, sensitivity, accuracy, and validity.

Several recent projects and papers provide useful theoretical frameworks that may be helpful for identifying relevant metrics and indicators. Mason et al. (2022) propose a set of ecological, governance and socioeconomic attributes for climate resilience in fisheries, where socioeconomic attributes included organization, learning, flexibility, assets, and agency. This was the foundation for a climate resilient fisheries planning tool (Eurich et al., 2024), where users can provide scores on a set of 22 climate resilience attributes. In this tool, users provide subjective scores, in part due to a lack of metrics or indicators for each feature. The proposed socioeconomic attributes for climate resilience are similar to those described as domains of adaptive capacity in Golden et al (2024a). As described in Section 2, Golden et al. (2024a) provide a conceptual framework for vulnerability, including exposure, adaptive capacity, and sensitivity (Figure 1). Relatedly, Ackerman et al. (2025)

identified five resilience factors that influence community resilience to environmental stressors in case studies in six non-urban Oregon fishing communities: "the presence of foundational assets; community livability; the capacity for effective action; community cohesion, engagement, and support; and the salience of external stressors relative to internal challenges."

A challenge that has been noted across the above theoretical frameworks is the need for empirical assessment to validate and operationalize them. Mason et al. (2022) note that comparative case studies are needed to evaluate which attributes and combinations thereof affect resilience outcomes—which is currently the focus of ongoing work at NOAA's Northwest Fisheries Science Center (NWFSC). Another recent study examined one aspect of resilience, resistance to change. Specifically, Speir et al. (2023) used an adapted relative stability index to measure port resilience to environmental and management shocks. When examining port stability with regard to different fisheries, port-level portfolio diversity and proximity and proportion of commercial fishery revenue were identified as important factors when interpreting and evaluating resilience to management changes.

While the CSVI, the Relative Stability Index, and other data on the West Coast may support evaluations of several resilience attributes identified in the literature, several other indicators that are provided in the CC ESR may also be helpful (Table 2). These include the Theil Index, which measures the concentration of fishing revenue across fishing communities; fishery participation networks, which provide a visual representation of linkages between fisheries for individual communities; the portfolio diversity index, which is a measure of how evenly revenue is spread across fisheries; and an adaptation of the CSVI, fishery reliance (per capita engagement). Other challenges for operationalizing these indicators are that they operate at different spatial scales (e.g., the Theil Index is coastwide), and some, like the relative stability index, are retrospective in nature so their utility for ex ante evaluations of impacts is more uncertain.

Table 2. Other Available Indicators for Community Resilience Evaluation

Indicator Name	Description	Source
Relative Stability Index	Measures the resilience of commercial fishing revenue to shocks and is the change in a port's contribution to the system-wide revenue calculated as the difference between the ratio of port-level landings to coastwide landings in the pre-shock period and in the year of the shock.	Speir et al. (2023)
Theil Index	Assesses the geographic concentration of fishing revenues calculated annually for all fisheries and specific management groups depending on the study.	CC ESR (Leising et al., 2024)
Fishery Participation Networks	Provides a visual representation of economically important commercial fisheries for individual communities	Fisher et al. (2021) Fuller et al. (2017) and CC ESR (Leising et al., 2024)
Portfolio Diversity Index	Measures how revenue is spread across species groups.	Kasperski and Holland (2013) and CC ESR (Leising et al., 2024)
Fishery Reliance	Measures the engagement relative to the population size of a community; Also known as per capita engagement	CC ESR (Leising et al., 2024)

3.3 West Coast Fishing Communities

This section discusses how West Coast fishing communities have been described and used in previous work. Communities along the West Coast that may be considered fishing communities range from small towns where commercial and recreational fisheries are central economic drivers—such as Newport, Oregon—to large cities, like Seattle, where fisheries are not a major part of the local economy but the port remains one of the nation's most important hubs for commercial fishing and seafood operations.

