Inventorying Baseline Data on Socioeconomics of Maine Fishing Communities

Informing Responsible Floating Offshore Wind Development in the Gulf of Maine

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Executive Summary

Background and Purpose of Report: Inventorying Baseline Data on Socioeconomics of Maine Fishing Communities

Fishing is a cornerstone of social life and an economic anchor for many coastal Maine communities. While the rise of offshore wind presents a unique and pressing opportunity for economic development and improved sustainability for the State, there is a need to further understand the potential positive and negative impacts of the emerging offshore wind industry on existing industries like fishing. These impacts coincide with the other challenges fishing communities are already facing, such as cost of living and housing affordability, climate change, and uncertainty around future growth of the fishing industry. Key stakeholders across government, academia, and private businesses must take intentional steps to research and foster a mutually beneficial coexistence between offshore wind and Maine's fishing industry and communities.

The Maine Offshore Wind Research Consortium (Consortium), created in 2021 through state legislation (LD 1619), and the Maine Offshore Wind Roadmap, released by Maine Governor's Energy Office (GEO)'s in 2023, contribute greatly to momentum for responsible offshore wind development in Maine. Together, the Consortium, which brings together leaders across a range of industries and sectors, and Maine GEO secured funding to advance pressing research to further evaluate the benefits of offshore wind while protecting Maine's vibrant maritime heritage and fishing industry. As a critical first step in this research, the Consortium prioritized **inventorying and examining existing socioeconomic data**

and developing actionable recommendations to guide future socioeconomic analysis.

This report, created by Karp Strategies and Colby College (the Study Team), summarizes a seven-month long project that intends to **set a baseline inventory and understanding of existing socioeconomic data of Maine fishing communities.** The Study Team used a mixed-method approach that included desktop research, a research literature review, and targeted stakeholder interviews in order to meet the following goals:

- Develop a robust inventory of existing socioeconomic data metrics

- Define existing data gaps and barriers to the completion of a robust socioeconomic research

- Identify current best practices of socioeconomic research as they relate to offshore wind and fishing communities

The Study Team has synthesized this research into a robust report that includes key learnings and actionable recommendations. While this phase of work does not conduct the analysis itself or draw conclusions around the positive or negative metrics compiled, this research can provide direction for where Maine GEO, the Consortium, and other partners should focus additional time and resources in order to achieve a comprehensive socioeconomic analysis.

Key Takeaways

This section includes a set of key takeaways and recommendations, which have been identified and developed based on the findings from our data inventory and stakeholder engagement.
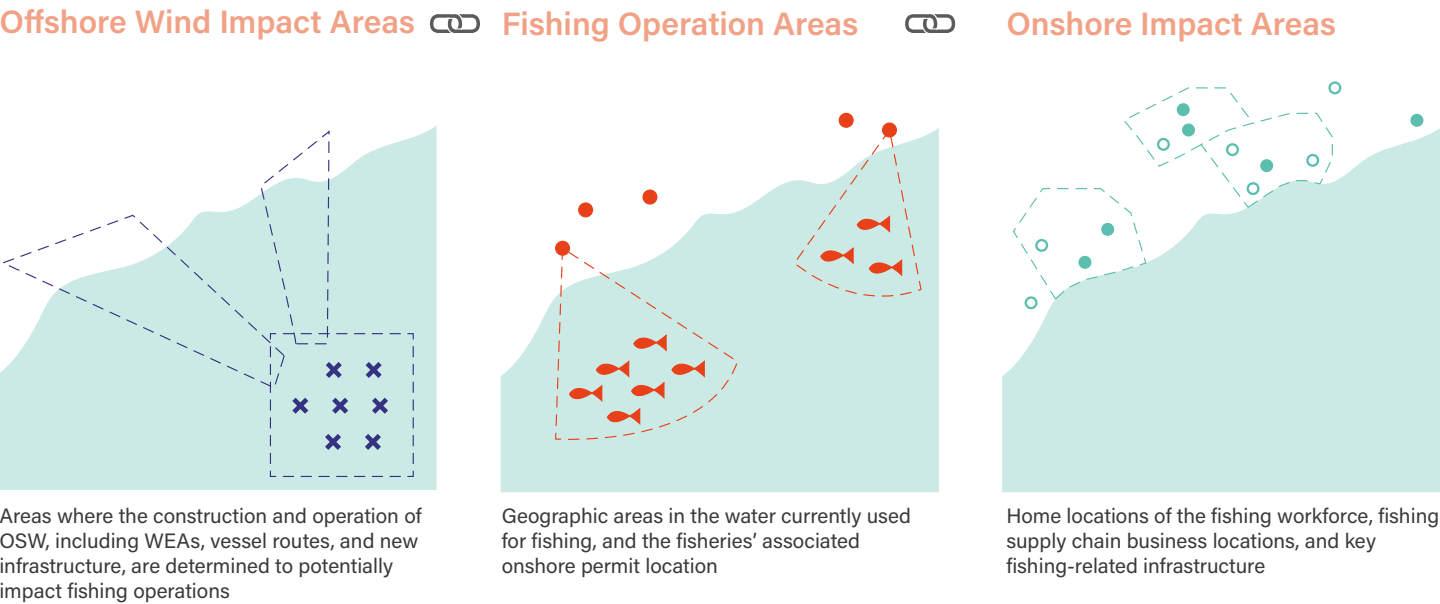
Takeaway 1 | There is a wide range of existing socioeconomic data about Maine's fishing industry, covering multiple disciplines and categories. While a few targeted data gaps have been identified, the State does not need to conduct an extensive data collection effort. **However, many data points that the fishing communities and key stakeholders are interested in have not been included in previous socioeconomic research.**

Takeaway 2 | Socioeconomic research and related impact assessments are complex and, in this case, need to be catered towards Maine's fishing industry and the potential impacts that are most critical to reflecting the conditions of the fishing population, businesses, offshore and onshore operations, and infrastructure. While the Study Team gathered a range of applicable quantitative and qualitative methodologies in this research, there is **not an existing industry "best practice" or socioeconomic research framework that comprehensively addresses**

the subject topic. Critically, there is a **lack of resources and academic research correlating offshore wind development and operations with socioeconomic impacts.**

Takeaway 3 | Fishing operations potentially impacted by offshore wind areas are not adequately linked to onshore communities, preventing the clear geographic connection of industry metrics and socioeconomic data. This link needs to be established at a level that identifies specific impacts to Maine fishermen, in order to successfully develop and execute an accurate socioeconomic analysis that incorporates both industry and human data indicators into the calculation of offshore and onshore effects.

Takeaway 4 | While there is a great foundation of research to define the fishing industry supply chain in Maine and the greater Northeast, there remains **a gap between specific business data and fisheries-specific supply chain information.** This makes it difficult to accurately assess the impacts to the fishing economy based on major and minor species that exist in a particular offshore impact area.

Offshore Wind Impact Areas 🔗 **Fishing Operation Areas** 🔗 **Onshore Impact Areas**

Areas where the construction and operation of OSW, including WEAs, vessel routes, and new infrastructure, are determined to potentially impact fishing operations

Geographic areas in the water currently used for fishing, and the fisheries' associated onshore permit location

Home locations of the fishing workforce, fishing supply chain business locations, and key fishing-related infrastructure

Recommendations

Building on the results of this socioeconomic data inventory, the Study Team offers the following recommendations to guide future research and planning efforts for Maine offshore wind and fishing stakeholders. While each recommendation is a necessary step towards a successful robust socioeconomic analysis, the recommendations range from targeted technical research that can be executed in the short-term, to broader management and operational recommendations.

Technical Research and Data Collection

To advance further socioeconomic analysis and research, there are clear actions that Maine GEO, the Consortium, and the fishing community should take prior to the development of a mixed-methods socioeconomic research analysis framework. The following steps build on the research and data collection efforts started by the Study Team, and could happen concurrently or in close alignment with each other:

- Engage in a broad socioeconomic **indicator prioritization exercise** involving members of the fishing industry, potentially impacted communities, and industry experts to evaluate competing interests and determine the most critical data indicators for future impact analysis.

- **Conduct targeted data collection efforts to fill existing gaps**, particularly qualitative metrics, based on the prioritization exercise.

- Work with industry leaders to develop a methodology to **link offshore fishing operations to corresponding onshore impacts.**

Socioeconomic Analysis Development

Once the above action items are completed, stakeholders with the required technical expertise should build out the socioeconomic research analysis methodology, understanding this to be a longer-term task requiring ongoing data collection and dedicated funding.

- Prioritize defining the Maine fishing industry more precisely to include **fisheries-specific business and workforce information.**

- Fund additional research and leverage the data inventory and resources developed in this study to **create a mixed-method socioeconomic analysis methodology** tailored to Maine's fishing and offshore wind industries.

- **Determine the key guiding research questions** with respect to socioeconomic impacts, including both benefits and challenges to the fishing industry.

Management and Operational Recommendations

The following long-term management and operational recommendations are important to enabling successful execution of the stated next steps and project goals. These recommendations can be implemented by Maine GEO, the Consortium, and industry partners immediately.

