Resident Perceptions of Local Offshore Wind Energy Development: Modeling Efforts to Improve Participatory Processes

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Abstract

Federal agencies anticipate local opposition where wind energy projects are proposed. When opposition manifests as social action in later stages of project development, it can complicate projects. Therefore, it is important to understand what mediates local opposition and oppositional action so potential concerns can be addressed earlier. Results indicate that Carolina coast residents are supportive of local offshore wind energy development, despite little to no awareness of such developments and uncertainty about potential impacts. Awareness and certainty of impacts are the largest drivers of support level, followed by perceived impacts. Residents generally believe local offshore wind energy will improve local economies but damage the environment; however, perceived impacts vary by factor importance. About twice as many Carolina coast residents intend social action related to local offshore wind energy compared to those who have engaged in related past actions. Holding a strong position and engagement in past actions are the largest drivers of intended action. For those in strong opposition, increased place attachment increases the odds of intending action, suggesting place-protective action. These findings enhance understanding about relevant values and perceptions from a broader range of stakeholders, which decision-makers can use to improve public engagement and participatory processes.

Keywords: offshore wind energy; public opinion; protective action; support level; local opposition; coastal residents

1 Introduction

There is a support paradox in the public's position on wind energy. People theoretically support wind energy, but may still oppose specific projects (Bell et al., 2013; Jones and Eiser, 2009). One explanation for this paradox is the existence of two support position categories: 'qualified supporters' and 'unqualified opponents' (Bell et al., 2013). Qualified supporters support wind energy, but only under specific circumstances or with caveats, and their opinions are likely influenced by ideology or impressions (Clarke et al., 2016; Boudet et al., 2014; Bell et al., 2013). Plans for a local project may trigger opposition in 'qualified supporters' because of the specific conditions that influence their support. On the other hand, 'unqualified opponents' oppose local wind energy projects regardless of potential benefits or efforts to mitigate potential negative impacts (Bell et al., 2013).

Perceived procedural fairness and social trust are key to gaining local support or acceptance of wind energy projects (Firestone et al., 2020; Dwyer and Bidwell, 2019; Mills et al., 2019; Langer et al., 2018; Firestone et al., 2017; Firestone et al., 2012). In planning and environmental management contexts, government agencies and developers use public participatory processes to increase stakeholder support hoping to improve policy or project outcomes; however, the success of participatory processes heavily depends on understanding the power dynamics of a given context, participant values, the way participants construct knowledge, and the types of knowledge they consider valid (Reed et al., 2018). Effective stakeholder engagement in a natural resource management and land development context requires the correct identification of stakeholders, including their intention to influence outcomes and the identification and

comprehension of issues that are salient to them (Gillgren et al., 2019; Freeman and McVea, 2006; Buanes et al., 2004; Grimble and Wellard, 1997).

Stakeholder identification and engagement may be further complicated in a wind energy context because of uncertainties in local sentiment due to the support paradox. For this reason, despite participatory processes having become a routine part of government efforts to engage the public, they can be ineffectual at achieving genuine, collaborative planning (Gillgren et al., 2019; Innes and Booher, 2004). For example, Aitken et al. (2016) found that public engagement methods in the United Kingdom often focus on consultation and raising awareness as opposed to facilitating meaningful dialogue on fundamental questions about projects, impacts, and societal benefits. Typical top-down, participatory activities, such as hearings, public informational meetings, and public comment initiatives, limit the range of stakeholders included and the degree of their participation, whether intentionally or unintentionally (Flannery et al., 2018; Reed, 2008; Buanes et al., 2004; Innes and Booher, 2004). Potential stakeholders may also not take advantage of opportunities to participate for a variety of reasons, including a lack of availability during the workday, beliefs that their comments will not be taken seriously, or distrust in the facilitator (Gopnik, 2015; Innes and Booher, 2004; Davies, 2001).

Unsatisfied stakeholders can require more intense and complex planning or implementation processes (Cleland, 2004; Moote and McLaran, 1997; Wondolleck, 1988) because of the risk of place-protective action (Bell et al., 2013; Devine-Wright and Howes, 2010; Ellis et al., 2007; Stedman, 2002). Such actions occur on a continuum of personal investment and effort, from donating money or signing petitions to organizing protests or initiating legal action (Stedman,

2002; Wolsink, 2000; Oliver and Marwell, 1992; Bullard, 1990). When place-protective actions occur late in the planning process, collaborative conflict resolution is more difficult because many decisions have already been made and there is less room for negotiation. In the United States, the Cape Wind Project proposed in Massachusetts is a notable example of stakeholders mobilizing to oppose an offshore wind energy project. After over a decade of legal challenges and administrative issues, the Cape Wind Project eventually failed (Kimmell and Stalenhoef, 2011; Dinnell and Russ, 2007; Firestone and Kempton, 2007; Kempton et al., 2005; Kaplan, 2004).

The goal of the present research was to identify the characteristics of potential, action-oriented stakeholders regarding local offshore wind energy development, regardless of their position, through analyzing the importance of local contextual elements, including awareness, place attachment, proximity, and perception of impacts. Specifically, the two main objectives were to identify elements predictive of 1) support level and 2) the intention to take action to advance a position related to local offshore wind energy development. This research contributes to existing literature on social action related to wind energy by using statistical modeling to identify these elements.

The remainder of this paper is organized into six sections. Section 2 provides a conceptual framework developed to predict support level and intended action. Section 3 describes the household survey data collected to test this model. Section 4 provides a summary of the model inputs and presents results from the modeling analyses. Section 5 discusses the key theoretical and methodological contributions. Conclusions and policy implications are stated in Section 6. Finally, Section 7 discusses avenues for future research.

2 Conceptual Framework

A conceptual framework (Figure 1) was developed to understand 1) the elements that may be predictive of support level for local offshore wind energy development and 2) the elements most likely to influence residents' potential for intended action.

Support level is predicted by awareness of local offshore wind energy development, perceived impacts of local offshore wind energy development on quality of life, strength of place attachment, and distance of an individual's household to the shoreline. Intended action is then predicted by support level, strength of place attachment, engagement in past actions related to local wind energy issues, and distance from an individual's household to the shoreline. The rest of this section will discuss the relationships between these variables.

2.1 Support Level

The relationship between awareness, knowledge, and support level for utility development projects, such as energy production, is inconclusive. Americans appear to be unfamiliar with or misinformed about novel forms of energy production (Graham et al., 2015; Boudet et al., 2014), including wind energy (Klick and Smith, 2010), but the provision of information about local development may not necessarily lead to support (Bidwell, 2016; Esaiasson, 2014). As a result, the authors hypothesize a non-linear relationship between awareness and support level, where individuals with greater awareness of local offshore wind energy development are more likely to take a non-neutral position, and individuals with low to no awareness are more likely to remain neutral.

After individuals become aware of local wind energy development, they can then evaluate its potential impacts (Devine-Wright, 2009). Botetzagias et al. (2015) suggests this evaluation takes the form of a personal cost-benefit-risk calculation. Specific to energy sources, public attitudes are also shaped by perceived environmental harm and economic benefits (Jessup, 2010; Ansolabehere and Konisky, 2009). The conceptual framework predicts a positive relationship between potential impacts to important quality of life factors and support level, where perceived positive impacts will likely increase support and perceived negative impacts will likely increase opposition. Further, the authors predict that the effects of perceived impacts on support level will be greater for individuals with greater awareness of local development.

