2021

Sailors' Perceptions of Offshore Wind Energy in the Northeastern United States

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May 19, 2021

A thesis submitted to the faculty of the Environmental Studies Program in partial fulfillment of the graduation requirements for the Degree of Bachelor of Arts with honors in Environmental Studies

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ABSTRACT

Offshore wind is an expanding form of renewable energy in the United States that will continue to grow through state and federal mandates. Offshore wind has often been met with criticism from a variety of ocean user groups and the academic literature has attempted to include the opinions of all user groups in order to improve policy making decisions. One of the biggest ocean user groups has been left out of the research, sailors. We investigated sailors' perceptions of offshore wind in the Northeastern United States through a quantitative survey and qualitative interviews to provide context, hoping to answer the following questions: 1. What are sailors' general attitudes towards wind farm development in Southern new England? 2. What factors are likely to influence the levels of support from sailors, and how can those negative factors be mitigated? 3. Will the negative impacts from wind farms restrict individuals from sailing in ways they could before the introduction of wind farms? During the winter of 2020-2021 we met with three subject matter experts for interviews and solicited survey responses from a random sample of sailing vessel owners in CT, RI, MA and NY. We found mixed support, but leaning in favor, for offshore wind farms from sailors. However, those that held the strongest attitudes for support or opposition tended to support wind farm development. In answering our second question, we did not find that previous experience of sailing near wind farms was a factor that increased the comfort level sailors had for sailing within one mile of a wind farm. Sailors are not likely to alter their sailing behaviors if a wind farm is developed near their home port, but those who sail with the most frequency are more likely to be negatively impacted than those who are not as dedicated to the activity. Most sailors believe that wind farms are a hazard or nuisance yet are still likely to be in favor of wind farm development. We find that sailors respond in different ways than many other ocean user groups. In Europe, fishers and boaters are more likely to feel comfortable near a wind farm if they have previous experience near a wind farm, but that was not the case in the United States. Previous experience is not a factor that determines someone's comfort level. Additional research will be required to determine exactly what factors influence comfort and support, but overall sailors are supportive of wind farm development.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Alison Bates, for her support throughout this long process. Over the course of the entire project she was always there to offer advice, answer questions, and provide guidance, especially when challenges arose.

Thank you also to my readers, Ben Neal and Manny Gimond, for helping me in their areas of expertise. Ben is an encyclopedia for all boating-related topics and Manny was vital in the completion of the GIS and statistical portions of this project. I also want to thank Leslie Lime for her help in the distribution of the survey and administrative requirements of a thesis project.

Thank you to the individuals who sat down with us for interviews and those that took the time to complete our survey.

Thank you to Nathan Haddon, Annabel McLaughlin, Will Seivwright, and Elliot Snow who worked with me during the course of January to send to the survey invitation letters. Without the help of any of these individuals this project would not have been possible to finish.

Finally, I want to express sincere gratitude to the Buck Lab and F. Russel Cole Student Fellowship for providing the necessary funding to complete this project.

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1. INTRODUCTION

1.1 U.S. National Energy Position

As the U.S. begins to generate much needed alternative energy sources, conflicts begin to arise. These conflicts are political, social, and economic, and there is no place where these conflicts are as evident than in the Northeastern United States. The need for a transition to renewable energy sources is becoming more and more accepted, although it has become as much a social issue as it has an environmental issue (Szarka, 2004). Energy production in the United States is currently split amongst several production types. The three primary forms of fossil fuels- natural gas, coal, and oil- comprised 80% of energy sources in the United States in 2019. Renewable sources accounted for just 11% of all energy generation, with wind power making up just 24% of renewables (U.S. Energy Information Administration, 2019).