- **Continue inter-organization convening and coordination**, building on Maine GEO and the Consortium's work. This is crucial for effective data sharing and cross-sector collaboration to maintain and update the data inventory, as well as develop the mixed-method socioeconomic analysis framework.

- **Broaden outreach and education to increase awareness** among fishing and offshore wind stakeholders about this project's efforts and encourage utilization of the data inventory and other resources.

- **Advocate for additional funding** for research to fill data gaps and develop a longitudinal study of socioeconomic indicators, ensuring all the aforementioned steps are well-supported.
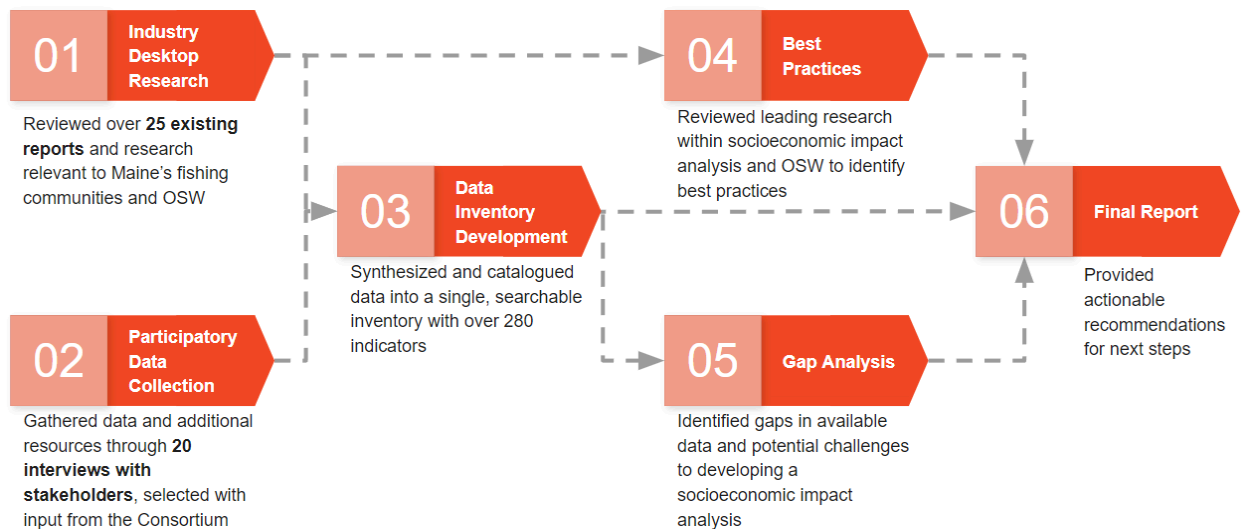
These takeaways and recommendations, in concert with the data inventory itself, will guide future socioeconomic analysis to incorporate unique conditions and needs of Maine's fishing communities.

1. Research and Data Collection Methodology

The project's central goal was to inventory baseline data on socioeconomics of Maine fishing communities to help assess potential positive and negative impacts of floating offshore wind in the Gulf of Maine. To accomplish this, the Study Team used a mixed methods approach including desktop research and stakeholder engagement to synthesize an understanding of current practice around socioeconomic research relating offshore wind to fishing communities. Research was divided into five interrelated tasks, connected as outlined by the figure below. Both desktop research and stakeholder engagement involved the synthesis of information from a wide range of sources, including community-based, industry-based, academic, and governmental.

Figure 1: Project Methodology and Task Flow

01 Industry Desktop Research
Reviewed over **25 existing reports** and research relevant to Maine's fishing communities and OSW

02 Participatory Data Collection
Gathered data and additional resources through **20 interviews with stakeholders**, selected with input from the Consortium

03 Data Inventory Development
Synthesized and catalogued data into a single, searchable inventory with over 280 indicators

04 Best Practices
Reviewed leading research within socioeconomic impact analysis and OSW to identify best practices

05 Gap Analysis
Identified gaps in available data and potential challenges to developing a socioeconomic impact analysis

06 Final Report
Provided actionable recommendations for next steps

1.1 Industry Desktop Research

Over 25 reports and research relevant to Maine's fishing communities and offshore wind were independently identified and reviewed by the Study Team for data sources and cited databases. Reports covered a wide range of topics, including existing socioeconomic research related to offshore wind and fishing communities, current conditions economic analysis of Maine's waterfront, and strategic planning surrounding Maine's coastal communities, ocean ecology, and fishing industry, among others. These reports contributed to the development of the data inventory.

1.2 Participatory Data Collection through Stakeholder Engagement

Stakeholder engagement contributed directly to the Study Team's creation of a data inventory as well as the identification and synthesis of key gaps and challenges towards ensuring the data inventory will be complete and able to support a future socioeconomic analysis.

1.2.1 Stakeholder Mapping

To determine which stakeholders should be included in targeted outreach, the Study Team took the following steps:
1. Developed an initial list of individuals and organizational representatives to contact;
2. Conducted preliminary outreach with these stakeholders to better understand the landscape of existing socioeconomic data;
3. Used "snowball sampling" in which initial contacts were asked for additional names with contact information to expand the reach of the study to yet to be included stakeholders
4. Finalized the full list of contacts with input from Maine GEO and the stakeholder engagement subcommittee of the Consortium Advisory Board.

The final prioritized outreach list targeted participants from the following respondent groups:
- Maine's Offshore Wind Research Consortium Advisory Board
- Participants in Maine's Offshore Wind Roadmap Working Groups and Advisory Committee;
- Leadership and partners of the Maine and New England Fishing Industry;
- Municipal, State and Federal Fisheries Agency Staff;
- Fishing and Fisheries-related Community Organizations/NGOs;
- Tribes[1];
- Academic Researchers;
- Supply Chain Experts; and
- Unaffiliated Fishermen.

While representatives from all groups were contacted, engaged participants did not include all of the above groups due to project timeline constraints.

1.2.2 Stakeholder Interviews

Interview questions focused on stakeholders' knowledge of anticipated impacts related to offshore wind, relevant existing analyses or reports that could include socioeconomic data, and historical information or other sources of data relevant to the industry. The Study Team completed 20 interviews over the course of March to June 2024. As the interviews ran concurrently with the other research, the team iteratively adjusted and added questions to directly respond to research findings.

1.3 Data Inventory Development

The Study Team identified over 280 individual socioeconomic data metrics through the desktop research and stakeholder interviews. The research scanned for metrics included reports from local, state, and federal agencies, industry professionals, and academic research centers or journals[2]. The data was then compiled in a single, searchable spreadsheet, which calls out important information and characteristics, such as the category of data, the publishing

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[1] The Study Team contacted Tribal representatives but were unable to receive their input due to the listed constraints.

[2] Refer to Appendix B: Comprehensive List of Reports Reviewed contains a list of the full extent of resources which were reviewed by the Study Team.

organization, geographic scale, the year and frequency data was collected, the year of the first and most recent data release, the public availability of the data, the collection methodology, etc[3].

1.4 *Socioeconomic Impact Assessment Best Practice Review*

The Study Team reviewed a range of reports and studies regarding fishing communities, their unique characteristics, and the industry's interactions with offshore wind and disruptive climate events in order to identify best practices of socioeconomic research specific to OSW and fishing. Reports were identified and selected through desktop research as well as recommendations from stakeholders in the interviews. The Study Team prioritized research that most aligned with Maine's coastal geography and the specific fishing industry, but also incorporated reports from a broader context that the team deemed applicable to the research topic. Sources included National Oceanic and Atmospheric Administration (NOAA), Bureau of Ocean Energy Management (BOEM), and U.S. state agencies, academic journals and non-governmental organizations[4].

1.5 *Gap Analysis*

The Study Team conducted a thorough gap analysis to identify and address missing socioeconomic metrics important for assessing the impacts of offshore wind (OSW) on Maine's fishing industry. These metrics were cross-referenced with operational and procedural challenges reported by members of the fishing industry during initial engagement sessions, allowing the team to pinpoint the reasons behind missing datasets and impediments to conducting effective socioeconomic analysis . To refine these findings further, an additional round of interviews was conducted, resulting in a set of prioritized takeaways that will guide future actions.

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[3] Refer to Appendix A: Data Inventory for the full list of meta data collected.
[4] See Appendix C: Reports Reviewed - Best Practices Research for the full list of reports reviewed.

2. Socioeconomic Data Inventory

The data inventory is a centralized repository that includes Maine's fishing-related baseline socioeconomic data across a range of topic areas. In order to prepare for and execute a comprehensive socioeconomic analysis of offshore wind on the fishing industry, it is critical to first understand the existing socioeconomic conditions of the fishing population and businesses.