Place attachment manifests from the positive emotional bonds that exist between individuals and a physical location or environment (Williams and Vaske, 2003; Low and Altman, 1992). Multidimensional, interrelated aspects of the individual (e.g., personal and psychological), social (e.g., culture, economy, and politics), and physical place mediate the nature and strength of these bonds (Ardoin et al., 2012; Scannell and Gifford, 2010). Studies have found that place attachment influences support level, where those who are more place-attached are more likely to oppose proposed developments (Firestone et al., 2012; Ansolabehere and Konisky, 2009), especially when the existing landscape or seascape is viewed as more natural or pristine and less industrialized (Bates and Firestone, 2015; Devine-Wright and Howes, 2010). Bates and Firestone (2015) discovered a more nuanced relationship between place attachment and support level, where effects were moderated by residents' age and retirement. The present research predicts a negative relationship between place attachment and support level, where support level will likely decrease with increased place attachment. As with perceived impacts,

the model predicts that the effects of place attachment on support level will be greater for individuals with greater awareness of local development.

Finally, proximity to proposed wind energy developments is relevant to understanding community responses, particularly when combined with other context-specific elements that influence support or opposition, such as ecological worldviews, political ideologies, perceived costs and benefits of renewable energy, landscape values, and beliefs regarding land use (Avila, 2018; Clarke et al., 2016; Larson and Krannich, 2016; Botetzagias et al., 2015; Firestone et al., 2012). The literature on a direct relationship between proximity and support level is inconclusive and likely linked to other elements, such as exposure to existing wind power projects and perceptions of procedural fairness (Hoen et al., 2019; Knapp and Ladenburg, 2019). Some studies have found that individuals are more supportive the further they live from wind development (Vecchiato, 2014; Swofford and Slattery, 2010; Ladenburg and Dungaard, 2009), whereas others have found the opposite effect (Hevia-Koch et al. 2018; Meyerhoff, 2013; Warren et al., 2005) or that support level is influenced by whether the turbines will be onshore or offshore (Ladenburg 2020). Clarke et al. (2016) and Firestone et al. (2012) found evidence that both support and opposition increase with distance from development. Finally, Ladenburg (2008), Johansson and Laike (2007), Lamy et al. (2020), and Ek (2005) found no relationship between proximity and support level. While the literature is varied, the authors predict a positive relationship between household distance to the shoreline and support level, where individuals who live closer to the shoreline are more likely to be opposed than those who live further inland.

2.2 Intended Action

Not all people join environmental movements, engage in significant environmental behaviors, or practice civic engagement to influence environmental policy. In 2008, 34% of Americans reported some level of civic or political involvement, and only 13% reported being highly engaged (Smith et al., 2009). For interest-based social action, stakeholder groups who have taken past actions are more likely to intend action because they have already overcome the costs of participation and important networks have already been established (Rowley and Moldoveanue, 2003). Additionally, these individuals may possess qualities, such as altruism, a sense of obligation, empowerment, or activist identity (Schmitt et al., 2019; Steg et al., 2005; Polletta and Jasper, 2001; Stern et al., 1999), which may predispose them to engage in social actions. As a result, the authors predict a positive relationship between past actions and intended action, where individuals who have engaged in past actions are more likely to intend action. Further, the authors hypothesize that individuals who have engaged in past actions and have taken a position, either in support or opposition, are more likely to intend action than individuals who have engaged in past actions and are neutral.

Disruptions to place attachment have also been found to lead to oppositional action. Devine-Wright and Howes (2010) found that those with strong place attachment are more likely to engage in place-protective behaviors, and Stedman (2002) found that the likelihood to engage in place-protective action is positively correlated with strength of place identity and the perceived degree of threat to the valued place. The present authors predict a positive relationship between place attachment and intended action, where individuals with increased place attachment are more likely to intend action. As with past actions, the conceptual

framework further predicts that attached individuals who have taken a position are more likely to intend action than attached individuals who are neutral.

The literature on the relationship between attitudes and behaviors is mixed. Some studies suggest only a weak correlation between the two, observing that what people say and what people do are not always consistent (Deutscher, 1996; Wicker, 1969; LaPiere, 1934). Other studies, however, align with Ajzen's (1991) theory of planned behavior, in which personal beliefs largely guide intention and behavior (Armitage and Connor, 2001). Eagly and Chaiken (1993) suggest there is a strong relationship between attitudes and observable behaviors, particularly aggregated behaviors, where the strength of this relationship is moderated by multiple factors related to attitude and the target objects of the behaviors. Following this principle, supportive attitudes will tend to predict supportive behaviors, while negative attitudes will tend to predict oppositional behaviors, particularly when behaviors are not habitual. Specific to energy development efforts, these mixed theories can be explained, in part, by environmental context. Stern (2000) and Stern et al. (1999) suggest that attitudinal factors, such as values, beliefs, and norms, are predictive of most 'environmental citizenship' behaviors, such as signing a petition or participating in an environmental organization. As a result, the authors hypothesize a nonlinear relationship between support level and intended action, where individuals who have taken a position are more likely to intend action than those who are neutral.

Only one study (Johansson and Laike, 2007) was identified that assesses the relationship between resident action and proximity to wind energy development, and it found no relationship. It is likely, however, that related participatory efforts and activities, such as public

meetings or petition drives, may be more convenient or common in neighborhoods closer to proposed development areas, making intended participation easier for those residents. Therefore, the authors predict a negative relationship between household distance to the shoreline and intended action, where individuals who live closer to the shoreline are more likely to intend action than those who live further inland.

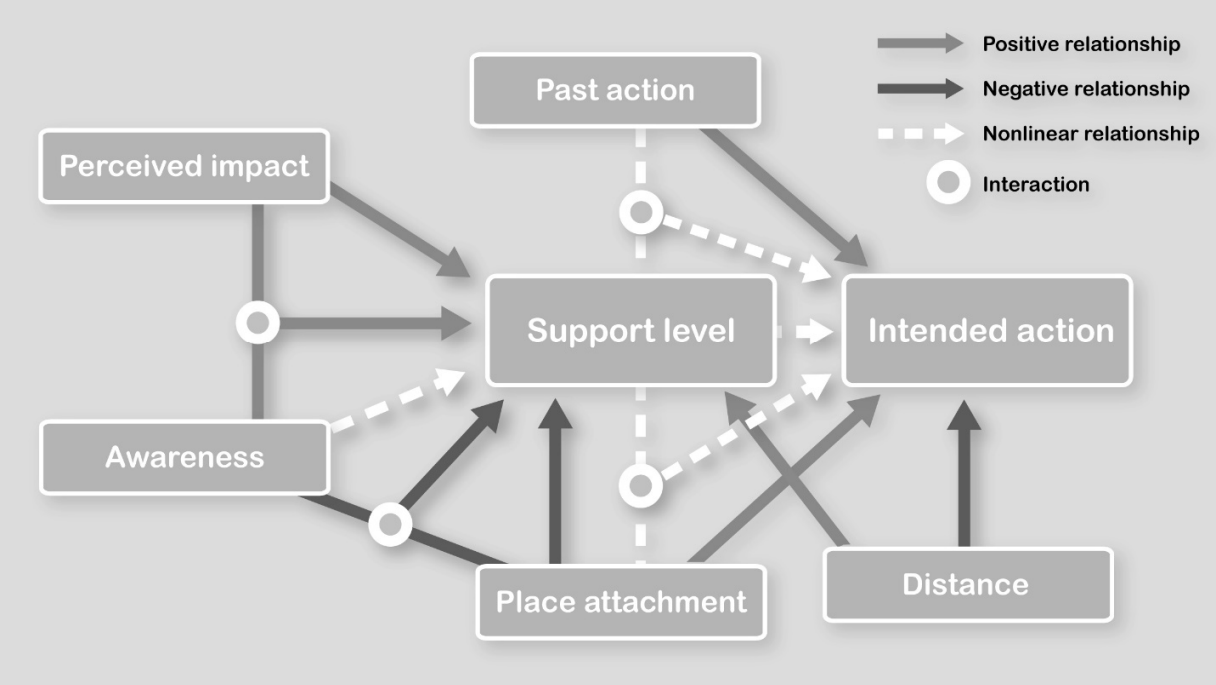

Figure 1: Conceptual framework for support level and intended action related to offshore wind energy development [1]