One of the best sources for regularly updated information about West Coast fishing communities, fisheries, and other ecological changes is the CC ESR (Leising et al. 2024). The CC ESR provides a list of those communities, defined at the scale of the CDP, which ranked highly in terms of their engagement with commercial and recreational fishing in a broad sense that is not disaggregated by particular species landed or fishery management plan (Table 3). The CC ESR features communities with high ranking commercial and recreational fishing measures, inclusive of all fishing activity regardless of target species, for any year from 2009 up to the present year of the report. Because fishing activity may fluctuate year to year, some of the included communities appeared highly ranked for many of the years within the examined period, while others were only highly ranked for a few or even just one of those years. As described previously, the CC ESR provides set of indicators and information for fishing communities including fishing engagement, community vulnerability, revenue diversification, and fisheries participation networks among other fisheries. All of these report components highlight community measures derived from annually reported data.

Table 3. CC ESR West Coast Fishing Communities

Washington	Oregon	California	
Bellingham	Astoria	Crescent City	Monterey
Anacortes	Garibaldi	Trinidad	Morro Bay
Neah Bay	Tillamook	Eureka	Summerland
Seattle	Beaver	Shelter Cove	Santa Barbara
Shelton	Cloverdale	Fort Bragg	Ventura
Olympia	Newport	Point Arena	Oxnard
Tokeland	Yachats	Bodega Bay	Port Hueneme
Westport	Florence	Tomales	Los Angelos
Bay Center	Winchester Bay	Dillion Beach	Marin del Ray
Ilwaco	Coos Bay	Bolinas	Dana Point
Chinook	Port Orford	San Francisco	Avalon
	Brookings	El Granada	Del Mar
		Half Moon Bay	San Diego
		Moss Landing	

Note: Communities here are individual CDPs that are highly engaged and reliant in either commercial or recreational fisheries from Figure P.3

Source: Leising et al. (2024)

A distinct but nonetheless similar methodology produced a list of 125 communities on the US West Coast. The communities included in this technical memorandum could be reasonably deemed "fishing communities" based on ties to commercial fishing activity indicated by available data (Norman et al., 2007). This early effort used a data envelopment analysis method to determine which communities were most connected to commercial fishing and, while it is reliant on much of the same fisheries data, it is nonetheless distinct from the factor analysis approach to community fishing reliance and engagement that was used later and updated annually (Jepson and Colburn 2013). While the NOAA technical memorandum was not subsequently updated, it did offer an encyclopedic approach to describing the location, demographics, history, current economy, governance structure, facilities, commercial fishing, sportfishing, and subsistence fishing aspects of fishing communities in Washington, Oregon, and California (Table 4).

Table 4. Norman et al. (2007) Fishing Communities by State and Region

State	Group/Region	Communities
Washington	North Puget Sound and Border	Blaine, Ferndale, Bellingham
	San Juan Islands	Friday Harbor, Lopez Island
	Skagit and Swinomish	Anacortes, La Conner, Mount Vernon, Sedro-Woolley
	North Olympic Peninsula	Port Angeles, Sequim, Port Townsend
	South Puget Sound	Olympia, Shelton, Fox Island, Lakewood
	Central Puget Sound	Seattle, Tacoma, Everett, Edmonds, Gig Harbor
	Snohomish Valley/North Puget Fringe	Stanwood, Silvana, Woodinville, Bothell
Oregon	Columbia River and North Coast	Astoria, Warrenton, Hammond, Clatskanie, Seaside, Rockaway Beach, Garibaldi, Tillamook, Cloverdale, Pacific City, Beaver
	Inland Oregon	Roseburg, Sisters, Monument
	Central Coast	Newport and South Beach, Depoe Bay, Toledo, Siletz, Logsden, Florence, Reedsport, Winchester Bay
	South Coast	North Bend, Coos Bay, Charleston, Bandon, Port Orford, Gold Beach, Brookings
California	Northern California	Crescent City, Trinidad, Eureka, Fields Landing, McKinleyville, Kneeland, Fort Bragg, Albion, Point Arena, Ukiah
	North Central California/ Bay Area	Bodega Bay, Valley Ford, Dillon Beach, Novato, Corte Madera, Sausalito, San Francisco, El Granada, El Sobrante, Santa Rosa, Sebastopol, Lafayette
	Central California	Half Moon Bay, Princeton, Santa Cruz, Moss Landing, Monterey, Marina, Pebble Beach, Los Osos, Morro Bay, Atascadero, Arroyo Grande, Avila Beach
	Southern California	Ventura, Oxnard, Port Hueneme, Santa Barbara, Los Angeles, Long Beach, Torrance, Culver City, Tarzana, Costa Mesa, Santa Ana, Sunset Beach, Dana Point, San Diego

Note: Individual fishing communities are generally CDPs

Regions listed are for simplification purposes only and to denote the general geographic area where communities are.