The Study Team found over 280 metrics of existing socioeconomic data, covering multiple academic disciplines and socioeconomic categories. The Study Team developed the socioeconomic data inventory by identifying and cataloging existing data metrics and other quantitative socioeconomic research efforts through targeted desktop research, guidance from the Consortium, and stakeholder engagement. Relevant metrics measure the social, economic, educational, workforce, and environmental characteristics of Maine fishing communities. Each metric has a varying level of visibility based on how much they have been used in mainstream analysis and reporting. The Study Team developed the inventory to include multiple pieces of metadata about each metric, outlined in Table 1: Data Inventory Fields and Description.

Table 1: Data Inventory Fields and Description

Field	Description	Example
Data Category	High-level classification of the indicators about the Maine fishing communities.	Workforce
Data points	The specific data metric that measures various characteristics of Maine fishing communities	Job openings
Data Set / Report	Program, database, or report which hosts the data point	Job Openings and Labor Turnover Survey
Publishing Organization	Institution, organization, or individual that has collected and compiled this data	Bureau of Labor Statistics
First Release	First year the data was released	2014
Most Recent Release	Most recent year the data was released	2024
Update Frequency	How often the dataset is updated	Monthly
Geographic Specificity	Geographic scale at which this data exists (census tract, county, state)	Region, State
Publicly available?	Is this data anyone can access or does it require special permissions	Yes
Link or data location	If data is published online, a link to the webpage. Otherwise, a note on where this data can be found	Link
Data Collection Methodology	How the data was measured/identified (survey, other existing data set, other qualitative research)	Sample-based estimates and official counts, both using surveys.

Are there any challenges in accessing the datasets? Are there any gaps present in this data source? Any other noteworthy items?	Additional information about the indicator.	This data is not directly available for the fishing industry, leaving a gap for an economic indicator to measure unmet demand for labor and assess labor shortages. This can however be used to understand unmet demand for industries that support and supply materials for the fishing industry.

While developing the inventory, the Study Team identified several limitations and barriers that future users should consider when leveraging it for socioeconomic impact assessments.

Despite capturing a comprehensive landscape of quantitative data on the social, economic, industry, environmental, health, and geographic data baselines of Maine's fishing communities, the inventory includes a limited number of qualitative data sources. For a broader understanding of qualitative information, users should refer to the Appendix B: Comprehensive List of Reports Reviewed (including the Fisheries and Offshore Wind Interactions: Synthesis of Science by Northeast Fisheries Science Center). Additional outreach with stakeholders and relevant organizations, including representatives of Tribes, would help to support and validate the cultural significance of coastal ecosystems, especially the deep and historic importance of these ecosystems to indigenous communities. Socioeconomic analysis should include this human aspect and incorporate the history and cultural aspects, which continue to contribute to the lives of Maine's coastal community members.

Additionally, several data sources reviewed were not publicly accessible due to confidentiality restrictions imposed by publishers, though access may be requested through agency agreements or purchased in some cases. Access to these confidential data sets is not guaranteed and they need to be individually requested by a researcher to the relevant body. Beyond data access, challenges also exist in data awareness and coordination across public agencies and academic institutions. Over 30 different public and private organizations contributed data, each with unique collection scales and frequencies. Building awareness of this centralized data repository can help support larger coordination efforts.

Further information on key takeaways and recommended action regarding existing data gaps and barriers can be found in the following section: Gap Analysis.

As an immediate next step, Maine GEO, the Consortium, and key data partners should determine a general strategy towards the ownership, publishing, and maintenance of the inventory going forward. This strategy may include the selection of a widely-available platform (such as a public webpage) which can host the inventory in an interactive manner. Once a path forward is determined, public and private organizations should be encouraged to contribute to the data inventory, ensuring information remains accurate and up-to-date.

3. Gap Analysis

To better guide future research and data collection, the Study Team used the data inventory and interviews with stakeholders to identify current data gaps and challenges to completing a socioeconomic analysis of offshore wind impacts on Maine fishing communities. Beyond the positive and negative impacts of offshore wind, fishing communities face numerous stressors contributing to feelings of uncertainty, with future research planned to examine these stressors to understand the broader picture of the challenges these communities face. This gap analysis represents the priority areas of data that require additional clarity or information, and should help guide future research efforts.

The Study Team's research identified gaps in existing available data across a range of distinct topic areas as listed below. In current practice, these gap areas limit which indicators can be analyzed and the geographic detail of the results.

3.1 Unavailable data points:

- **Labor and Supply Chain:** Detailed fishing and offshore wind related industry and workforce data, including employment, wage, and the participation of immigrants or undocumented workers, is critical to understanding the potential impacts towards populations with intersecting vulnerabilities.
- **Preferences and Cultural Differences:** Cultural values and differences are important to communities, particularly communities with a long history tied to a specific industry and geography, such as the fishing communities in Maine and Tribal communities. For example, fishermen and crews are often intergenerational family operations, and as such contribute to an added human importance to shifts in the industry and cost of living changes. The cultural values of fishing communities in Maine and Tribal communities may require available access to limited harbor and shore space which would be further competed with by the introduction of offshore wind.
- **Necessary Repairs and Equipment Upgrades:** Several participants noted the importance of characterizing the economic cost of repairs, equipment purchasing or upgrades to fishing vessels and infrastructure, as this has a direct contribution to the Maine economy.
- **Safety/Accidents:** Although data signaling risky behavior, such as Maine Marine Resource violations via the Maine Marine Patrol, is available, health and safety data about on-the-job injuries and the economic impacts of vessel crashes in general lacks systematic collection.
- **Docking Access:** Increased documentation around private dock access and the spatial capacity of docks would help support analysis to place impact and possible avenues of adaptation for fishing operations.
- **Housing Affordability and Coastal Accessibility:** Housing is a critical need for community stability; increased data around housing-cost, living arrangement trends, and public access to the coast can provide information about shifts in communities.
- **Environmental Justice:** Similar to the lack of definition of "fishing communities," there are ongoing discussions as to what should constitute an Environmental Justice community, and how this designation may affect future policy and market intervention.

- **Equity:** Planning for and tracking the equitable distribution of benefits was brought up by several respondents. For example, it was suggested that community benefits should be targeted not necessarily to the "closest" community to a wind farm, but to where there is more need. Many stakeholders also suggested dedicating funding to school systems to bridge funding gaps due to declining enrollment as residents are squeezed out of coastal communities, which would require further data collection on public school operations.
- **Health Outcomes:** Many respondents discussed the high-risk nature of fishing employment as it connects to stress-related negative health outcomes, such as decline in mental and physical health and substance use disorders. Others discussed the multiple stressors facing rural or remote fishing communities that contribute to well-being.
- **Geographic Impact of OSW Development and Operation**: There are still ongoing discussions and research around how OSW projects and their ancillary infrastructure will geographically impact fishing activities. For example, understanding the expected increase in anchor strikes of seafloor cables and the related costs of such incidents would help to further clarify impact analysis.

3.2 Additional Data Gaps and Challenges

Missing links between the home and on-water locations of marine fishing workforce. Across the various industries and stakeholders working in the field, there is no widely agreed upon definition of "fishing community" that links the on-water fishing industry to a geographic boundary. Establishing the geographic linkage between the marine fishing operations and home locations of the fishing population would enable the use of census or other data to understand the socioeconomic characteristics of onshore labor and vessel crews. Most stakeholders described a fishing community in terms related to people working directly in the fishing industry: a group of people who share similar licenses/permits, use similar gear and similar sized vessels, frequent similar areas, and/or fish from the same or nearby port. Other participants described fishing communities as geographic communities with high reliance on fishing, are a port community, or have a clear link to the supply chain such as the existence of fish processing or related marine-based businesses. Developing a framework to make this linkage is critical in order to paint a much more comprehensive picture of the fishing industry and community than the currently available license data, which speaks only to the permit holder/owner/operator of a vessel and not the entire crew and additional on water and shoreside support. A key challenge to addressing this data gap is that detailed fishing data is held in confidential data sets and is not publicly available.

Limited fisheries-specific socioeconomic data. There is currently a gap in available socioeconomic data and research that focuses on fishing businesses and population by fishery type (based on management, permit, or species categories). This gap exists nationally across regions of the fishing industry. Information is either not collected or unavailable due to data protection measures and confidentiality concerns. Understanding differences in socioeconomic characteristics across fisheries is important as the impacts of OSW construction and operations vary across different fisheries. Additionally, fishery-specific data can help to reveal additional benefits created by offshore wind through the creation of jobs with overlapping skill-sets. Collecting fishery-specific baseline data is critical to be able to evaluate socioeconomic impacts based on the OSW operations in wind areas, each of which may consist of a different and unique

mix of fishery activity.

Undefined fishing industry supply chain characteristics. To adequately capture the direct, indirect, and induced socioeconomic impacts to fishing communities, researchers must not only understand the existing conditions of the individuals and businesses working directly in fishing, but also of the various industries and businesses reliant on the fishing industry, referred to as the "supply chain." Currently, there is no known database of the individual components of the fishing supply chain in Maine, nor in-depth data or analysis around individual businesses and their workforce. This contributes to a lack of evidence-based analysis of potential job opportunities in offshore wind that could have overlapping skill-sets with the current fishing-related workforce. Several respondents mentioned the importance of interdependence among fisheries - specifically, bait (herring) and lobster. The lack of specific data on the flow of product shoreside was noted as a data gap among several respondents (fishing industry and researchers).