3 Methodology and Data

To test the conceptual framework, a random household survey of residents 18 years of age or older was conducted from January to May 2018 in a coastal region of North and South Carolina

[1] This graphic modified from a required deliverable under OCS Study BOEM 2019-054.

adjacent to proposed offshore wind energy development areas (Figure 2). The self-administered, mail-back survey measured awareness of local offshore wind energy development, support level, perceived impacts to important quality of life factors, place attachment, past actions and intended action, and demographic and household characteristics.

To ensure adequate spatial representation, a sampling geography that captured both rural and

urban populations was selected. This sampling geography was then stratified by state and three distance bands that align with Census block boundaries. The first band included households within two miles of the shoreline, the second band included households between two and five miles of the shoreline, and the third band included households between five and twenty miles from the shoreline. These distances were chosen to capture coastal residents, based on ease of access for frequent trips to the shoreline for beach-going and other ocean-related activities. Residents in band 3 have the least potential for daily aesthetic or other shoreline-proximate impacts from their residence and likely have varying strength or type of coastal connection, but residents in this group are still likely to have some connection to the ocean environment.

Figure 2: Sampling geography and coverage by Census block

There were 3,953 respondents for a response rate of 32.7% for the entire sampling geography. Figure 2 shows the geographic coverage of respondents by Census Block. On average, respondents live 4.48 miles (SE = 0.08) from the shoreline. While there appears to be gaps in coverage, these are mostly large tracts of preserved game land, marsh, or other non-housing types of development. Responses were weighted using iterative proportional fitting (raking) to mitigate non-response bias and to account for the complex sample design. The following control variables were used as weighting factors: sex, race (white, black), and age group (18-34, 35-44, 45-54, 55-64, 65-74, and 75+). Weights were simultaneously trimmed to be no less than 0.5 and no greater than five in order to reduce the mean squared error of key outcome estimates (Kolenikov, 2014). Respondent characteristics are provided in Table 1. Unless otherwise stated, all values are weighted.

Table 1: Respondent and population characteristics

Variables	Categories	Respondents	Population
Age	Under 35	21.7%	29.0%
	35-44	15.5%	16.0%
	45-54	16.4%	17.4%
	55-64	19.1%	18.3%
	65 and over	27.4%	19.3%
Sex	Male	47.2%	48.3%
	Female	52.8%	51.7%
Race	White	89.8%	83.0%

	Black	7.0%	11.9%
	Other	5.7%	5.1%
Ethnicity	Hispanic/Latino	1.9%	4.8%

Respondents were asked to indicate their level of awareness of and support for local offshore wind energy development efforts using five-point Likert scales. They were also asked if and how they have expressed support or opposition for the potential for offshore wind energy development in any city, county, or state where they have lived, and if they intended to take action related to offshore wind energy development in their current city, county, or state within the next 12 months. The following types of action were presented to respondents:

- Signed a petition
- Wrote, emailed, or called a public official
- Joined a citizen-based advocacy group because of their position
- Attended public meetings sponsored by a government agency
- Attended public meetings, gatherings, or demonstrations sponsored by an advocacy group
- Contributed money to an organization or campaign

Respondents were also asked to indicate the importance of a series of factors to their quality of life using a five-point Likert scale and whether they believed offshore wind energy would positively, negatively, or not impact each factor. Respondents were also given the option of indicating they were “unsure” of the potential impacts. Factors were chosen due to likely or

perceived impacts from offshore wind energy development given previous studies (Larson and Krannich, 2016; Firestone et al., 2012; Kimmell and Stalenhoef, 2011; Jessup, 2010; Firestone and Kempton, 2007) and local interests expressed by project partners. The following factors were presented to respondents (parentheticals show abbreviations used in analysis for shorthand reference):

- Tax revenues (tax)
- Job opportunities (job)
- Electricity affordability (elec)
- Community image (comm)
- Shipwrecks and other submerged maritime heritage sites (ship)
- Local property values (prop)
- Daytime ocean views (dview)
- Nighttime ocean views (nview)
- Recreational fishing (rec)
- Habitat for birds (bird)
- Habitat for fish (fish)
- Habitat for marine mammals and sea turtles (mamm)

Finally, respondents were asked to indicate their level of agreement or disagreement with eight statements (Table 2) intended to capture four dimensions of place attachment: biophysical, sociocultural, psychological, and political-economic (Ardoin et al., 2012). This interdisciplinary approach allows for a more "comprehensive understanding of the multifaceted relationship

between people and place (i.e. an understanding of the multiple dimensions of people's connections with their places)" and "may help in making management and policy decisions that more holistically and accurately consider human and biophysical possibilities and opportunities" (Ardoin et al., 2012, p. 600). Principle components analysis was conducted to identify components of place attachment.

Table 2: Dimensions of Place Attachment

Dimension	Survey Statement
Biophysical	I like the Carolina coast's mix of plants, animals, and landscapes.
	I think the natural parts of the Carolina coast are beautiful.
Political-economic	I think the economy is strong on the Carolina coast.
	The Carolina coast is the best place for what I like to do.
Psychological	The Carolina coast is a special place for me and/or my family.
	The Carolina coast says a lot about who I am.
Sociocultural	I feel a strong sense of community on the Carolina coast.
	I feel connected to the other people who live on the Carolina coast.

4 Results

This section first summarizes the relationships between variables, which were used to inform modelling efforts. Results from the subsequent support level and intended action models are then described.

4.1 Summary of Key Variables

As shown in Table 3, Carolina coast residents are generally supportive of local offshore wind energy development, despite little to no awareness of such development. Almost 16% (SE=0.01) of Carolina coast residents have engaged in past actions related to local offshore wind energy and roughly 30% intend action. The average number of past action types is 0.34 for all residents and 2.17 (SE=0.09) for residents who have engaged in past actions related to wind energy.

Table 3: Summary of Key Model Variables

Variable	Mean (SE)	Variable	Mean (SE)	Variable	Mean (SE)
Strongly oppose	0.11 (0.01)	**Not at all aware**	0.34 (0.01)	**Past wind action types**	0.34 (0.02)
Somewhat oppose	0.08 (0.01)	**Slightly aware**	0.23 (0.01)	**Future action**	0.30 (0.01)
Neutral	0.24 (0.01)	**Moderately aware**	0.23 (0.01)		
Somewhat support	0.28 (0.01)	**Very aware**	0.14 (0.01)		
Strongly support	0.29 (0.01)	**Extremely aware**	0.06 (0.01)		

Table 4 summarizes the proportion of Carolina coast residents who have engaged in each of the specified action types. Of those who have engaged in past actions, about half (mean=0.50, SE=0.03) have only engaged in one action type, less than 2% (mean=0.02, SE=0.01) have engaged in all the specified types, and almost two-thirds intend action (mean=0.65, SE=0.03). The most popular action type is signing a petition, and the least popular action type is contributing money to an organization or campaign.