Subsequent work has identified some of these same communities in terms of their connections to specific fisheries and fishery management plans. A particular focus has been applied to communities tied to the shore-based West Coast groundfish trawl fishery and the permit-stacking program associated with the sablefish fishery (Colburn et al., 2017). These fisheries are highlighted in part because of their management via catch shares or similar quota-like management systems, which allows for more abundant data by which the specific fisheries are tied to specific ports and communities (Colburn et al., 2017; Samhouri et al., 2024). In particular, a NOAA technical memorandum (Colburn et al., 2017) identified the following communities as being of particular importance to the shore-based groundfish trawl fishery:

- **Washington:** Westport, Seattle, Chinook, Ilwaco, Bellingham
- **Oregon:** Astoria, Newport, Coos Bay, Brookings
- **California:** Fort Bragg, Eureka, Crescent City, Monterey, Morro Bay, San Francisco, Half Moon Bay

Similarly, the same technical memorandum found the following communities to be important to the West Coast sablefish permit-stacking program:

- **Washington:** Chinook, Bellingham, Seattle, Westport, Neah Bay, Port Angeles, Ilwaco
- **Oregon:** Newport, Astoria, Coos Bay, Florence, Winchester Bay, Brookings, Reedsport
- **California:** Crescent City, Moss Landing, Eureka, Fort Bragg, San Francisco, Bodega Bay, Morro Bay

Colburn et al., 2017 focuses exclusively on the communities, again defined at the scale of the CDP, important to fisheries managed via catch share programs. Additional West Coast fisheries, managed typically through broad FMPs, are also important to West Coast communities and will vary in importance by community according to their total landings and revenue. Some of these differences in FMP revenue proportions may be dependent upon the social, geographic, and economic/structural realities these communities face. No single publication features a multi-year breakdown of FMPs by community, though data on fisheries landings and revenue by port are available through the Pacific Fisheries Information Network (PacFIN).

4 Interviews

In order to better understand ongoing work relevant to the project, gain stakeholder perspectives, and fill any information gaps from the literature review, the study conducted interviews with stakeholders including experts, fishermen and fishing community representatives, and managers. Interviews were used primarily to:

1) Better understand ongoing and recently completed work on these topics on the West Coast;

2) Explore how key definitions, current indicators and tools align with stakeholders' perceptions of factors that contribute to resilience, vulnerability, and adaptive capacity, and how to assess impacts across different types of fishing communities to identify any important gaps;

3) Confirm choice of indicators and tools with other social scientists and economists involved in ongoing development of indicators.

The project team conducted a series of 12 interviews with fishery stakeholders including those who work or have worked within NOAA on west coast fisheries and community resilience research, those who are familiar with the Pacific Fishery Management Council process, and those who are familiar with or participate in West Coast fishing or fish processing. Five of these interviews were conducted with fishing industry or fishing community representatives, five were with NMFS employees who have expertise in fishing communities research and projects, and two were conducted with academic and non-governmental organization professionals with relevant expertise. There were six main themes that surfaced across the interviews: infrastructure; community impacts from outside factors; specific fishery concerns; definitions of fishing communities; integrating established community vulnerability and resilience metrics into regulatory processes; and alternative measures of resilience beyond the previously established metrics. There were also some specific themes that arose when speaking with people representing different groups, which are also discussed below.

