



Analysis

Bird Killer, Industrial Intruder or Clean Energy? Perceiving Risks to Ecosystem Services Due to an Offshore Wind Farm



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ABSTRACT

Proposals to develop renewable energy technologies may threaten local values, which can generate opposition. Efforts to explain this opposition have focused on perceived negative aesthetic and environmental impact. Less attention has been paid to a fuller suite of the perceived risks and benefits associated with new energy technologies. This paper thus investigates impacts of an offshore wind farm pertaining to individual perceptions and judgments, and why risks to some ecosystem services might be cause for greater public concern than others. We find that this difference can be attributed to the affective and intuitive ways in which people perceive risk. Our mixed-methods design used interviews ($n = 27$) that involved risk-benefit weighting tasks and an animated visualization to help people imagine an offshore wind farm in a familiar place. We found that affectively-loaded impacts (harm to charismatic wildlife and visual intrusion) were assigned greater weight than more easily quantifiable impacts (displacement of fishing, impact to tourism, cost of compliance with regulations). Interviewees identified increased regional energy self-sufficiency as the most valued potential benefit of an offshore wind farm. These results have implications for ecosystem service assessments generally and, more specifically, for our understanding of 'affective' dimensions of development proposals.

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1. Introduction

A central strategy for climate change mitigation entails the replacement of existing sources of energy with low carbon renewable energy (Hoffert, 2002; IPCC, 2011). The speed and scale at which renewables are deployed and fossil fuels phased out will have significant consequences on the world's climate trajectory (Moss et al., 2010; Nordhaus, 2013). Local opposition to renewable energy development is a major challenge to transitioning to low carbon technologies since it can shape if and how energy infrastructure is built (Ansolabehere and Konisky, 2014; Devine-Wright, 2005; Roberts et al., 2013). Such opposition to renewable energy innovations can be a function of numerous socio-political, community and market factors (Wüstenhagen et al., 2007), including but not limited to actual and perceived economic costs, inequitable distribution of costs and benefits, unfair siting processes and unacceptable risks associated with the development, such as the risk of environmental impacts (Bell et al., 2005; Devine-Wright, 2005; Roberts et al., 2013; van der Horst, 2007; Wolsink, 2000).

We focus here on how individuals perceive risk, which is one of many facets of acceptance and rejection of new technologies and proposed developments. Risk research is central here, as it has identified predictable logics underpinning the perceived risk of new technologies (Slovic, 1999, 2000). In particular, this literature has documented the role of what is known as dual processing theories of cognition: how people integrate affective ("risk as feelings") and deliberative ("risk as analysis") cognition when forming risk judgments (Finucane et al., 2000; Loewenstein et al., 2001; Slovic, 2010; Slovic and Peters, 2006).

Qualitative understandings—meanings—influence people's perceptions of risk, in addition to, and perhaps even more than, quantitative information (Slovic, 2010). In this sense, studies of risk perceptions have demonstrated how perceived risk is both predictable and quantifiable based on a limited set of often intuitive and affective factors, including the extent to which a risk is understood, who is exposed, and whether or not the object in question invokes dread, which can be defined as extreme fear or anxiety regarding future events (Slovic, 1987) (for a full list of factors, see Table 1). This research, typically conducted with expressed preference surveys, has sought to explain why and how people evaluate a hazard according to various psychometric rating scales (e.g., severity of consequences, novelty). Risk research has evolved to focus more on affective responses (Loewenstein et al., 2001; Slovic, 2010; Slovic and Slovic, 2010), but we use the psychometric risk

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Table 1

Common concerns associated with offshore wind farms. They were derived from literature and early tests of the interview protocol. Interviewees allocated 20 tokens representing relative level of concern across these topics. The ecosystem service concerns are the dependent variables in the proceeding analysis.

Ecosystem service concerns Potential consequences of risk from wind farms to ES provision	Human safety & economic concerns Potential costs and hazards associated with a wind farm
Negative impact on birds	Navigational safety issue
Negative impact on marine mammals	Cost of construction
Displacement of commercial fishing	Cost of compliance with regulations
Negative impact on tourism	Cost of maintenance
Displacement of recreational fishing	Increased cost of electricity
Displacement of recreational boating	Decreased property values
Negative visual impact	Insufficient local benefit
Negative impact on other species (specify)	Other (specify)

paradigm because it helps explain why people have affective responses to particular risks. The psychometric risk paradigm theorizes that perceived risk is both predictable and quantifiable based on the extent to which the risk is known to science and dreaded/affectively loaded (Slovic, 2000).