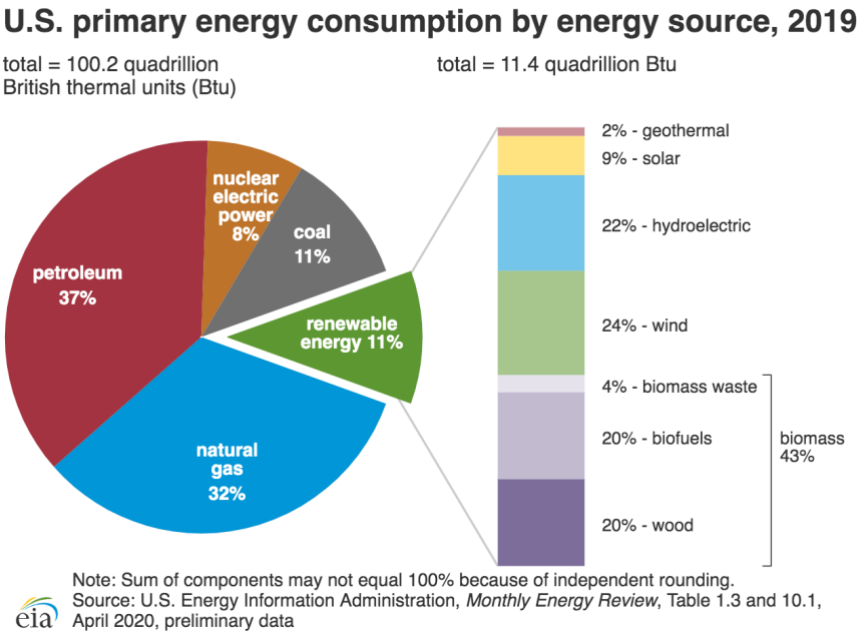


Fig. 1.1: Breakdown of the United States Energy Consumption (U.S. Energy Information Administration, 2019)

Energy production accounts for 27% of the United States' greenhouse gas (GHG) emissions (United States Environmental Protection Agency, 2018). One pathway to reduce GHG emissions from energy production is through renewable means. The National Renewable Energy Laboratory estimates that the offshore wind potential in the United States

is 2,000 gigawatts, more than enough to quench the country's energy demands (Office of Energy Efficiency and Renewable Energy & U.S. Energy Information Administration, 2013). Companies like GE are developing larger turbines each year and increasing the capacity of modern wind farms (General Electric, 2021). Although offshore wind has yet to obtain mainstream status in the United States, it is starting to grow, as evident by recent actions of the federal government. The Biden Administration announced in March 2021 that it aims to deploy 30 GW of offshore wind by 2030, more than the already thriving offshore wind industry in Europe (The White House, 2021). In order to accomplish this goal, the administration said it would increase the pace at which projects attain permitting, increase investment in research and development, and provide low-interest loans to the industry (Dennis & Eilperin, 2021). NOAA has also been granted $1 million and tasked with researching the impacts on fishing operations and coastal communities (The White House, 2021).

The Block Island Wind Farm (BIWF) is located off the coast of Block Island, an island roughly 9 miles off the coast of Rhode Island and 14 miles east of Long Island. It began operation in 2016 and was the first offshore wind farm in the United States. Four years after going online the socioeconomic effects of the project have been well documented. Data exists on the public perception of this development, the economic impact on commercial fishers, changes in recreational behavior, and the economic viability of offshore wind in the US (Bidwell, 2017; EcoRI, 2019; Firestone & Kempton, 2007; Gray, Haggett, & Bell, 2005; McLeish, 2019; Smythe, Bidwell, Moore, Smith, & McCann, 2020). There are now more than five proposed, commercial-sacle wind farms southeast of the Block Island operation (Bureau of Ocean Energy Management, 2021).

There have been many studies on the public perception, impact on commercial fishing, changes in recreational behavior and economic viability of offshore wind in the U.S. One area that has not been investigated for any developments is the recreational sailing industry. The estimated economic impact of recreational sailing in these waters are in the hundreds of millions of dollars (NOAA, 2017), and affect thousands of individuals- including fishers, tourists, and recreationalists. This study expands on previous studies that have

focused on commercial and recreational fishing, general recreational uses of the water, and Not In My Backyard (NIMBY) syndrome.