4.1 Interview Themes

One of the major themes across interviews was infrastructure. Interviewees mentioned that community resilience can greatly depend on infrastructure that is available in their community such as, but not limited to, net and vessel repair businesses, bait and tackle retail storefronts, showers and working waterfront amenities for fishermen, processors, access to roadways for transporting product, ice plants, and slips or docks. An aspect that may not be traditionally considered within the rubric of infrastructure but that is just as important is the ability to access infrastructure. A barrier to accessing existing infrastructure can arise when processors cannot take catch because of the inconsistent nature of landings, slips or dock space become unaffordable, or ability to access or reach fishing grounds is curtailed. Beyond the direct infrastructure required for the fishing businesses,

community resilience increases when there is infrastructure for the broader community. Fishermen and those who participate in fishing businesses could, in that case, access such fundamental community infrastructure including health care, education, and alternative income streams that may support fishermen and other industry participants in challenging times.

During interviews, particularly with those associated with fishing businesses, a number of factors were identified that can impact a fishing community that are outside the standard fishery management regulatory process. One of these factors was taxes on fuel in relation to state-level emissions goals and the increasing costs of supplies. These increases are contributing to the increasing costs and decreasing profit margins associated with the fishing industry. Another major factor brought up is competition with other ocean uses such as offshore wind, which may compete for ocean space. With increasing uses in the ocean, fishermen may start becoming more restricted in where they can travel and harvest their target species. The status and management of livelihoods and sectors within communities that offer alternatives to fishing incomes was also mentioned in this context. Fishermen may supplement their income, or take advantage of the seasonality of fishing, by accessing other income sources. Regulatory changes outside of fishing could disrupt the annual balance of income sources that some fishermen find in their communities, thereby impacting their resilience. There were also some comments made about reforming council processes to include different locations that would allow increased participation for different communities.

Another theme that came up was the challenge of managing for community resilience when each fishery is unique. In some fisheries, a workforce may contribute to the local economy before heading out to sea for the season and again when they return at the end of the season. Changes to fisheries and their management may impact the dynamics of the workforce and therefore the community and that community's resilience. It was also noted that in some fisheries, port landings do not always account for all of the catch in the fishery and that catcher-processors may be a sector that can contribute to community resilience. Finally, there is a concern about resilience of fishing communities that are part of larger cities (e.g., Seattle, Tacoma, etc.) due to the rapidly increasing cost of living in those areas.

These interviews provided an opportunity to explore the definition of fishing community and ensure that this process represents and evaluates communities with a specific standard. Interviewees acknowledged that most management processes currently evaluate potential outcomes at the regional or coast-wide level and are limited in their evaluation on scales smaller than that. It was suggested that using IO-PAC port groupings would be beneficial since a single port may serve multiple CDPs, which is the scope that is often used to evaluate fishing communities, particularly within the CSVI framework, but which may not be the most informative. Additionally, an interviewee mentioned that using county-level business data (as described by Clay 2024) may be informative in developing resilience metrics to better understand communities.

As discussed above, the CVSI has been used previously to understand community vulnerability in a standardized approach. Interviewees stressed the importance of integrating CSVI measures, or a similar method, more directly into the development of regulations at the outset, which could benefit from a greater understanding of impacts to stakeholders at the community level. Interviewees associated with NOAA Fisheries, and those who work with CVSI and in the field of community resilience acknowledged the limitations of applying the current CSVI methods to measure the particular status of fishing communities as compared to their larger whole community milieus. This concern is particularly relevant to those communities where fishing is not one of the primary industries supporting the community economy.

The final theme that came up in interviews, particularly in conjunction with the discussion of CSVI, was that of alternative measures of community resilience. Some suggested that documenting attitudes, beliefs, and perceptions of fishermen in communities could provide a nuanced approach to some information about the fishing industry within the community. Similarly, interviewees tied to the industry and Council process suggested community resilience may rest in individual leadership roles for fishermen and measures of social capital. While community social capital measures have been developed in the literature (Holland et al., 2020), these measures have depended on data that are not annually collected. Others suggested including information on tourism that is associated with the fishing industry. While all of these views presented alternatives to currently available data and management processes, in terms of measuring for and building community resilience, interviewees acknowledged that such innovations and changes in community metrics and community engagement would require entirely new efforts that may not be feasible in all cases.

4.2 Information on In-Progress Initiatives

Interviews were critical in revealing that there are projects that are developing concurrently with this project that could work in conjunction with the output of this project and ultimately inform understanding of this work. These and other resources should be considered by anyone who applies the methodology that is developed from the information in this report.