Risk perception studies have also generally focused on risks of direct harm to personal health with less attention paid to environmental risks. We see an opportunity to integrate ecosystem services approaches into the risk literature. Scientists and practitioners have used the ecosystem services (ES) framework to identify, quantify and often estimate a monetary value for the human consequences of environmental impacts. However, ES as a field has focused primarily on impacts *as quantified biophysically and often translated into monetary terms* to highlight benefits from nature that could be lost depending on development choices (Daily, 1997; Kareiva et al., 2011; Nelson et al., 2009) (e.g., a specified tract of forest in a watershed provides x amount of clean water worth $\$y$). There has been little attention within ecosystem services research to understanding how some services and benefits at risk from infrastructure development might be cause for greater public concern than others based on the affective and intuitive ways by which people perceive risk.

Thus far, risk perception theory has been tested primarily in the context of direct risks to human health and safety, rather than risks to one's broader sense of well-being as experienced via loss or degradation of ES. This paper addresses the broad question: do the same logics by which some personal risks loom larger than others also apply to the context of perceiving risks to ES?

Our research applies risk theory and methods in a new context: perceptions of the risks posed by the development of an offshore wind farm as mediated by the environment. That is, people remain those judging the risks, but instead of evaluating risk to human health or even environmental health (e.g., air quality), we instead attempt to measure the relative level of concern associated with risk to various ESs.

For instance, we assess the relative magnitude of concern associated with the risk that an offshore wind farm would pose to birds, which tends to be a prominent concern based on public surveys (Firestone et al., 2009; Warren et al., 2005), as compared to other ecosystem services (ES). We hypothesize that the relative weighting of various risks to ES follows the logic of the psychometric theories of risk, which posits that the relative weight of risks will follow the degree to which an impact is affectively loaded and/or dreaded and unknown to science (Slovic, 2000).

Results from early studies based on the psychometric paradigm are now interpreted as derivative of the affect heuristic (Slovic et al., 2007). The affect heuristic explains how feelings or emotions often precede and drive judgments of risk and benefit. Instead of judging potential outcomes impartially, people tend to judge risks based on immediate emotional reactions. Non-experts generally perceive an inverse relationship between risk and benefit; high-

risk activities or technologies are associated with low benefits and vice versa. If people like or, in other words, attach positive affect to an activity or technology, they tend to see associated risks as low and benefits as high. If they dislike it, they will associate it with high risk and low benefits (Finucane et al., 2000). Feelings of dread are now seen as predictors of a high level of perceived risk because dread is an affectively loaded quality.

Such affective aspects of risk perception are likely key for understanding why some proposed energy projects elicit highly charged resistance. Understanding these risk perceptions and what drives them is particularly important because renewable energy infrastructure and risks associated with them are likely to be increasingly salient to people as such technologies become more widely known and prominent in inhabited landscapes. We note a broad literature on affective dimensions of renewable energy proposals, for example as it relates to cultural ecosystem services (Gee and Burkhard, 2010), visual impacts (Bishop and Miller, 2007; Ladenburg, 2009), and disruption to place attachment based on symbolic qualities associated with a proposed project and impacted places (Devine-Wright and Howes, 2010; Firestone et al., 2015). These studies, however, did not explicitly test or apply risk perception theory.

In this article, we thus test theories of risk as applicable to the changes in ES potentially introduced by an offshore wind farm. Our investigation focuses on ES concerns associated with both tangible (e.g., commercial fisheries) and intangible services (e.g., aesthetic value as assessed by perception of visual impact). Our illustrative case study provides a proof of concept for integrating risk perception and ES literatures. We seek to advance the integration of risk perception theory and method into ES assessment and research agendas and inform mitigation strategies for local environmental and social impacts of renewable energy. Another aim is to contribute to understanding a building block of public support or rejection of renewable energy infrastructure, specifically how individuals perceive risk in this context. In so doing, we address three research questions:

1. On a relative scale, what are study participants most concerned about when it comes to the development of an offshore wind farm?
2. Do psychometric risk dimensions and the associated affect heuristic predict how study participants weight potential consequences of the risk from wind farms to the provision of ES?
3. On a relative scale, what do study participants perceive as important benefits associated with an offshore wind farm?

2. Methods

We used semi-structured interviews to ask two overarching questions: what risks associated with a hypothetical offshore wind farm are most salient to people who live near potential wind farm sites? What benefits are most salient?

The hypothetical wind farm site has strong, consistent winds and shallow waters, but no wind farm proposal currently exists for the site. Consequently, participants' perceptions were not influenced by local campaigns for or against an offshore wind farm since such campaigns were nonexistent. The interviewer provided brief background materials using neutral language about energy, renewable energy, and offshore wind farms, followed by a visualization of an offshore wind farm in a location familiar to participants. Participants were asked about their perceived impacts to ES and opinions on offshore wind farms and then asked to assign weights to a variety of risks from the hypothetical wind farm development. The risk weighting scores from participants were then compared to (correlated with) a set of coded risk attributes based on how interviewees responded to open-ended questions. The topics of these coded risk attributes were derived from the psychometric risk paradigm. The following subsections explain the study context, sample, interviews, weighting of risk and risk factor calculation methods in more detail.

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