Margin of error in survey-based data sources (including the US Census). Socioeconomic data and fishing industry data is often gathered through self-reported surveys, which have well-documented limitations. Respondents noted that Census data often fails to capture the unique socioeconomic characteristics of fishing communities, including their distinct economic activities, cultural values, and family connections; and that community-specific data is essential for accurate analysis. For national survey-based data sources, such as the U.S. Census, respondents noted that low response rates lead to a great deal of missing information. These low response rates were partially attributed by respondents to distrust in decision-making institutions among fishing communities.

Wide breadth of available data leading to gaps in awareness across disciplines and stakeholder groups. The Study Team found a gap in individual stakeholder awareness of the total available information due to the wide range of relevant fields related to the social and economic characteristics of fishing industries. A holistic analysis of socioeconomic impacts requires the incorporation of multiple experts across fields of study, each of whom brings a specific piece of knowledge and awareness around available datasets, tools, and past analysis.

Potential for increased coordination among public and nonprofit organizations. Due to the vision and leadership of Maine GEO, members of the Maine Offshore Wind Research Consortium and other collaborators, there is a strong foundation of cross-sector and coordination in Maine. A comprehensive economic impact analysis will require cross-sector coordination and data-sharing between government agencies, academia, NGOs, and private businesses. Stakeholders pointed to challenges such as rapid funding cycles creating unintentional redundancy, difficulty for large institutions to respond quickly to data collection requests, and the need for confidentiality to protect individuals within fishing-related data as factors that make coordination challenging across different stakeholder groups.

Looking ahead, there are multiple pathways to address each gap identified by the Study Team. These next steps range from methods linking existing datasets or resources to guidance for collaborative efforts towards the collection of new data. Fishing business and industry data from state and federal sources can be utilized to capture fishery specific characteristics, and collection efforts can fill gaps in available data addressing topics such as labor, social justice, health, affordability, and access. In many cases, future socioeconomic analyses will need to rely on surveys and other self-reported data, building upon baselines set by larger collection efforts such as the US Census. As outreach and awareness around this research continues and the data inventory grows, stakeholders should continue to track and address data gaps. More detailed recommendations for the data gaps can be found in Section 6.

4. Socioeconomic Impact Assessment Best Practices Review

Assessing the socioeconomic impact of offshore wind (OSW) on fishing communities requires quantitative and qualitative methods that capture complex economic and social metrics, consider the supply chain of industries connected to fishing and OSW, and incorporate local knowledge. **For Maine, the Consortium and other collaborators to best prepare for and execute future impact analyses, it is critical to understand what methods and tools have been successful across relevant industries and geographies.** The Study Team recommends reviewing the benefits and limitations of the following indicators and methodologies, which have been identified to provide a benchmark for the future research design of socioeconomic impact analysis.

The goal of a socioeconomic impact analysis can be thought of in two parts: **What are the positive or negative social and economic changes related to some collection of events; and where specifically will these changes occur?** Across the Study Team's literature and research review, there was not a singular methodology or study that incorporated all elements of a socioeconomic analysis that would adequately capture both the economic and human elements critical to understanding the future of OSW in Maine.

There are a wide range of tools and analytic workflows that use qualitative and quantitative methods to capture either the economic, social, or spatial components of a potential impact. Any future analyses of the socioeconomic impact of OSW on fishing communities in Maine will require sensitive, site-specific scoping, which should incorporate a combination of the following lessons learned and best practices outlined in this report.

4.1 Indicators

As part of this research, the Study Team reviewed 20 reports[5] to identify key socioeconomic indicators that are typically used to measure the impact of OSW development on fishing communities. This preferred list of indicators can be used as a checklist for future socioeconomic analysis in Maine, ensuring that the nuanced impacts of OSW on Maine's fishing communities are thoroughly understood and effectively addressed.

It is important to note that indicators differ from the metrics collected through the Study Team's data inventory process. **Metrics are data points typically taken at one point in time to quantify or characterize a socioeconomic condition of a certain population, industry, or geography (e.g., annual household income, business revenue). In contrast, indicators measure changes in these metrics over time, enabling us to forecast or retrospectively analyze the positive or negative impact on a particular socioeconomic condition because of an external factor.** In this context, the external factor is OSW-related construction and operation, and indicators speak to the resulting positive or negative changes and effects on metrics related to the fishing population, economy, workforce, and supply chain (e.g., change in household income and business revenue)[6].

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[5] Refer to Appendix C: Reports Reviewed - Best Practices Research for the full list of reports reviewed.
[6] Refer to Appendix D: List of Indicators for the full list of identified indicators.

4.2 Tools and Analytical Workflows

Analyzing the wide range of socioeconomic indicators requires the use of multiple tools and analytical workflows that measure impact following market changes or other climatic and regulatory changes. The agencies leading the critical data gathering and analysis found by the Study Team include the Census Bureau, BOEM, NOAA, Marine Management Organization, the Maine Department of Marine Resources (DMR), and others.

Each of the identified methods below, whether quantitative or qualitative, face challenges which highlight the complexity of assessing total socioeconomic impact. Even in an undertaking which utilized all analytical workflows, something yet unseen in reviewed literature, the bridging of results would require significant assumption for interpretation.

Economic Modeling. Input-output impact analysis is a common method of modeling regional economic impacts of industry events in terms of related new jobs and income totals, economic contribution (GDP), and sales. This method can provide insight into the direct, indirect, and induced impacts on marine industries, meaning the changes to the analyzed industry itself (direct), businesses which support that industry or contribute to its supply chain (indirect), and the household spending of local individuals (induced).

The most common tool for input-output forecasting from the Study Team's research is IMPLAN software. In many cases, including via BOEM and NOAA reports, analyses used the NMFS Commercial Fishing & Seafood Industry (CFSI) model, which is integrated into IMPLAN software. An alternative tool used to perform economic analysis is the National Renewable Energy Lab's Jobs & Economic Development Impact (JEDI) OSW model. This methodology follows best practices laid out by the *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources* and includes forecasting of jobs and earnings based on wind farm characteristics, including costs and turbine specifications. While the JEDI model's free cost makes it a more immediately available tool, IMPLAN software provides more robust user guidance and model customization options.

Regardless of the tool used to execute the input-output analysis, this method of economic forecasting is a crucial part of understanding socioeconomic impact which must be included in any future analysis.

Spatial Impact Assessment. Spatial analysis is necessary to understand the local distribution of positive and negative impacts, economic or otherwise, which typically rely on outputs at the regional scale. Modeling the competing spatial demand of fisheries and other ocean industries allows a more robust understanding of the geographic distribution of vulnerability and benefits among communities. These place-based analyses enable decision makers to pursue strategic planning or policy solutions which seek to direct the regional benefits forecasted by input-output methods.

Through understanding the location choices of fishermen and projecting future limitations of ocean space, researchers can begin to predict where regional economic trends will take place. In current research, probabilistic and regression modeling has been used to analyze these effects. These methods are typically implemented using geographic information system software.

Qualitative Methods for Impact Assessment. Where spatial analysis provides a quantitative method of localizing expected impacts, qualitative research interacting directly with fishing communities allows another means to support the interpretation of regional economic and social changes into a local scale. Surveys are a common tool used across existing research to capture the spatial needs of fishermen, the impacts of disrupting events such as storms, and demographic data not available through typical data sources, such as detailed crew characteristics.

In some cases, qualitative data is analyzed in order to achieve statistically validated conclusions regarding the importance and prioritization of complex topics or policy options among various stakeholder groups. One method found in current practice is the Analytic Hierarchy Process, a method of assigning mathematical weights to decision making problems. Software tools such as Expert Choice can be used to execute these methods.

As a whole, these qualitative methods are critical in socioeconomic impact studies in order to measure human-centric indicators such as awareness, changes in hiring difficulty, operational changes related to safety concerns, and other industry or population data that isn't captured by standard quantitative methods defined above.

Table 2: Reviewed Existing Socioeconomic Impact Analysis Methods

Method	Strengths	Limitations
Economic Modeling		
Input-Output Analysis	Captures the majority of economic effects created by industry change. Provides outputs related to both employment and jobs and regional economic output.	Difficult to attribute to local areas, instead modeling for a region. Assumes a supply of qualified workforce to fulfill newly created jobs. Does not account for disruptive or transformative events. Forecasts a limited number of indicators narrowly focused on jobs and economic output
Spatial Assessment		
Location Choice Modeling	Allows community-level attribution of modeled operations.	Difficult to incorporate qualitative knowledge of local preferences or opinion into models.
Regression Trends Analysis	Allows the factoring of multiple ocean industries into a single spatial model.	Does not account for disruptive or transformative events. Difficult to capture interdependencies between variables.
Qualitative Analysis		
Surveying - Descriptive Analysis	Can be used to provide a standardized format for collecting qualitative data over multiple points in time.	Analysis lacks scientific rigor towards proving mathematical significance of identified variables. Input captured may be difficult to interpret into

		modeling and future analysis.
Surveying - Analytic Hierarchy Process	Useful to decision makers by providing definitive hierarchy on issues or policy where perspectives diverge.	Can require substantial qualitative data gathering to develop hierarchy tools.
Interviews - Descriptive Analysis	Provides the most in-depth information from stakeholders and can reveal previously unknown resources and tools.	Analysis lacks scientific rigor towards proving mathematical significance of identified variables. Input captured may be difficult to interpret into modeling and future analysis.
Focus Groups - Descriptive Analysis	Discussion allows alternate perspectives to come to common conclusions or identify issue nuances.	Analysis lacks scientific rigor towards proving mathematical significance of identified factors. Input captured may be difficult to interpret into modeling and future analysis.