Work being done through the Changing Ecosystems and Fisheries Initiative (CEFI) at NOAA generally focuses on vulnerability, resilience, and adaptive capacity as discussed above, and expands on that description. This project is working to assess how indicators of flexibility and assets are related to resilience to various shocks. As part of this work, an extension of the relative stability index (RSI) as developed by Speir et al. (2023) will be examined as a response variable in models evaluating adaptive traits that allow ports to weather shocks more easily than others. This work seeks to use the RSI to measure the efficacy of adaptive behaviors by tracking RSI results within the two natural experiments of the Pacific sardine and the Chinook salmon fisheries in California. Initial results suggest that the RSI could be useful in understanding nuances of which communities may be doing better than others, particularly if communities overall do not weather a shock well. Within this work, an included effort will examine several of each West Coast community's CSVI index measures as

"assets," in order to determine if these assets measurably influence the RSI results. Within this same CEFI framework, there is also work being conducted looking into sensitivity and its metrics. This project examines shock sensitivity and its connection to adaptive capacity through the lens of node strength (a port's fishery participation network) and proportion of a port's revenue for the affected fishery (A. Golden, personal communication, July 31, 2025).

Further refinement of CSVI is being developed with a specific focus on impacts to the fishing industry using the Covid-19 pandemic as a case study while recognizing there are multiple challenges in integrating vulnerability analyses into management processes (Mamula et al., 2025). There are also expansions and further examinations being conducted with regard to CSVI. One approach is looking at the composite measures of community vulnerability. The measures presented in Jepson and Colburn (2013) may be limited in what they can tell us about a community and its vulnerability. Some items of interest to better understand vulnerability and how these indices could be applied include understanding community sensitivity, different types of areas of interest (rural vs urban) or other aggregated communities, and different types and severity of impacts to fishing communities. Additionally, there is work being done to create similar indices to the CSVI described above, but these inchoate indices may be dependent on novel data or may be better designed in terms of measuring "vulnerability" for those more specifically connected to the fishing sectors within the broader community.

4.3 Conclusions Across All Interviews

Interviewees representing NMFS expertise were particularly valuable in identifying ongoing and recently completed work on West Coast fishing communities and resilience. In particular, NMFS staff have engaged in efforts to empirically test the predictive value of CSVI measures, long in use with respect to community impacts of fishery management policies and processes. NMFS staff are also utilizing these measures more holistically in previous and upcoming California Current ecosystem analyses and associated case studies. Federal fisheries social science and economic staff are additionally interested in developing approaches to community adaptive capacity by first assessing prior approaches to community measures, including CSVI measures and the relative stability index, which has been used to evaluate the resilience of fishing revenues for each West Coast port (Speir et al., 2023). NMFS interviews were important in that they described the likely continued use of CSVI measures in the short term even as these measures are likely to be relabeled and comprehensively re-evaluated in the long term. Lastly, both NMFS experts and stakeholders pointed to gaps in community considerations in existing Council processes. Interviewees suggested that community resilience measures and concerns would be best included at the outset of a management action, in its design, and may be folded into analyses that more carefully examine the ways in which management changes in a particular fishery are connected to multiple communities and fisheries not normally included in these kinds of policy analyses.

For the most part, these interviews served to validate the key definitions included in this effort, including definitions for resilience, vulnerability, adaptive capacity, and, notably, community. Stakeholders and research and policy experts alike generally endorsed these definitions and their associated measures and indicators, including CSVI and commercial fishing reliance and engagement measures. Fishing communities, in the context of constructing a tool for evaluating and supporting resilience, are probably best examined as geographic place-bound entities at the scale of the town or port, as is longstanding practice. Interviews validated the perception that policy processes tend to consider other, broader community definitions in their fleet analyses. The recognition of alternative uses of ocean space (such as offshore energy development) as a new force operating on community resilience was a place where the interviews highlighted the connections between communities on land and fishing grounds at sea.