Table 4: Past Wind Action Types

Action Type	**Mean (SE)**
Signed a petition	0.68 (0.08)
Wrote, emailed, or called a public official	0.43 (0.08)
Joined a citizen-based advocacy group because of their position	0.40 (0.09)
Attended public meetings sponsored by a government agency	0.35 (0.09)
Attended public meetings, gatherings, or demonstrations sponsored by an advocacy group	0.42 (0.09)
Contributed money to an organization or campaign	0.31 (0.08)

Other	0.50 (0.08)

Figure 3 summarizes responses to the quality of life factors in a four-quadrant presentation, where the x-axis measures the perceived impacts of local offshore wind energy development and the y-axis measures the importance to quality of life. Axes intersect at No Impact and the average importance score for all twelve factors. Therefore, factors on the left half of the figure are perceived to be negatively impacted, factors on the right half are perceived to be positively impacted, factors on the bottom half are relatively unimportant, and factors on the top half are relatively important.

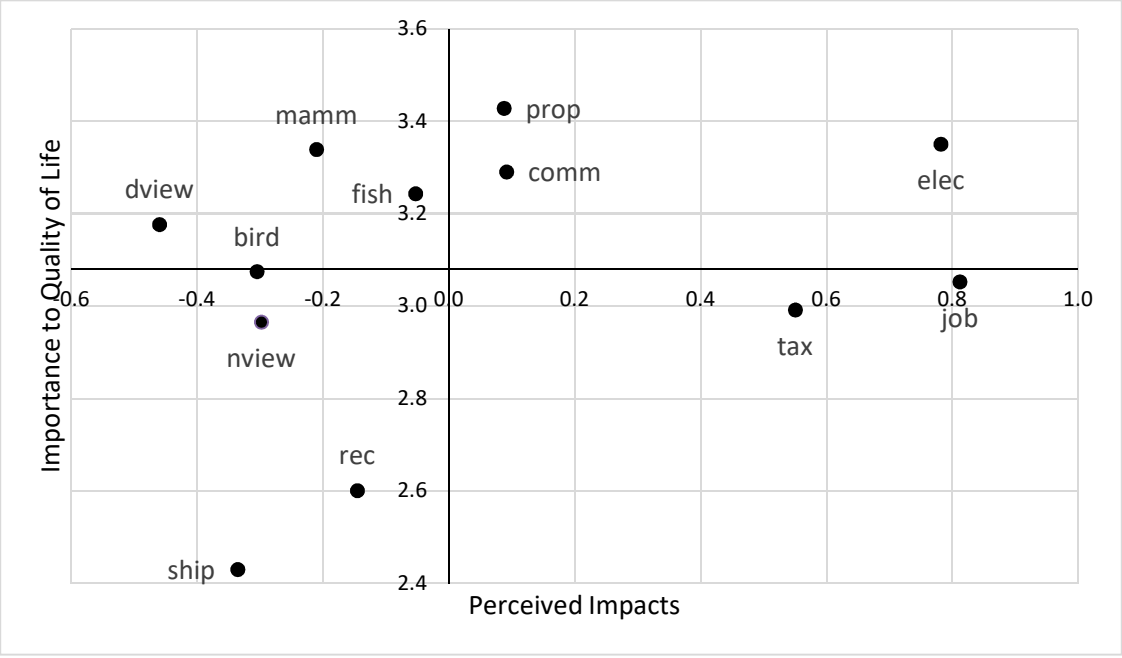

Figure 3: Importance of factors to residents' quality of life (y-axis) compared to residents' perceived impacts (x-axis) of local offshore wind energy development on those factors. Point

0.0 is indicative of no perceived impact and average importance to quality of life.[2]

In general, Carolina coast residents believe environmental factors will be negatively impacted and economic factors will be positively impacted. Local property values (prop) is most important to residents' quality of life, and least important is shipwrecks and other submerged maritime heritage sites (ship). The factor with the perceived greatest positive impact is job opportunities (job), and the factor with the perceived greatest negative impact is daytime ocean views (dview).

As shown in Table 5, several groups of factors are moderately to strongly correlated in their importance and/or perceived impacts. To determine if these correlations imply respondents may have rushed through the survey instead of distinguishing between factors, the number of unique response patterns was determined for the importance and impact questions. Only 3.7% (unweighted) of respondents selected the same non-missing importance level for each quality of life factor, and only 3.3% (unweighted) of respondents selected the same non-missing perceived impact. This suggests respondents did not rush through these questions and these correlations represent true correlations in importance and perceived impacts.

Table 5: Correlations between quality of life factor importance and impacts

Factors	Importance	Impact
Daytime ocean views (dview) and nighttime ocean views	r=0.81,	r=0.90, p<0.01

[2] This graphic was modified from a required deliverable under OCS Study BOEM 2019-054.

(nview)	p<0.01	
Habitat for birds (bird), habitat for fish (fish), and habitat for marine mammals and sea turtles (mamm)	0.77<t<0.85, p<0.01	0.72<t<0.81, p<0.01
Habitat for fish (fish) and recreational fishing (rec)	t=0.55, p<0.01	t=0.86, p<0.01
Electricity affordability (elec) and job opportunities (job)	--	t=0.60, p<0.01
Local property values (prop) and community image (comm)	--	t=0.58, p<0.01

One important caveat is that Carolina coast residents are moderately unsure of these perceived impacts. This uncertainty could be related to whether there will be an impact or the direction of the potential impact. As shown in Figure 4, the mean percentage of residents who are unsure ranges from about 19.4% to 40.5%. Response rates also tend to be lower for factors with less certainty, which suggests some respondents did not provide an answer if they were unsure. In general, residents seem more certain about impacts that could directly affect them, such as job opportunities and electricity affordability.

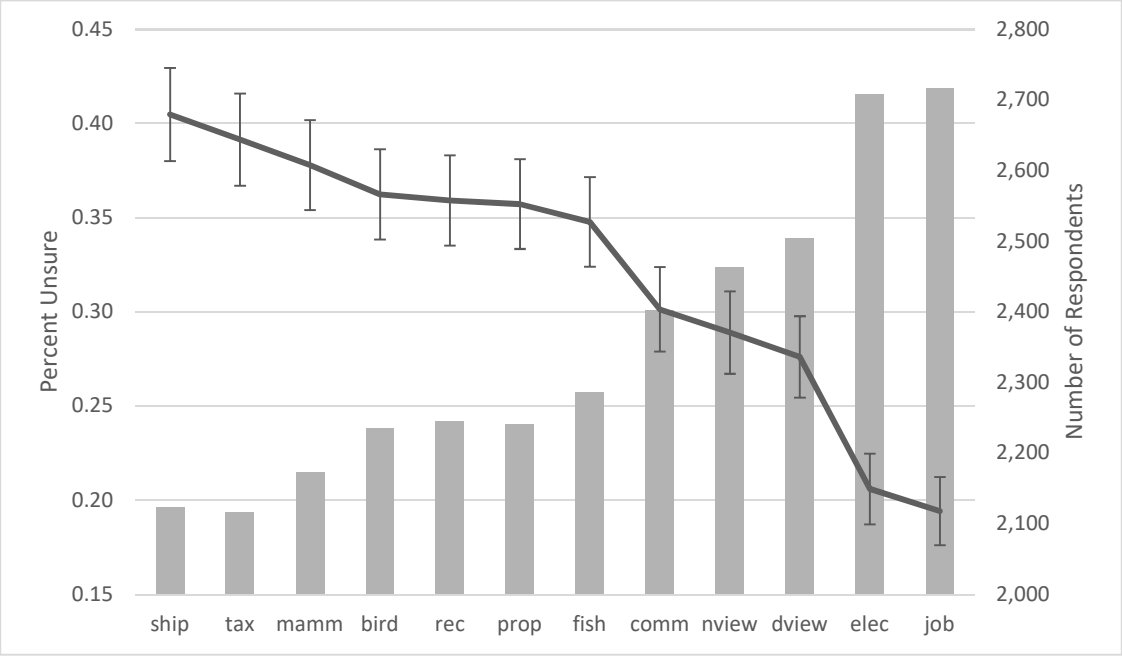

Figure 4: Percent of residents who were unsure of perceived impacts on factors and (unweighted) number of respondents for each factor.