4.3 Limitations

The socioeconomic landscape of fishing communities is complex, and many reports and studies face similar challenges when attempting to accurately capture socioeconomic impacts from OSW:

- **Defining a time horizon to analyze before and after conditions** is challenging given the long life cycle of OSW development and operations, but is critical when performing impact assessments. While no single timeline has been established as best practice, a 10-year horizon has been suggested in some literature as a minimum period along which to quantify cumulative impacts.

- **Capturing the competing spatial needs of OSW and fishing communities** represents a continual challenge for anticipating the impact of OSW on fishing communities. The costs of cross-industry competition for ocean and harbor space are important to account for in socioeconomic analysis and require additional analysis beyond regional economic modeling. This includes elements such as demand for harbor space, increased on-seas vessel traffic, and interactions between fishing operations and OSW related infrastructure (for example sea-floor cables).

- **Data gaps contribute to challenges** estimating the full breadth of costs associated with changes in the economic outputs of fishing industries, including direct and ripple effects from OSW or other outside factors. These gaps and challenges, along with recommendations to address them, are discussed in section 6 of this report.

- **The local knowledge of fishermen** is a valuable resource of highly specific information regarding ocean navigation, ecological trends, and fishing practices, but this is challenging to fully capture and incorporate into a socioeconomic analysis framework. Underpinning this challenge is a lack of consistent survey tools and efforts that can create a foundation for before-after analysis.

- ○ **Intersecting impacts of outside factors such as climate change, workforce changes, and regulatory changes were not captured** with respect to the overall effect of OSW on fishing communities. It will be important for future data collection and analysis to identify when there are multiple potential factors of change at play, especially when drawing conclusions regarding causation and correlation.

Overall, applying best practices in socioeconomic impact analysis requires a balance of standardizing methods and data collection tools for consistent indicators, with an understanding of the specific geographic context of Maine fishing communities. While input-output analysis represents the foremost methodology for modeling economic impacts, it must be supplemented with spatial impact assessments and qualitative research to capture the intricate relationship between fishing communities and OSW. Utilizing the full range of best practices outlined in this report will lead to a comprehensive understanding of socioeconomic impacts dependent on the continued empirical monitoring of outcomes over time.

By undertaking such a mixed-methods study, Maine has the opportunity to show meaningful leadership in the OSW and marine sector. Prior to completing socioeconomic impact analyses, Maine should invest in additional research to address (i) understanding the use of specific tools over others, and (ii) identifying formal standards set by states or other federal authorities to help to refine the best practices towards data collection and survey design.

5. Key Takeaways

The following takeaways highlight the Study Team's learnings from the data inventory, gap analysis, and best practices research, which have directly informed the recommendations and next steps in Section 6.

Takeaway 1 | There is a wide range of existing socioeconomic data about Maine's fishing industry, covering multiple disciplines and categories. While a few targeted data gaps have been identified, the State does not need to prioritize an extensive data collection effort. **However, many data points that the fishing communities and key stakeholders are interested in have not been included in previous socioeconomic impact studies**.
- Through our stakeholder interviews and research literature review, the Study Team collected over 280 socioeconomic data metrics relevant to fishing communities. This data inventory covers a wide range of topic areas, but primarily comprises quantitative data.
- Comparing feedback from stakeholders with existing best practices, most existing economic impact assessment studies do not include many of the socioeconomic indicators (such as mental health stressors, physical health conditions, residential gentrification risk, capacity of fishing infrastructure, etc.) and qualitative data measures (such as: local ecological knowledge and cultural aspects of fisheries), which are critical to prioritizing lived experiences and have been identified as priorities by key constituents.
- This suggests the need to build agreement among stakeholders regarding the prioritization of indicators, and that future research should include a broader range of data metrics identified in the inventory, leading to a more accurate and thorough analysis.

Takeaway 2 | Socioeconomic assessments are complex and, in this case, need to be catered towards Maine's fishing industry and reflect the conditions of the fishing population, businesses, offshore and onshore operations, and infrastructure. While we have gathered a range of applicable quantitative and qualitative methodologies in this research, there is **not an existing industry "best practice" or socioeconomic impact assessment framework that comprehensively addresses the subject topic**. Critically, there is a **lack of resources and academic research correlating offshore wind development and operations with socioeconomic impacts.**
- There are a wide range of economic impact methodologies that have been used in Maine and across geographies, as defined in our Best Practices analysis. However, our research did not identify a precedent framework that adequately incorporates the *human element* of a socioeconomic analysis into an offshore wind model.
- While the specific data metrics and geographic boundaries may vary, all socioeconomic impact assessments are built on a foundation of research that explains how certain actions (the development or introduction of the new industry/building/policy) will impact a certain subject (population/industry/output).
- As OSW is an emerging industry in Maine and in the United States, there is not an adequate supply of academic and scientific research linking offshore wind and the fishing industry, as compared to socioeconomic impact assessments in more established industries.
- By pursuing evidence-based before-after analyses structured to be replicable over distinct intervals of time, Maine has the opportunity to show strong leadership within the field of socioeconomic research surrounding offshore wind.

Takeaway 3 | To successfully develop and execute an accurate socioeconomic analysis that incorporates both industry and human data indicators, there is a need to **adequately link existing offshore fishing operations with onshore impacts. Figure 2 below visualizes the spatial relationships between offshore wind impact areas, fishing operations, and onshore impacts.**

- First, it is important to clearly define fishing operation areas (geographic areas in the water currently used for fishing) that would be impacted by the construction and operation of offshore wind (WEAs, lease areas, offshore wind vessel routes, cabling routes). Then, proceed with linking those offshore areas to onshore impact areas (home locations of the fishing workforce, fishing-related businesses locations, and key fishing-related infrastructure) where the impacts of offshore wind will be felt the most.
- The next step is to establish the geographic linkage between the marine fishing operations and home locations of the fishing population to enable the use of census or other data to understand the socioeconomic characteristics of on-shore labor and vessel crews. This linkage will enable a much more comprehensive picture of the industry than the currently available license data, which speaks only to the permit holder/owner/operator of a vessel and not the entire crew and additional on water and shoreside support.
- Crafting a methodology for this linkage will allow future researchers to utilize the offshore and onshore data, much of which already exists, for a socioeconomic analysis that connects OSW actions to socioeconomic indicators across Maine's onshore communities.

Figure 2: Geographic linkage between the offshore wind impact areas, fishing operation areas, and onshore impact areas.
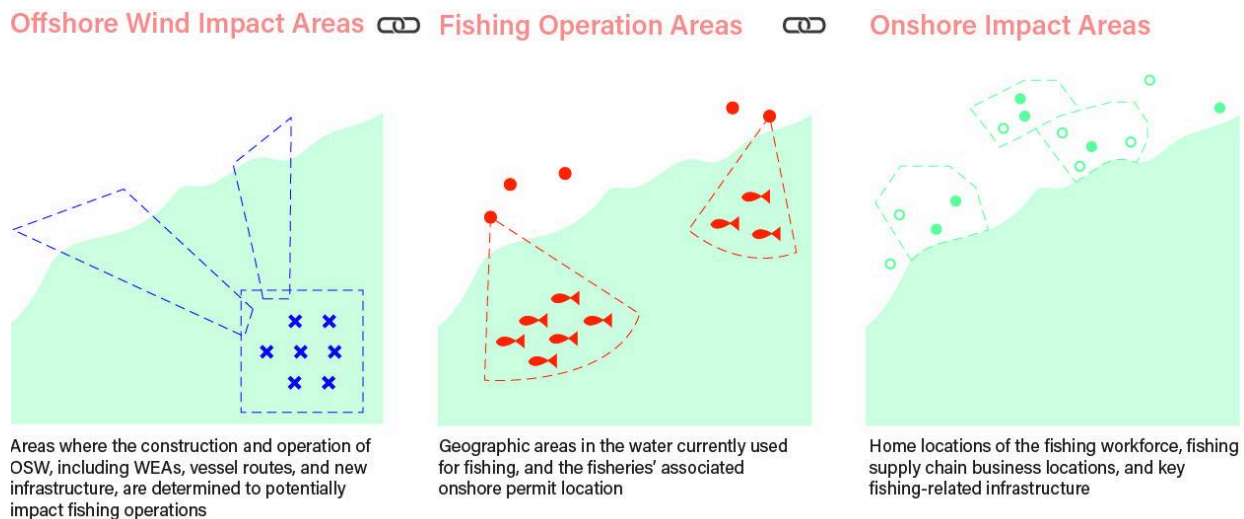
Offshore Wind Impact Areas 🔗 **Fishing Operation Areas** 🔗 **Onshore Impact Areas**

Areas where the construction and operation of OSW, including WEAs, vessel routes, and new infrastructure, are determined to potentially impact fishing operations

Geographic areas in the water currently used for fishing, and the fisheries' associated onshore permit location

Home locations of the fishing workforce, fishing supply chain business locations, and key fishing-related infrastructure

Takeaway 4 | While there is a great foundation of research to define the fishing industry supply chain in Maine and the greater Northeast, there remains a gap between specific business data and fisheries-specific supply chain information. That gap makes it difficult to accurately assess the impacts to the fishing economy based on major and minor species that exist in a particular offshore impact area.