In terms of gaps, interviews with stakeholders were important in pointing out challenges with extant measures. Notably, several interviewees identified infrastructure, in multiple forms, as central to community resilience, even as infrastructure data and indicators are not currently included in widely used community measures. More granular components of infrastructure are also an important consideration, according to interviewees. For example, the presence of one or more processors in a community would be important to that fishing community's resilience, but the specific capacity of individual processors is also important in adaptation considerations. As fishery-specific harvests may shift along the coast, the lack of capacity for processing novel fisheries may prevent adaptation within communities. This nuance within infrastructure was importantly identified as a gap by stakeholders and others cognizant of diverse fishery portfolios as a component of resilient communities.

5 Synthesis and Gaps

5.1 Synthesis and Conclusions

The goal of this report is to summarize and synthesize the current state of knowledge and tools related to fishing community resilience in order to identify any possible gaps and needs for developing the community resilience framework. This framework will be used by the Council to increase its ability to evaluate the impacts of its processes and decisions on West Coast fishing communities and identify ways to bolster community resilience to shocks and long-term changes.

Based on the nature of Council decision-making processes and where such information may be considered (Section 1), we recommend that for this project, fishing communities should generally be defined as place-based, following status quo practices that align with the MSA and NS8 (Section 1), though exceptions to this may be desirable or necessary depending on the nature of the action.

We also find that vulnerability and adaptive capacity are critical concepts for resilience evaluations, where vulnerability may be viewed as the pre-shock state and resilience represents the change in that state after a shock occurs. Because the nature of Council decision-making processes largely relies on ex ante evaluations (i.e., predictive, or forward looking, rather than retrospective), it is practical for the Council to continue to primarily consider the vulnerability of fishing communities, though empirical evidence on resilience impacts from past actions or other shocks (e.g., Speir et al 2023; Mamula et al. 2025) may be integrated and considered where relevant.

While current practices for evaluating the vulnerability of fishing communities to management changes generally rely on the CSVI, based on our review of the literature and interviews we find that aligning the evaluation of vulnerability with the framework illustrated in Golden, Levine et al. 2024 may be useful (Figure 2). In adopting or adapting the Golden, Levine et al. framework, we believe there is enough overlap that current approaches and indicators, particularly the CSVI's indicators of reliance and engagement, are useful, but there is a need to identify metrics and indicators for adaptive capacity corresponding to the various domains (as identified within the Golden, Levine et al. 2024 framework). It may also be useful to preserve the CSVI method's indicators of social vulnerability for context, as was recommended in interviews. Many of the other community indicators and information currently prepared for the CC ESR will also be helpful for supporting ex-ante evaluations of adaptive capacity, particularly flexibility, such as the Theil Index, fishery participation networks, and fishery diversification index. Datasets that will be further critical to this work include PacFIN data, and NOAA data (including West Coast Regional Office permit data, and NWFSC survey data, such as the West Coast Fisheries Participation survey).

Several in-progress initiatives are highly relevant to the project; however, it will be challenging for this project to consider them until they are finalized. This includes changes to the CSVI through a new NMFS-led working group and a CEFI project, which seeks to validate current vulnerability measures

and potentially identify new ones. To overcome these challenges, the project team plans to continue to communicate with leads from each relevant project and seeks to align the approach of the framework to anticipate integration when possible to do so.

5.2 Identified Gaps and Needs

Ultimately, the community resilience framework will need to balance what is ideal, based on theory and what is desirable from a stakeholder perspective, and what is available across time and communities up and down the coast. However, there may be an opportunity to close this gap with the current project as well as outline areas for future research and development.

A primary gap that this current project may be able to at least partially fill is to link preexisting indicators and datasets to the vulnerability framework provided by Golden, Levine et al. 2024. As discussed in Section 3, while there are several currently available theoretical frameworks of resilience, vulnerability, or adaptive capacity for fishing communities, less work has been done to suggest relevant indicators or metrics based on empirical evidence or validation of existing frameworks. However, the CEFI project discussed is working to assess which theoretical indicators or metrics are most closely tied to resilience. Results of that project may be used to refine our community resilience framework when available.

Other gaps or challenges where it is unclear whether it is feasible to close in the scope of the current project are detailed below.