Finally, two components of place attachment were identified using principal components analysis. The first component, Personal Connection (mean=0.00, SE=0.05), has positive associations with the biophysical and psychological dimensions, as well as the political-economic statement: "The Carolina coast is the best place for what I like to do." The second component, Social Connection (mean=0.00, SE=0.04), has positive associations with the sociocultural dimension, as well as the political-economic statement: "I think the economy is strong on the Carolina coast." The components are highly correlated ($r=0.74$, $p<0.01$), and

relatively large Chronbach's alpha values (Personal Connection: 0.88, Social Connection: 0.75) suggest reasonable internal consistency within the components.

4.2 Modeling Results

4.2.1 Support Level

Support level for local offshore wind energy development was analyzed using a generalized ordered logistic model. This model was chosen because support level is measured by ordered categories, as well as to relax the parallel lines assumption, which assumes that the coefficients in the model are the same across all response categories. By relaxing this assumption, a separate odds ratio (OR) is estimated for each variable and response category.

Results of the support level model are shown in Table 7. Due to high correlation between the two place attachment components and in an effort to simplify the model, only one place attachment component is included. The results presented below include the Personal Connection component, and results including the Social Connection are provided in Appendix A. Only the relatively important quality of life factors are included in the model (Table 6). As the importance of and perceived impacts to habitats for fish (fish) and marine mammals and sea turtles (mamm) are highly correlated, only habitat for marine mammals and sea turtles (mamm) is included as it is relatively more important. While the concept of certainty had not been considered during conceptual framing efforts, due to the low certainty of perceived impacts discovered during analysis, the proportion of factors for which a respondent did not select "unsure" (Certainty) is also included (mean = 0.68, SE = 0.01). Distance is measured as the shortest distance (miles) between an individual's household and the shoreline. Finally, the

square root of age (Sqrt(age)), sex (Female), and race (White) are included as demographic controls in the model.

Table 6: Summary of Extremely Important Quality of Life Factors

Quality of Life Factor	Mean	SE
Electricity affordability	0.51	0.01
Local property values	0.55	0.01
Community image	0.46	0.01
Daytime ocean views	0.47	0.01
Habitat for marine mammals and sea turtles	0.53	0.01

Multiple specifications of the model were tested (Appendix A). Since both awareness and factor importance are measured as 5-point Likert scales, a model incorporating them as separate binary variables for each level was tested, as well as a model treating them as continuous variables. The results of these initial models suggest that awareness and importance levels should not be treated as continuous variables, and that the end points of awareness are more relevant to support level than the intermediate levels. Therefore, two binary variables for awareness are included in the model to indicate if the respondent was not at all aware or extremely aware of local offshore wind energy development. Additionally, to simplify the model and to remain focused on relative importance, only one binary variable measuring whether each quality of life factor is extremely important or not is included. Summary statistics for these

quality of life factors are shown in Table 6. Linear and logarithmic distance were also tested and results were minimally different, so the linear form is used to simplify interpretation.

Whether or not the regression should be weighted was tested by adding the weight and the interaction of the weight with each independent variable to the model and testing if the coefficients of these additional covariates are jointly equal to zero (DuMouchel and Duncan, 1983). Given that this test is significant ($\chi^2 = 88.96, \quad = 0.09$), the unweighted estimators are probably biased by the sample selected and the weighted estimates are preferable.

Table 7: Support Level Model Results (Neutral Baseline)

	Strongly oppose			**Somewhat oppose**			**Somewhat support**			**Strongly support**		
	OR	**SE**	**SIG**	**OR**	**SE**	**SIG**	**OR**	**SE**	**SIG**	**OR**	**SE**	**SIG**
Not at all aware	5.38	4.61	**	6.16	2.77	***	2.74	0.76	***	2.99	0.80	***
Extremely aware	0.18	0.18	*	0.48	0.47		0.82	0.74		0.05	0.07	**
Certainty	0.10	0.04	***	0.26	0.07	***	0.57	0.13	**	0.13	0.04	***
x Not at all aware	0.23	0.26		0.19	0.11	**	0.48	0.19	*	0.83	0.37	
x Extremely aware	2.84	3.15		1.47	1.58		1.75	1.71		15.60	25.77	*
Attachment (personal)	0.88	0.05	**	0.88	0.04	**	0.93	0.03	*	0.94	0.03	
x Not at all aware	1.10	0.14		1.21	0.12	**	1.09	0.07		1.14	0.07	**
x Extremely	1.25	0.16	*	1.17	0.12		1.24	0.14	*	1.25	0.22	

aware												
Electricity affordability	1.29	0.23		1.44	0.23	**	1.22	0.16		0.90	0.14	
Local property values	1.00	0.20		1.18	0.19		0.88	0.12		0.87	0.14	
Community image	1.12	0.21		0.91	0.16		1.01	0.14		1.07	0.17	
Daytime ocean views	0.60	0.12	**	0.72	0.11	**	0.88	0.11		1.00	0.15	
Habitat for marine mammals and sea turtles	0.58	0.12	**	0.69	0.10	**	0.88	0.11		0.67	0.10	**
Distance to shore	1.06	0.02	***	1.04	0.02	**	1.02	0.01	*	1.01	0.02	
Sqrt(Age)	0.81	0.07	**	0.83	0.05	**	0.87	0.05	**	0.91	0.05	
Female	0.74	0.12	*	0.76	0.10	**	0.85	0.10		1.24	0.18	
White	1.51	0.57		1.35	0.42		1.16	0.27		1.17	0.29	
Constant	202.82	173.01	***	33.42	22.62	***	3.21	1.63	**	1.46	0.82	
Number of observations=3,163												
F=11.34, p=0.00												
P(correct)=0.38												
***99%, **95%, *90%												

Note: An ‘x’ preceding a variable indicates an interaction term.

Regression diagnostics suggest that the model is a good fit. The model accurately predicts support level 38.0% of the time, as compared to 20% accurately predicted at random, and the significant F-statistic suggests the fit of an intercept-only model is significantly reduced compared to the tested model.

