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A synthesis of socioeconomic and sociocultural indicators for assessing the impacts of offshore renewable energy on fishery participants and fishing communities

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Introduction

- Offshore renewable energy, particularly wind energy, is rapidly expanding globally.
- The addition of these structures may impact fish production and preclude fishers from historical fishing grounds.
- It is important to understand the socioeconomic and sociocultural impacts of offshore wind development to:
  - identify appropriate mitigation strategies, and
  - develop data collection, monitoring, and adaptive management strategies
- This review synthesizes the quantitative and qualitative indicators that have been used to identify the impacts of offshore wind to fisheries.
- This review can serve as a guide to those designing monitoring plans and community benefit agreements between wind energy lessees and the affected fishing community.

Methods

Offshore wind is a relatively new renewable energy solution, with limited studies on its effect. Therefore, our systematic review included peer-reviewed and gray literature on three primary causes for fisheries displacement:

- vessel preclusion from marine renewable energy sites,
- marine spatial closures, and
- shifts in fishery operations due to climate change

We analyzed 67 studies were analyzed and identified 49 indicators, organized into **9 categories.**

Results

Changes in catch and revenue

- Total catch
- % of region-wide landings from closed area
- Total revenue (ex-vessel value)
- % of region-wide revenue from closed area
- Catch quality
- Catch composition
- Catch per unit effort
- Value per unit effort
- Value per unit effort

Competition and safety concerns

- Competition (vessel density / crowding)
- Collision and capsizing risk
- Trips during dangerous conditions

Livelihood and economic well-being effects

- Fisher's income
- Entrance and exit (# of fishers or vessels)
- Access and ability to switch to alternative economic opportunities
- Economic well-being

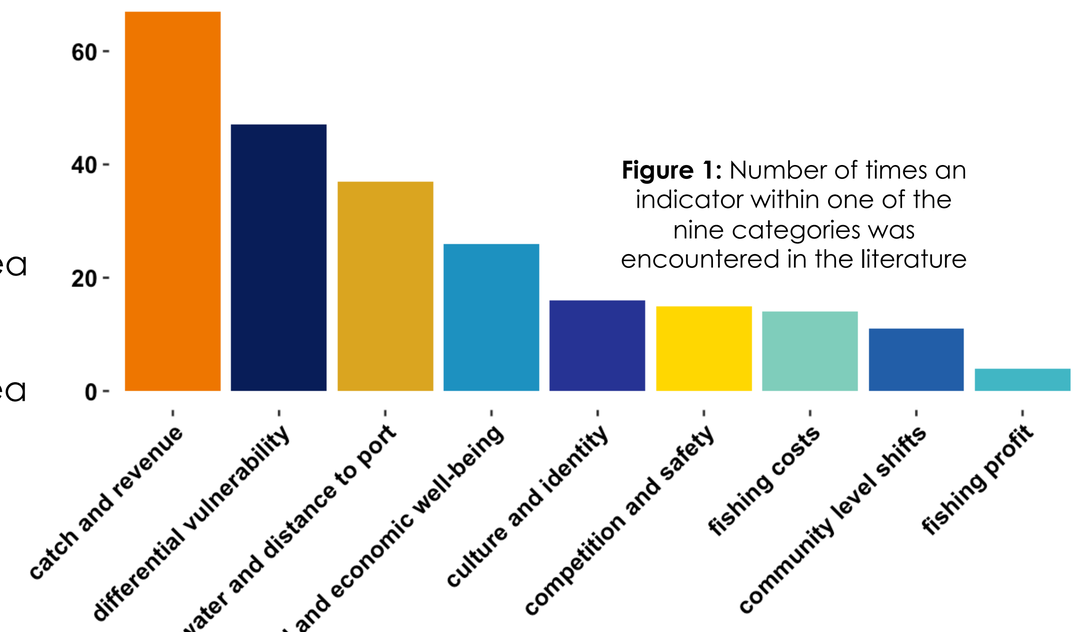


Figure 1: Number of times an indicator within one of the nine categories was encountered in the literature

Shifts in fishing costs

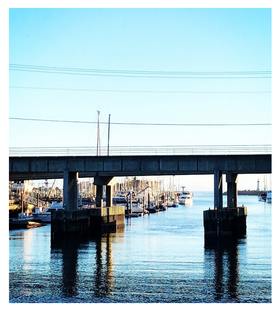
- Fixed costs (insurance, moorage/slip costs)
- Capital expenses (new license, new gear)
- Variable costs (fuel, maintenance)
- Average fleet cost ($\frac{total\ cost}{catch}$)

Community level impacts

- Total income generated in the local county economy from fishing
- Fishing community infrastructure
- Tourism
- Food security / availability

Changes in time spent on the water and in distance to port

- Time at sea
- Steaming time/ distance traveled
- Fishing effort
- % of effort inside closed area
- Number of fishing trips
- Primary landing port



Shifts in fishery profit

- Profit
- Gross value added $(revenue - fuel\ cost)$
- Resource rent $(revenue - cost - subsidies)$

Cultural and identity consequences

- Place-based identity
- Job satisfaction
- Traditional knowledge / cultural heritage
- Mental health

Indicators to assess fishers' differential vulnerability

Vessel attributes:

- Gear type / target species
- Vessel specifications (e.g., length)
- Number of target species / permits associated with vessel
- Vessel home port

Fisher attributes:

- Dependence on fishing
- Number of dependents supported by fishing
- Wealth reserves
- Underrepresented groups
- Years spent fishing / fishers' age
- Previous employment other than fishing
- Ability to fish out of other ports / boats
- Member of fisher association / network

Summary

- The most common indicators were direct economic impacts measured empirically pre- and post-closure.
- Qualitative methods (e.g., surveys, interviews) were often used to deepen understanding of economic impacts, to provide context for unexpected results, and to expand the scope of the analysis to include changes in social and cultural indicators.
- For most studies, only potential impacts were examined and often reported negative impacts of offshore wind. However, studies measuring indicator values pre- and post-closure often reported neutral to positive effects.

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