5.2.1 Contextual Information

Contextual information on what pre-existing stressors exist or could exist for communities is desirable for the purposes of Council decision-making, and is helpful for empirical evaluations of resilience; however, such information is not currently compiled or categorized across all fishing communities. This information might include past or reasonably foreseeable fishery management actions that affect fishing communities, including closures, fishery disasters, or changes in Annual Catch Limits or allocations; fishery and fishing community changes such as economic changes, processor closures, or storms or natural disasters; or non-fishery management changes such as Clean Water Act regulations (Plaven, 2023) or offshore wind energy projects. Such information may be provided as relevant within a given action through public comment or advisory body/Council input and be incorporated into impact evaluations qualitatively, but interviewees expressed concerns that they might not be aware of the full scope of these contextual factors when making decisions. The California Fishing Communities website[7] provides a timeline of events affecting various fisheries and a summary of current issues for each community, which may be similar to what may be needed for all West Coast fishing communities.

[7] *https://fishingcommunities.net/*

5.2.2 Infrastructure

Having functional and available infrastructure from processors, vessel services, marinas, and harbors, to ice and bait suppliers and cold storage facilities, is often noted as critical for fishing communities; however, data on infrastructure are notoriously limited. Such data include where infrastructure is, what condition or state it is in, and who uses it (i.e., which fisheries). Recently, however, the NWFSC has collected information on access to infrastructure including processors/buyers and industry suppliers/services through their survey of West Coast Fisheries Participation (NWFSC, 2025).[8] Also The California Fishing Communities website provides a description of infrastructure for each community, in part by providing information on fish business licenses by license type (e.g., fish receiver, processor, retail) and other information about port infrastructure. It may be possible to pull and maintain new databases of business licenses across all three West Coast states, though it is not known if it will be and how comparable such information may be.

5.2.3 Thresholds and Tipping Points

As discussed throughout the report, it is much easier to identify how vulnerable a given fishing community is to impacts, and what options they may have to mitigate impacts, than it is to tell, in advance, if such impacts are likely to lead to permanent, long-term effects. This may include things such as bankruptcies or other economic tipping points, permit or vessel sales, or processor closures. Identifying such thresholds would be extremely valuable to advance impact evaluations, but it is unclear whether available information and indicators are enough to provide even a qualitative evaluation of such effects.

5.2.4 Unique Fishery and Community Connections

A deficit of the CSVI and much of the current available information about fishing communities is that these measures rely on landings and fish ticket data connected to specific communities and ports on land. More specifically, fundamental data are collected when the commercial catch is hauled into port to be processed. For this reason, CSVI measures are not designed to include unique commercial harvest arrangements such as the at-sea processing sector, organized to catch whiting within the groundfish FMP. Because this fishery involves harvest and processing entirely at sea, data which tie vessels, crew and catch to specific places on land are not available, nor would they be commensurate with CSVI measures based upon more common commercial vessel harvest and landing processes. The at-sea sector is important to the industry, to vessel crew and places on land, but the data do not support their analyses within the CSVI methodology.

Additionally, the CSVI method's reliance on Census data at the scale of the CDP means that some important tribal fishing communities must be included through an ad hoc process, where Census data

[8] More information including links to the tool here: *https://www.fisheries.noaa.gov/national/science-data/west-coast-fisheries-participation-survey-results*.

are aggregated to account for smaller, rural communities that are not designated by the census as single "places" in the same way as other communities included in CSVI analyses.

5.2.5 Confidentiality

As fishing fleets, dealers, and processors in individual communities decline, so does the ability to provide nonconfidential representations of these data. Since federal rules require any data that are required to be reported, such as landings and revenue data, to be comprised by at least three entities in any grouping (e.g., community) this is increasingly constraining for even simple visualizations of landings and revenue by homeport or landing port community. A challenge for this project will be to pick informative spatial scales, potentially including groupings of communities, in order to show as much information as possible, or develop new ways to represent information that would not violate confidentiality rules.

Ultimately, while we find that there is much available work to incorporate and build off of in the community resilience decision framework, there are several areas where more information would be desirable to facilitate a thorough evaluation of fishery management impacts on fishing community resilience based on what is outlined in the academic literature and what is desirable based on the interviews with stakeholders. Ultimately, the tool will need to balance what it can provide with these realities of what is available and reasonable to include.

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