The marginal effects at the mean (MEM) of each variable on support level is shown in Figure 5. Awareness and certainty have the greatest significant effects on support level. Being not at all aware increases the odds of holding a non-neutral position, whereas being extremely aware decreases the odds of holding a strong position. Increased certainty increases the odds of being neutral, but for those who are not at all aware, increased certainty decreases the odds of being either somewhat supportive or somewhat oppositional. Further, while place attachment slightly increases the odds of being either neutral or strongly supportive, for those who are not at all aware, increased place attachment increases the odds of being either somewhat opposed or strongly supportive. For those who are extremely aware, increased place attachment greatly increases the odds of being either somewhat opposed or strongly supportive. The quality of life factors have a moderate effect on support level. The odds of a Carolina coast resident being somewhat opposed are higher if they believe electricity affordability is extremely important. Their odds of being either neutral or supportive are higher if they believe daytime ocean views are extremely important, and their odds of being either neutral or somewhat supportive are also higher if they believe marine mammal and sea turtle habitats are extremely important. Believing either local property values or community image is extremely important has no

significant effect on support level. Finally, age, sex, and distance from the shore have minimal effects. Females have greater odds of being either neutral or supportive, older residents have greater odds of being either neutral or strongly supportive, and the odds of being either neutral or strongly supportive increases the closer to the shore a resident lives.

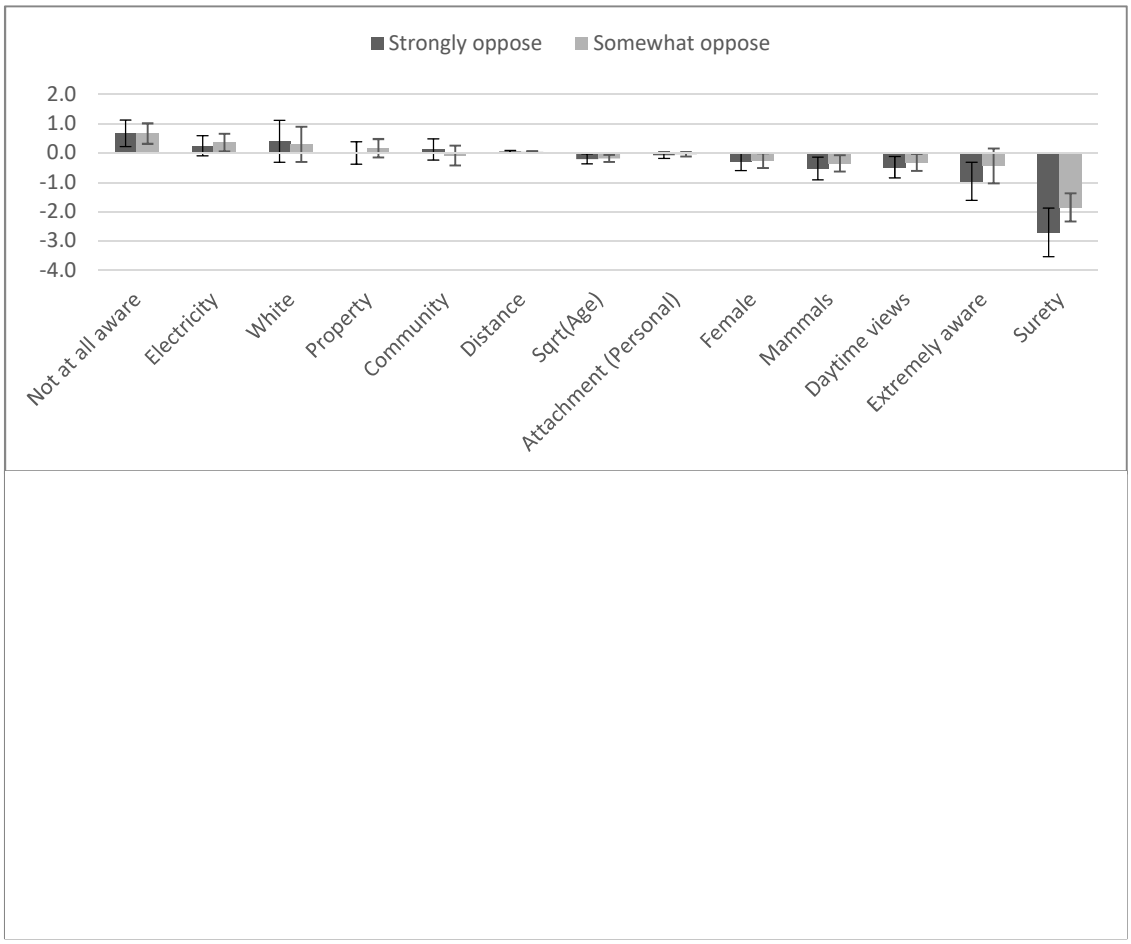

Figure 1: Marginal effects of inputs to support level

4.2.2 Intended Action

A logistic model was used to model intended action because it is a binary variable. The results of the intended action model are shown in Table 8.

Whether or not the regression should be weighted was also tested (DuMouchel and Duncan, 1983). Given that this test is insignificant ($\chi^2 = 191.76, \ = 0.41$), the weighted and unweighted estimates are not significantly different, and weighted estimates are provided for consistency.

Table 8: Intended Action Model Results (No Action Baseline)

	OR	SE	SIG
Strongly oppose	4.45	1.15	***
Somewhat oppose	2.44	0.67	***
Somewhat support	1.75	0.38	**
Strongly support	3.10	0.65	***
Attachment (personal)	1.10	0.12	
x Strongly oppose	1.40	0.24	**
x Somewhat oppose	1.32	0.29	
x Somewhat support	1.00	0.14	
x Strongly support	0.91	0.12	
Past wind action types	2.39	0.67	**
x Strongly oppose	1.08	0.43	
x Somewhat oppose	0.62	0.24	
x Somewhat support	1.03	0.36	

x Strongly support	0.89	0.29	
Distance to shore	0.97	0.02	*
Sqrt(Age)	0.91	0.05	*
Female	1.03	0.13	
White	1.05	0.34	
Constant	0.31	0.17	**

Number of observations=3,060

F=9.70, p=0.00

P(correct)=0.72

***99%, **95%, *90%

Note: An 'x' preceding a variable indicates an interaction term.

Regression diagnostics suggest this model is a good fit, as well. The model accurately predicts intended action 71.8% of the time, as compared to 50% accurately predicted at random, and the F-statistic is, again, significant. Further, the area under the ROC curve (AUC) suggests the model can correctly distinguish between intended action and no intended action 74.9% of the time.

The MEM of each variable on intended action is shown in Figure 6. Support level, specifically strong opposition or strong support, has the greatest significant effect on intended action, where the odds of intending action are greater for individuals who have taken a position as opposed to those who are neutral. The marginal effects of being strongly opposed or strongly

supportive on intended action are not significantly different from each other (F=2.37, p=0.12), and neither are the marginal effects of being somewhat supportive or somewhat oppositional (F=0.55, p=0.46). The relatively large effect of being strongly opposed is due, in part, to its interaction with place attachment; however, place attachment does not have a significant effect on intended action on its own or when interacted with other support levels. The number of types of past action related to wind energy has the next greatest significant effect on intended action, where the odds of intending action increase with the number of past action types. The effect of past actions related to wind energy, however, does not depend on support level. The marginal effect of past actions is not significantly different from the marginal effects of being somewhat opposed (F=0.00, p=0.95), somewhat supportive (F=0.96, p=0.33) or strongly supportive (F=0.69, p=0.41). Finally, distance and age both have minimal, but significant, impacts on intended action, but neither race nor sex has an effect.