- Economists in the Gulf of Maine Region are currently designing an approach to establish local fisheries multiplier effects, which could support these efforts.
- The fishing industry does not follow state lines, and future socioeconomic analysis will need to make decisions around how to consider out-of-state fisheries and supply chain businesses that may be impacted by changes in Maine.
- Therefore, future research should supplement the traditional industry data sources with direct outreach and engagement with businesses along fishery-specific supply chains to refine the socioeconomic modeling of the broad fishing industry.

6. Looking Forward: Recommendations for the Data Inventory & Future Research

Continuing the data collection efforts started with this project and preparing for a robust socioeconomic analysis will require collaboration across multiple stakeholders and, likely, several research efforts happening simultaneously. The Study Team shares the following recommendations in order to best guide Maine GEO, the Consortium and other collaborators' future research and planning efforts in order to address the key takeaways and gaps listed above.

The first three recommendations are technical research and data collection efforts that should *be completed prior to the development of a mixed-methods socioeconomic methodology.* These next steps are short-term and could likely happen concurrently or in close alignment with each other. Successfully completed, the work that follows these recommendations will be strengthened.

- Future research should engage in a broad **socioeconomic indicator prioritization exercise** across fisheries, potentially impacted communities, and industry experts to determine what of the identified data indicators are most critical to prioritize for future impact analysis efforts.
    - The Study Team collected over 280 data metrics through our data inventory process. It is not feasible to include all of these in a future socioeconomic research framework. Recognizing that different stakeholders will have different priorities, this exercise will need to be thoughtful in how to evaluate competing interests.
    - Current data gaps, as defined in our Gap Analysis, should be included as part of the prioritization exercise, as those are likely critical to understanding the lived experiences of fishing communities.

- Once we understand the priority metrics and indicators, Maine stakeholders including Maine GEO, the Consortium, and the fishing community can then **prioritize data collection efforts to fill existing data gaps,** particularly qualitative metrics, and update currently out-of-date datasets.
    - Data gaps that have been identified as priorities for a future socioeconomic analysis through the Study Team's research includes housing affordability, coastal access and waterfront infrastructure, seafood economy support businesses and labor, and equity and health metrics.

- Future researchers should work with industry leaders to develop a methodology framework and data sharing mechanism to **link the offshore impact areas to the onshore impact.**
    - In order to use population data that is aggregated spatially (i.e.: Census data) to describe shifts in socioeconomic indicators of fishing communities, analysts would need to connect the on-water community to the on-land community, which can be done by linking port identifiers with home addresses found in federal permit data and landings data. However, there are privacy concerns and future researchers would require special permissions to access confidential fishing landings data.

      ○   Key stakeholders should prioritize developing and publishing this linkage analysis and the corresponding geographic data about onshore impact areas.

Once these critical action items are complete (understanding that data collection will be ongoing), **the key stakeholders can further build out the socioeconomic analysis framework over the long-term**, including further defining the target geography and population of potential impacts.

- Through a combination of data analysis and on-the-ground interviews, future researchers should prioritize **further defining the Maine fishing industry to include fisheries-specific business and workforce information.**
    - Researchers can build on the existing supply chain resources to solidify the list of applicable industry categories (NAICS codes).
    - Outreach and engagement with various permit holders can provide more information on the workforce and understand who individual fisheries source material and labor from throughout the supply chain.
    - Similar to the offshore/onshore linkage described above, combining landings and permit data can define the fishery-specific activity in offshore impact areas.

- Future research should **leverage the data inventory and the resources developed through this study to build a mixed-method socioeconomic analysis methodology** that accounts for the considerations unique to Maine's fishing and OSW industries.
    - It is critical to fund additional interdisciplinary research to establish a stronger data-backed correlation between impacts of OSW on fishing operations and fishing population. Efforts should also include highly local, context-driven qualitative research in priority communities. This research will act as a foundation for socioeconomic analysis.

Finally, to enable successful execution of the stated next steps and project goals, **the following overarching operational recommendations are important to keep in mind as this work continues:**

- Building on the work led by Maine GEO and the Consortium, **continued inter-organization convening and coordination** is required to ensure there is adequate sharing of existing data and cross-sector collaboration to develop the mixed-method socioeconomic impact analysis framework.
    - Maine GEO and the Consortium are well positioned to act as a convener, but will require support from a broader network of stakeholders.
    - Spending time upfront to build new patterns of coordination will streamline data collection efforts, save time and money in the long run, and lead to better outcomes.
    - Future efforts should also prioritize ensuring open and regular communication channels, using collaborative knowledge sharing platforms, organizing workshops and training, partnering with local institutions, etc., for increased coordination between the public and nonprofit organizations.

- Alongside this cross-sector collaboration, there should be **broader outreach and education** to build awareness among fishing and OSW stakeholders about this project's efforts and encourage them to utilize these resources.
    - By developing an inventory of existing data, the Study Team has taken a step towards the creation of a resource that a range of stakeholders can use to view and share currently available information. Maine GEO and the Consortium, in addition to other state and federal groups, can use this tool in outreach and public information campaigns and update the data inventory as needed.

- All of the previously stated next steps will require time and resources. Stakeholders should continue to **advocate for additional funding and research** in order to fill the data gaps and develop a longitudinal study of socioeconomic indicators.

These recommendations outline a collaborative path to developing a complete and prioritized inventory of relevant socioeconomic data metrics, and to establishing a strong foundation for a socioeconomic analysis framework that is specific to assessing Maine's fishing communities with respect to offshore wind. With the framework in hand, Maine GEO and its partners and stakeholders will be well equipped to pursue the next phase of work: running the research analysis that calculates and evaluates socioeconomic impacts - beneficial, harmful, or neutral - from the advancement of offshore wind.

In pursuing these next steps, Maine GEO, the Consortium, and other collaborators have the opportunity to foster stronger relationships between stakeholders from all parts of the fishing community and offshore wind industry. Given the broader range of data metrics believed to be important to deliver a strong and accurate assessment, new partnerships with other organizations may be helpful. As Maine GEO looks forward, involving collaborators across sectors and who can inform the technical, applicative, and operational exercises discussed will lead to better research. The new insights discovered are sure to inform ongoing conversations and decisions about the future of Maine's fishing industry and offshore wind.

Appendix

Appendix A: Data Inventory

Appendix B: Comprehensive List of Reports Reviewed

BOEM
1. *Data and Methodology for Developing Revenue Exposure Estimates in the Northeast Atlantic.*
   https://www.boem.gov/sites/default/files/documents/renewable-energy/Appendix%20A%2006232022_0.pdf
2. *Reducing or Avoiding Impacts of Offshore Wind Energy on Fisheries.*
   https://www.boem.gov/renewable-energy/reducing-or-avoiding-impacts-offshore-wind-energy-fisheries

Canadian Science Publishing:
1. *Economic Diversity of Maine's American Lobster Fishery.*
   https://cdnsciencepub.com/doi/abs/10.1139/cjfas-2022-0096?journalCode=cjfas

Center for the Blue Economy of the Middlebury Institute:
1. *The Economic Impact of the Maine Seafood Sector.*
   https://www.seamaine.org/wp-content/uploads/2023/03/FINAL-SEAMaine-Economic-Impact-Analysis-Report-2.pdf

Fisheries (Journal):
1. *Slow Adaptation in the Face of Rapid Warming Leads to Collapse of Gulf of Maine Cod Fishery.*
   https://www.researchgate.net/publication/283447602_Slow_adaptation_in_the_face_of_rapid_warming_leads_to_collapse_of_the_Gulf_of_Maine_cod_fishery

Frontiers in Marine Science:
1. *Harvester Perceptions of Climate Vulnerability: Contributions to Building Climate Resilient Fisheries.*
   https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2022.1049445/full
2. *Implementing Ecosystem Approaches to Fishery Management Risk Assessment in the US Mid-Atlantic.*
   https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2018.00442/full

GMRI
1. *Maine Farmed Shellfish Market Analysis.*
   https://www.gmri.org/projects/maine-farmed-shellfish-market-analysis/