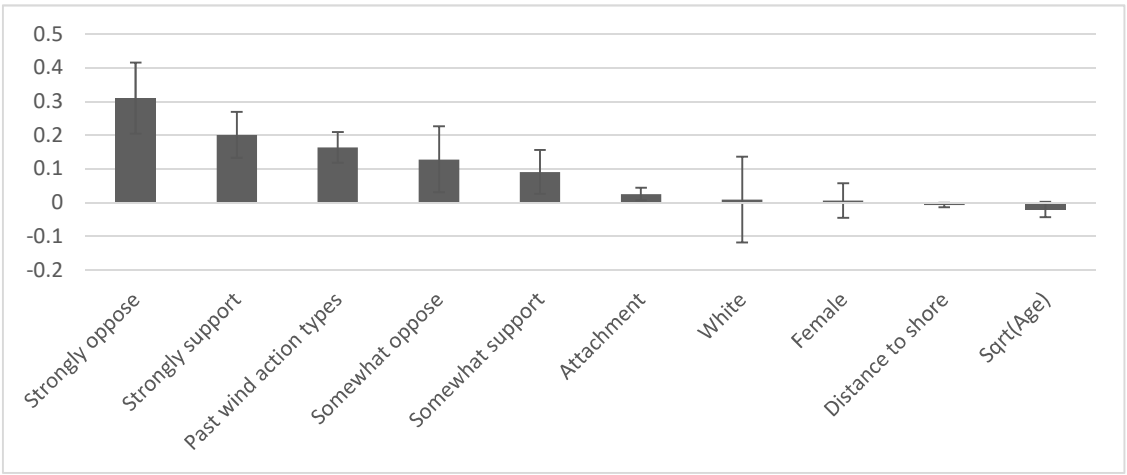

Figure 6: Marginal effects of inputs to intended action

5 Discussion

The goal of this research was to first identify drivers of support or opposition, followed by characteristics of potential, action-oriented stakeholders of local offshore wind energy development, regardless of their position. Overall, Carolina coast residents are supportive of local wind energy development, despite having little to no awareness of such developments and low certainty about potential impacts. The relationship dynamics between awareness and support level, however, are complex, and the influence of awareness and information availability on support level is often case-specific. For example, greater awareness has been found to increase support for invasive species management (Novoa et al., 2017) and wind energy development (Bidwell, 2016), and has motivated positive environmental behaviors (Eom et al., 2018). However, Cale and Kromer (2015) found no correlation between awareness and support for nuclear energy, and Esaiasson (2014) reported that the availability of information increased the likelihood of local opposition to the siting of cell phone towers and recycling complexes. On the Carolina coast, zero awareness increases the odds of holding a non-neutral position for local offshore wind energy development, but has a greater effect for those in either somewhat or strong opposition than for those in support. On the other hand, extreme

awareness increases the odds of being neutral, somewhat supportive, or somewhat oppositional. Given these results and the mixed findings from previous studies, examination of awareness interacted with impact certainty and place attachment in the present research provides more context.

Consistent with Edwards (2018) and Devine-Wright (2009), uncertainty does not simply equate to neutrality on the Carolina coast. Instead, while increased certainty increases the odds of neutrality, there is a moderating effect of awareness on certainty. Residents who are not at all aware of local offshore wind energy development efforts but are more certain of potential impacts have higher odds of either being neutral or holding a strong position, and residents who are extremely aware and are more certain of potential impacts have much higher odds of being strongly supportive. Awareness also has a moderating effect on place attachment. Contrary to previous studies (Brownlee et al., 2015; Firestone et al., 2012; Devine-Wright, 2011a; Devine-Wright and Howes, 2010), place attachment was found to increase the odds of neutrality for Carolina coast residents. However, those who are strongly attached and not at all aware of local offshore wind energy development have greater odds of being either somewhat supportive or strongly opposed, and those who are strongly attached and extremely aware have greater odds of being either somewhat opposed or strongly supportive. In both cases, the effects of awareness on place attachment and certainty produce a divergent effect, which may suggest that as changes in awareness, impact certainty, and place attachment occur, support level may change across the spectrum.

Results suggest that the importance of quality of life factors also affect support level. The average Carolina coast resident believes local offshore wind energy development will damage

the environment but improve local economies. Those who believe daytime ocean views are extremely important, however, have lower odds of opposition to local offshore wind energy development, and those who believe marine mammal and sea turtle habitats are extremely important have greater odds of being either neutral or somewhat supportive. Further, those who believe electricity affordability is extremely important have greater odds of being somewhat opposed. While these findings may appear inconsistent, there are a few possible explanations.

First, the support level model focuses on those who believe these quality of life factors are extremely important, and these individuals have different perceptions than the average resident. For example, those who believe daytime ocean views or marine mammal and sea turtle habitats are extremely important are equally likely to anticipate positive or negative impacts (dviews: $t=0.38$, $p=0.71$; mamm: $t=0.64$, $p=0.52$) and less likely to anticipate no impact (dviews: $2.92<t<4.77$, $p<0.01$; mamm: $4.18<t<4.26$, $p<0.01$). This suggests there are two subgroups of residents: those who anticipate negative impacts to the seascape or environment and those who anticipate positive impacts.

Related to marine mammals and sea turtles, prior research indicates that people generally like these charismatic megafauna and support their conservation and protection (Naylor and Parsons, 2018; Campbell and Smith 2006). While much of the literature has focused on exploring the potential for negative impacts from offshore energy development on the environment (Best and Halpin, 2019; Slavik et al., 2019; Vallejo et al., 2017; Carpenter et al., 2016; Vanermen et al., 2015; Bergström et al., 2014), the true ecological impacts remain

unclear due to the complex and dynamic interactions between devices and ecosystems (Lin and Yu, 2012; Bonar et al., 2015), as well as limited direct observations within U.S. wildlife habitats. Additionally, impacts and their relevance to local communities are likely to vary with location and season (Bailey et al., 2014; Boehlert and Gill, 2010; Gill, 2005). Some literature suggests there may, instead, be possible environmental benefits from offshore wind energy. For example, wind turbine foundations may act as artificial reefs, which could increase both the number of shellfish and the animals that feed on them, including other fish and marine mammals (Bailey et al., 2014; Russell et al., 2014; Lindeboom et al., 2011; Maar et al., 2009; Wilhelmsson et al., 2006). A sheltering effect may also occur where the exclusion of boats within safety buffer zones surrounding wind turbines may become de-facto marine reserves where fish stocks and benthic habitats are able to recover (Bailey et al., 2014; Alexander et al., 2013; Witt et al., 2012). The exclusion of some or all types of fishing could also increase local prey abundance for top predators, while further reducing the risk of bycatch (Bailey et al., 2014; Lindeboom et al., 2011). The finding from the present research that almost 40% of residents are unsure of the potential impacts to animal habitats highlights the environmental impact uncertainty reflected in the literature. It is possible that those who consider animal habitats extremely important have considered these nuances of offshore energy development, whereas the average resident has not.

Second, despite these two subgroups potentially focusing on different ends of the impact spectrum, their greater odds of support for local offshore wind energy development may stem from generalized environmental concerns and ethical obligations to reduce carbon and other greenhouse gas emissions (Devine-Wright, 2011b; Ladenburg, 2010; Warren et al., 2005). As

the importance of marine mammal and sea turtle, fish, and bird habitats are highly correlated, respondents who indicated these animal habitats are extremely important may have stronger environmental values, more generally, which may factor into their support. Residents may also be considering personal tradeoff calculations, where they may choose to accept some level of adverse impact to daytime ocean views and animal habitats when compared to perceived impacts from traditional forms of energy generation (Hazboun and Boudet, 2020; Arveson and Hertwich, 2011; Hansen et al., 2018; Boone, 2005; Magoha, 2003; Thayer and Freeman, 1987) or continued climate change (Keith et al., 2004).

Third, those who believe electricity affordability is extremely important are equally likely to anticipate positive, negative, or no impacts ($0.12<t<0.83$, $0.41<p<0.91$), and are significantly less likely to be sure of the potential impacts to electricity affordability ($t=2.28$, $p=0.02$). Opposition by those expecting positive or neutral impacts may stem from concern that local residents will not see any benefits or that benefits will accrue too far in the future (Zyadin et al., 2014; Baxter et al., 2013; Groth and Vogt, 2014), that some conventional forms of energy production may still be less expensive (Zyadin et al., 2014; Groth and Vogt, 2014; Klick and Smith, 2010), or that wind energy is less reliable (Guo et al., 2015; Devine-Wright and Devine-Wright, 2006; Bosley and Bosley, 1992; Gipe, 1991; Thayer and Freeman, 1987).

About twice as many Carolina coast residents intend action compared with those who have engaged in past actions related to local offshore wind energy development. Strong opposition has the greatest effect on intended action; although, residents who hold any position have increased odds of intending action as compared to residents who are neutral. Further, the

effect of past actions related to wind energy on intended action is not significantly different than the effect of being somewhat opposed, somewhat supportive, or strongly supportive on intended action, which suggests that past activism is a relatively strong predictor of current activism (McAdam, 1989; McAdam, 1988). It also supports Tindall's (2004) premise that continued participation in collective activism groups or organizations may inspire continued participation in activism itself. Place attachment has the next greatest effect on intended action, but only for those in strong opposition, which suggests place-protective action (Devine-Wright, 2011a; Devine-Wright and Howes, 2010; Cass and Walker, 2009; Devine-Wright, 2009; Stedman, 2002).

Of the demographic controls, only sex and age have a significant effect on support level, where females have greater odds of being either neutral or supportive, and older residents have greater odds of being either neutral or strongly supportive, in addition to having reduced odds of intending action. Finally, distance to local wind energy development has minimal effects on both support level and intended action, where residents closer to the coast have slightly greater odds of being either neutral or strongly supportive and slightly higher odds of intending action. As distance was included in the models to capture missing or unobserved inputs to support level and intended action that are correlated with distance, these results suggest there are minimal spatial effects beyond the included factors.

6 Conclusions and Policy Implications

Effective stakeholder engagement related to renewable energy development requires the correct identification of stakeholders, their intention to influence outcomes, and their

perceptions regarding issue importance. Traditional forms of public engagement in planning processes, however, typically have limited goals of primarily informing stakeholders and getting 'buy-in' (Gillgren et al., 2019). Therefore, traditional approaches can be ineffective at detecting and addressing the nuanced concerns of all community members.

When salient issues are not known or understood, planners cannot thoughtfully engage the public, and could even alienate segments of a community. Consequently, 'qualified supporters' (Bell et al., 2013) will remain wildcards for planners of local wind energy projects because they cannot fully anticipate, identify, or account for the priorities and issues important to all segments of communities. Once excluded, disenfranchised members of the community could become important stakeholders who actively oppose projects outside of planning processes. This will make collaborative conflict resolution less likely when opposition mounts.

Of course, decision-makers cannot hope to canvass every resident in an area to gauge support level and identify concerns. Therefore, information from studies that evaluate public perspectives on local wind energy projects can be used to profile existing issues in a community. Findings from this research disentangle the complexity of sentiment in local communities in terms of people's understanding and awareness of wind energy, valuation of quality of life factors and certainty of perceived impacts, and reactions to local wind energy projects. It also provides insight into the issues more likely to influence support level and for which people are more likely to intend action. For example, of the quality of life factors evaluated in this study, wildlife habitat, daytime ocean views, and electricity affordability appear to be of particular interest from a policy standpoint.

Nuanced findings related to these perceived impacts underscore the complexity of public perceptions and the importance of examining the beliefs of various user groups since increases in negative public perceptions, especially when coupled with strong place attachments, could result in social action. Communities and their inhabitants have unique perspectives and understandings toward various elements of specific projects (Russell et al., 2020). As more data emerge, these nuanced public perceptions are likely to shift, and decision-makers may benefit from understanding not only the knowledge base of ocean-adjacent residents, but also how they receive and process new information. Recognition that citizens use numerous sources of information to formulate their policy perceptions (Steel et al., 1992; Steger et al., 1988) may help agencies tailor outreach efforts and campaigns through a variety of information channels to reach a wider array of residents and their shifting perceptions. This and similar research presents planners with an opportunity for proactive public engagement to provide information and manage expectations appropriately. Decision-makers can tailor outreach efforts and campaigns to preemptively identify issues important to local communities and, if possible, mitigate perceptions of negative impacts through encouraging targeted public dialogue within communities and offering information and applicable science.

Efforts to manage the public's expectations about renewable energy development processes and outcomes may help alleviate some concerns within local communities. Dwyer and Bidwell (2019) identified procedural techniques that allow process managers to first foster public trust in themselves, then in the process, and ultimately in the outcome. While perceived procedural fairness appears to lead to increased support and acceptability of renewable energy projects (Dwyer and Bidwell, 2019; Liu et al., 2019), trust in organizational management and sincerity

are key elements (van Prooijen, 2019; Liu et al., 2019; Goedkoop and Devine-Wright, 2016; Carlisle et al., 2015).

Because offshore wind energy development efforts are relatively new in the United States, how initial efforts are currently being handled may affect community receptivity to projects in the future. Therefore, agencies responsible for leasing efforts may benefit from fostering trust within communities adjacent to offshore wind energy development. Where possible, agencies may realize some advantage from awarding leases to wind energy development companies that demonstrate a sensitivity to local interests and concerns. Generally, preemptive efforts to gather information during early planning phases about issues and concerns would create a more inclusive participatory process, thereby building trust. Moreover, use of such information would enable agencies to make traditional public engagement activities, such as hearings, public informational meetings, and public comment initiatives, more effective.

This research offers an approach for understanding how differing values and perceptions within communities may influence support level for local offshore wind energy development and the likelihood of becoming involved to advance a position. With this enhanced understanding of a broader range of stakeholders, agencies and developers are better able to anticipate public response, and can more meaningfully engage potential stakeholders throughout the planning process.

7 Future Research

The results of this research apply only to residents in the study region, which is essentially a coastal zone. Future studies might explore these relationships with statewide samples and in

different coastal geographies. This research also took place during two active offshore wind energy development efforts (surveyed residents were adjacent to two wind energy areas off North Carolina and four call areas off South Carolina), and it would be useful to compare results across different planning stages, particularly contrasting results prior to and after public comment periods and informational meetings. Additional research to better understand awareness, certainty, and sources of information, as well as elements that may shift an individual's support level and intended action would be beneficial. This information may also help identify 'qualified supporters' and 'unqualified opponents' (Bell et al., 2013), both of which require special attention from policymakers. Exploring residents' environmental values alongside their support level for offshore wind energy development, as well as more effectively capturing the subtleties of impact perception, would also be useful. In addition, longitudinal studies and those that assess public perception at various points throughout project planning and development efforts can provide a more nuanced understanding of elements influencing support level over time (e.g., Firestone et al., 2012). On the Carolina coast, longitudinal or repeat studies might inform better predictive modeling of support level and the propensity to engage in social action. Finally, measuring support levels across other forms of renewable and nonrenewable energy sources would provide a useful comparison.

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