Gulf of Maine Council on the Marine Environment:
1. *Large-Scale Offshore Wind Power in the United States: Assessment of Opportunities and Barriers.*
   https://www.nrel.gov/docs/fy10osti/40745.pdf

International Council for the Exploration of the Sea:
1. *Reflecting on the recent history of coastal Maine fisheries and marine resource monitoring.*
   https://www.researchgate.net/publication/373526383_Reflecting_on_the_recent_history_of_coastal_Maine_fisheries_and_marine_resource_monitoring_the_value_of_collaborative_research_changing_ecosystems_and_thoughts_on_preparing_for_the_future

Island Institute:
1. *Community Indicators: Livelihoods on Maine's Coast and Islands.*
   https://www.islandinstitute.org/wp-content/uploads/2020/09/Final-Waypoints-2018-Web-Version.pdf
2. *Waypoints Connect: Infrastructure indicators for Maine's Coast and Islands.*
   https://www.islandinstitute.org/wp-content/uploads/2020/09/Waypoints_Connect.pdf
3. *Waypoints Community Indicators for Maine's Coast and Islands.*
   https://www.islandinstitute.org/wp-content/uploads/2020/09/Final_Waypoints_01_13_2017_0.pdf

Journal of Environmental Economics and Management:
1. *Commercial Fisheries & Local Economies.*
   https://www.researchgate.net/publication/348825427_Commercial_fisheries_local_economies

Maine Aquaculture Hub:
1. *Maine Aquaculture Roadmap.*
   https://repository.library.noaa.gov/view/noaa/48190

Maine Department of Economic and Community Development:
1. *State of Maine Renewable Energy Goals Market Assessment.*
   https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/GEO_State%20of%20Maine%20Renewable%20Energy%20Goals%20Market%20Assessment_Final_March%202021_1.pdf

Maine DMR:
1. *The Gulf of Maine in Context.*
   https://www.gulfofmaine.org/state-of-the-gulf/docs/the-gulf-of-maine-in-context.pdf

Maine GEO:
1. *Maine Research Lease Application.*
   https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Maine-Research-Leas-Application.pdf
2. *Maine Economic Development Strategy 2020-2029.*
   https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/DECD_120919_sm.pdf
3. *Research Lease on the Outer Continental Shelf (OCS) Offshore Virginia, Request for Competitive Interest.*
   https://www.federalregister.gov/documents/2013/07/30/2013-18283/research-lease-on-the-outer-continental-shelf-ocs-offshore-virginia-request-for-competitive-interest
4. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development.*
   https://www.boem.gov/sites/default/files/documents/renewable-energy/2021-Lighting-and-Marking-Guidelines.pdf
5. *Strengthening Maine's Clean Energy Economy.*
   https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/StrengtheningMainesCleanEnergyEconomy_Nov92020.pdf
6. *Maine Floating Offshore Wind Research Array: Pre-Application Siting and Stakeholder Summary.*
   https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/GEO%20Research%20Array%20Siting%20and%20Stakeholder%20Summary%20July%202021.pdf

Maine State Chamber of Commerce:
1. *Multicultural Market Analysis: Cambodian, Vietnamese Seafood.*
   https://www.seamaine.org/wp-content/uploads/2023/01/Multicultural-Marketing-Analysis-Cambodian-and-Vietnamese-Seafood.pdf

Midcoast Council of Governments
1. *St George Working Waterfront Vulnerability Study.*
   https://www.midcoastcog.com/community-development#st-george

National Library of Medicine:
1. *Chronic social disruption following a systemic fishery failure.*
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6859345/

National Oceans Economic Program:
1. *State of the U.S. Ocean and Coastal Economies Coastal States Summaries - 2016 Update.*
   https://midatlanticocean.org/wp-content/uploads/2016/03/NOEP_National_Report_2016.pdf

National Renewable Energy Laboratory:
1. *Considerations for Floating Wind Energy Development in the Gulf of Maine.*
   https://www.nrel.gov/docs/fy23osti/86550.pdf
2. *Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology*
   https://www.nrel.gov/docs/fy20osti/75618.pdf

New England Fishermen's Stewardship Association:
1. *NEFSA OSW Report.*
   https://www.nefishermen.org/_files/ugd/c2fa45_db7a181604024936b677f74a86f437d1.pdf

NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy:
1. *Commercial Fishing as an Occupational Determinant of Opioid Overdoses and Deaths of Despair in Two Massachusetts Fishing Ports, 2000–2014.*
   https://journals.sagepub.com/doi/abs/10.1177/10482911211023476?casa_token=LogxCkrsK0gAAAAA%3AvqFYA9KlSSmPnv4O8kWDe-BsJgv6iErg_Dmq774YoykVtlfkLVWcibI8-a3StrxiPhXU9TPkQZWF&journalCode=newa

NMFS:
1. *Atlantic Herring Fishery Management Plan.*
   https://d23h0vhsm26o6d.cloudfront.net/Herring-A8-FEIS.FINAL_191007_135918.pdf
2. *Descriptions of Selected Fishery Landings and Estimates of Vessel Revenue from Areas: A Planning-level Assessment.*
   https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/com/OCS-A_0562_com.html

NOAA:
1. *Creating Space for Community in Marine Conservation and Management: Mapping "Communities at Sea".*
   https://www.researchgate.net/publication/317508699_Creating_Space_for_Community_in_Marine_Conservation_and_Management
2. *Fisheries Economics of the United States Report.*
   https://www.fisheries.noaa.gov/resource/document/fisheries-economics-united-states-report
3. *Landing and Revenue Data for Wind Energy Lease Areas, 2008-2022.*
   https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development
4. *2024 State of the Ecosystem (Mid Atlantic).*
   https://s3.amazonaws.com/media.fisheries.noaa.gov/2024-05/SOE-MAFMC-508-2024.pdf
5. *Commercial Fishing Business Cost Survey.*
   https://www.fisheries.noaa.gov/new-england-mid-atlantic/commercial-fishing/commercial-fishing-business-cost-survey
6. *Social Indicators for Coastal Communities.*
   https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities

Northeast Center for Occupational Health and Safety:
1. *Lines of Support: Tackling Stress at Sea.*
   https://necenter.org/portfolio/fishing_mental_health/

NREL:
1. *Atlantic Offshore Wind Transmission Study.*
   https://www.nrel.gov/docs/fy24osti/88003.pdf
2. *Marine Resources Summary of Industry Engagement and Siting Information for Proposed Offshore wind Research Array.*
   https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/DMR%20Siting%20Information%20for%20Proposed%20OSW%20Research%20Array_0709021FINAL_0.pdf
3. *Slow Adaptation in the Face of Rapid Warming Leads to Collapse of Gulf of Maine Cod Fishery.*
   https://www.researchgate.net/publication/283447602_Slow_adaptation_in_the_face_of_rapid_warming_leads_to_collapse_of_the_Gulf_of_Maine_cod_fishery

Safety and Health at Work:
1. *Musculoskeletal Disorders in Northeast Lobstermen.*
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5605894/

SEA Maine:
1. *SEA Maine Roadmap for the Marine Living Seafood Economy.*
   https://www.seamaine.org/wp-content/uploads/2024/02/SEA-Maine-Roadmap-full-version.pdf
2. *Maine-Seafood-Market-Report.*
   https://www.seamaine.org/wp-content/uploads/2023/11/SeaMaine-Seafood-Market-Report.pdf
3. *Global Opportunities Assessment.*
   https://www.seamaine.org/reports-presentations/

4. *Current State of Knowledge in Maine's Wild Catch Fisheries and Seafood Workforce.*
    https://www.seamaine.org/wp-content/uploads/2022/04/FINAL-workforce-phase-1-report.pdf
5. *Maine's Seafood Baseline.*
    https://www.datadashboard.seamaine.org/wp-content/uploads/2022/10/Foundational-Data-Report.pdf
6. *RECRUITMENT, TALENT ATTRACTION, & RETENTION: EXAMINING CAREERS IN MAINE'S SEAFOOD ECONOMY.*
    https://www.seamaine.org/wp-content/uploads/2023/06/FINAL-SEAMaine-Toolbox-1_5.31.23.pdf
7. *EDUCATION AND TRAINING: LEARNING SKILLS FOR MAINE'S SEAFOOD ECONOMY.*
    https://www.seamaine.org/wp-content/uploads/2023/06/FINAL-SEAMaine-Toolbox-2_5.31.23.pdf
8. *BEST PRACTICES: SHARING STATEWIDE & NATIONAL KNOWLEDGE.*
    https://www.seamaine.org/wp-content/uploads/2023/06/FINAL-SEAMaine-Toolbox-3_5.31.23.pdf

State of Maine:
1. *Emerging Issues - CIRCA 2010.*
    https://www.gulfofmaine.org/2/wp-content/uploads/2014/03/emerging-issues.pdf
2. *Maine Climate Action Plan.*
    https://www.maine.gov/climateplan/sites/maine.gov.climateplan/files/inline-files/MaineWontWait_December2020_printable_12.1.20.pdf

Tidal Bay Consulting:
1. *Working Waterfront Inventory Template.*
    https://www.mainecoastfishermen.org/_files/ugd/24e976_683a8bb2f87a4dc385d401b91365be84.pdf

University of Maine:
1. *MR446: Profiles of Sixteen Eastern Maine Fishing Communities: Advancing Research for Coexistence with Maine's lobster industry and offshore wind.*
    https://core.ac.uk/download/pdf/217131924.pdf

Appendix C: Reports Reviewed - Best Practices Research

1. Bureau of Ocean Energy Management. 2021. *Information Needs to Assess Fisheries Socioeconomic Impacts from Offshore Wind Energy Projects in the U.S. Greater Atlantic Region.* https://media.fisheries.noaa.gov/2022-02/Socioeconomic-InfoNeeds-OSW-GARFO.pdf

2. Bureau of Ocean Energy Management, U.S Department of the Interior. 2017. *SocioEconomic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic. Volume I—Report Narrative.* https://espis.boem.gov/final%20reports/5580.pdf

3. Chaji, M. & Werner, S. Marine and Coastal Fisheries. 2023. *Economic Impacts of Offshore Wind Farms on Fishing Industries: Perspectives, Methods, and Knowledge Gaps.* https://doi.org/10.1002/mcf2.10237

4. Cheng, J. & Chen, Z. Transport Reviews. 2021. *Socioeconomic impact assessments of high-Speed rail: A meta-Analysis.* https://doi.org/10.1080/01441647.2021.1979689

5. City of South Portland. 2020. *Portland Harbor Economic Assessment and Data Collection.* https://content.civicplus.com/api/assets/68be4cec-ef0d-4137-abcf-5e12366b8fbc?cache=1800

6. Crandall, Mindy S., James L. Anderson, and Jonathan Rubin. Maine Policy Review. 2017. *Impacts of Recent Mill Closures and Potential Biofuels Development on Maine's Forest Products Products Industry.* https://doi.org/10.53558/JONV9555

7. Hsiao, Y.-J. Fishes. 2022. *The Socioeconomic Impact of Coastal Environment Changes on Fishing Communities and Adaptation Strategies.* https://www.mdpi.com/2410-3888/7/5/243

8. Island Institute. 2021. *The Critical Nature of Maine's Working Waterfronts and Access to the Shore.* https://www.islandinstitute.org/wp-content/uploads/2021/11/WWF-Report_web.pdf

9. Island Institute. 2020. *The Last 20 Miles: Mapping Maine's Working Waterfront.* https://www.islandinstitute.org/wp-content/uploads/2020/09/TheLast20Miles_web.pdf

10. Maine Governor's Energy Office. 2022. *Socioeconomic Analysis of Offshore Wind in the Gulf of Maine.* https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/Maine%20OSW%20DNV%20Socioeconomic%20Analysis%20of%20Offshore%20Wind%20in%20the%20Gulf%20of%20Maine%20Final%20Report.pdf

11. Methratta, E.T., Silva, A., Lipsky, A., Ford, K., Christel, D. and Pfeiffer, L. Marine and Coastal Fisheries. 2023. *Science Priorities for Offshore Wind and Fisheries Research in the Northeast U.S. Continental Shelf Ecosystem: Perspectives from Scientists at the National Marine Fisheries Service.* https://doi.org/10.1002/mcf2.10242

12. National Federation of Fishermen's Organisations, Scottish Fishermen's Federation. 2022. *Spatial Squeeze in Fisheries*.
https://www.nffo.org.uk/wp-content/uploads/2022/06/R3900_SpatialSqueeze_Final_23Jun2022-part-1.pdf

13. National Marine Fisheries Service. 2023. *Fisheries Economics of the United States, 2020*.
https://media.fisheries.noaa.gov/2023-02/FEUS-2020-final-03.pdf

14. National Marine Fisheries Service. 2009. *The NMFS Commercial Fishing & Seafood Industry Input/Output Model (CFSI I/O Model)*.
https://www.st.nmfs.noaa.gov/documents/Commercial%20Fishing%20IO%20Model.pdf

15. National Oceanic and Atmospheric Administration. 2024. *Socioeconomic Impacts of Atlantic Offshore Wind Development*.
https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development

16. National Oceanic and Atmospheric Administration. 2023. *Fisheries and Offshore Wind Interactions: Synthesis of Science*. https://repository.library.noaa.gov/view/noaa/49151

17. National Oceanic and Atmospheric Administration. 2018. *Applying National Community Social Vulnerability Indicators to Fishing Communities in the Pacific Island Region*.
https://repository.library.noaa.gov/view/noaa/17121

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Appendix D: List of Indicators

The table below presents a comprehensive list of qualitative and quantitative indicators designed to forecast the positive or negative impacts of offshore wind (OSW)-related construction and operation on fishing communities in Maine. Each indicator is assigned a priority level based on best-practice research and stakeholder interviews. Indicators, which are commonly used in impact assessments and are critical and essential for measuring socioeconomic effects are marked as "required." Those identified through stakeholder engagement as desirable by Maine fishing communities and potentially beneficial for guiding decision-making are marked as "recommended."

Indicator	Priority	Data Type
Economic Indicators		
Change in the direct economic output of the fishing industry	Required	Quantitative
Change in the indirect economic output of the fishing industry	Required	Quantitative
Change in the induced economic output of the fishing industry	Required	Quantitative
Change in the direct value added to the fishing industry	Required	Quantitative
Change in the indirect value added to the fishing industry	Required	Quantitative
Change in the induced value added to the fishing industry	Required	Quantitative
Change in direct income/compensation for fishing industry workers	Required	Quantitative
Change in indirect income/compensation for fishing industry workers	Required	Quantitative
Change in induced income/compensation for fishing industry workers	Required	Quantitative
Economic opportunity for disadvantaged fishing businesses (contractual value)	Recommended	Quantitative
Increase or decrease in fishing demand	Recommended	Qualitative
Impact on poverty levels of the fishing population	Recommended	Qualitative
Impact on residential gentrification affecting fishing population	Recommended	Qualitative
Impact on commercial gentrification affecting fishing businesses	Recommended	Qualitative
Impact on cost of living	Recommended	Quantitative
Impact on existing real estate pressure, including home sales	Recommended	Quantitative
Impact on energy burden of the fishing population	Recommended	Qualitative
Workforce Indicators		
Change in number of direct fishing jobs (part-time/full-time)	Required	Quantitative
Change in number of indirect fishing jobs (part-time/full-time)	Required	Quantitative
Change in number of induced fishing jobs (part-time/full-time)	Required	Quantitative
Change in number of jobs at disadvantaged fishing businesses	Recommended	Qualitative
Educational requirement for new jobs	Required	Quantitative
Occupational breakdown of new jobs	Required	Quantitative
Skill requirements for new jobs	Required	Qualitative
Opportunities for skill building in small businesses	Recommended	Qualitative
Opportunities for career development	Recommended	Qualitative
Changes in perceived difficulty of hiring	Recommended	Qualitative

Changes in the availability of training opportunities	Recommended	Qualitative
Industry and Supply Chain Indicators		
Impact on landings (by weight)	Required	Quantitative
Impact on landings (by value)	Required	Quantitative
Impact on landings (by species)	Required	Quantitative
Impact on harvest (by weight)	Required	Quantitative
Impact on harvest (by value)	Required	Quantitative
Impact on harvest (by species)	Required	Quantitative
Impact on fishing operations by permit type	Recommended	Qualitative
Impact on fishing operations by gear type	Recommended	Qualitative
Impact on number of dealers and first receivers	Recommended	Quantitative
Impact on the number of commercial fishing trips	Recommended	Quantitative
Impact on the number of recreational fishing trips	Recommended	Quantitative
Opportunity for diversification of the fishing industry	Recommended	Qualitative
Opportunity for fishing-related small business participation in offshore wind construction and operations	Recommended	Qualitative
Job opportunities for environmental justice communities to be employed in the supply chain	Recommended	Quantitative
Impact on waterfront public access	Recommended	Qualitative
Impact on access to shoreside facilities and fishing infrastructure	Recommended	Qualitative
Impact on all-tide water access	Recommended	Qualitative
Impact on safety of fishing workers	Recommended	Qualitative
Impact on safety of fishing equipment and vessels	Recommended	Qualitative
Impact of reliance of waterfront communities on commercial fishing	Recommended	Qualitative
Fiscal Impact Indicators		
Increase or decrease in fishing-related property tax	Required	Quantitative
Increase or decrease in fishing-related sales tax	Required	Quantitative
Increase or decrease in fishing-related income tax	Required	Quantitative
Impacts on the above tax types at they federal, state, county, and local levels	Required	Quantitative
Opportunities for infrastructural development based on the increase in tax generation	Recommended	Qualitative
Health Indicators		
Physical health impact	Recommended	Qualitative
Mental health impact	Recommended	Qualitative
Impact on stress, anxiety, and depression because of industry disruptions	Recommended	Qualitative

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