1.2 United States Offshore Wind Strategy

The United States recognizes the need to advance offshore wind development as a low-carbon, low-cost domestic energy resource (The White House, 2021). Following the advances that offshore wind energy has made in Europe, there are new opportunities for offshore wind to play a substantial role in the future of large-scale affordable energy in the United States. Two executive agencies are creating the strategy for offshore wind development in the US, the Department of Energy (DOE) and the Department of the Interior (DOI). Each has identified the problems they plan to address and the objectives they hope to meet in solving those problems (Gilman et al., 2016).

DOE's primary objective is to lower the costs associated with offshore wind (Gilman et al., 2016). They aim to accomplish this goal by advancing the technology to a point where wind is able to compete with fossil fuels and support a plan where wind farms and all ocean users can coexist relatively conflict free. DOI's aim is to produce a more effective regulatory program in order to reduce the bureaucratic burden placed on developers and community stakeholders (Gilman et al., 2016). One of the key tenets of effective regulatory procedures, according to DOI, is the ability to change them and mold them to the needs of all stakeholders (Gilman et al., 2016).

Both DOI and DOE recognize the substantial potential for offshore wind and highlight the fact that further development is realistic and provides huge energy opportunities to the United States. They highlight these factors in several ways. Theoretically, we have the wind capacity to double the annual electric generation of the entire country, in the next decade the price of wind energy will likely drop to a point where it is legitimately competitive with existing forms of energy production, the positive externalities of offshore wind are massive and include: reduced greenhouse gas emissions by 1.6 billion metric tons, $2 billion in savings from cleaner air, reduced water consumption by 5%, $440 million in

annual lease payments and $680 million in annual tax payments, and the capacity for 160,000 domestic jobs (Gilman et al., 2016).

While the federal government has laid out its strategy through the DOI and DOE, each state has separate offshore wind strategies. The four states of interest in this study are Massachusetts, Connecticut, New York, and Rhode Island. In 2018, Massachusetts passed an Act to Advance Clean Energy. This bill mandated the increase of renewable energy in Massachusetts' portfolio to increase 2% every year through 2029, then to 1% a year from 2030 in perpetuity (Mass. Clean Energy Center). Additionally, the Massachusetts state government passed An Act Relative to Energy Diversity in 2016 which requires utilities companies to produce 1,600 MW of renewable energy from offshore wind farms by 2027 (Mass. Clean Energy Center). The states must work with the federal government to accomplish these goals. The Block Island Wind Farm is in state waters and is controlled by the state of Rhode Island, but the major 5 commercial-scale developments (Vineyard Wind, Mayflower Wind, South Fork Wind, Beacon Wind, and Revolution Wind) will be in federal waters. The permitting process is through BOEM, not the states, although the power-purchase agreements have all been with state governments and utilities (Bureau of Ocean Energy Manangement, 2021).

In November 2020, Rhode Island announced plans to buy up to 600 additional MW of energy produced from offshore wind installations (Kuffner, 2020). This is a drastic increase from the 30 MW produced from the already existing BIWF. In order to meet this goal of 600 MW, Rhode Island purchased 400 of the 700 MW expected to be produced from the Revolution Wind Farm, currently under development between Martha's Vineyard and Block Island. Connecticut has purchased the remaining 300 MW (Faulkner, 2020).

The governor of New York has voiced his approval of a 90 MW wind farm off the coast of Montauk that will be visible from shore. He has also proposed a commitment of an additional 2.4 GW of wind power by 2030. New York's outline of its offshore wind protocol is critical to its goal to increase its energy portfolio to 50% renewable by 2030 (New York State, 2017).

Compared to Europe, however, the US lags behind. In 2019, the European Commission voted to pass the European Green New Deal. The plan aims to decrease Europe's greenhouse gas (GHG) emissions by 50% of 1990 levels by 2050. One of the platforms the European Commission plans on achieving this goal is through revolutionizing Europe's energy system. The goal of the Green New Deal is to establish a circular system where unused energy is recaptured and re-used in the system (European Commission, 2020). Offshore wind energy has a large role making these outcomes possible. Wind makes up 15% of Europe's energy production today and the International Energy Agency believes that by 2027 wind can be Europe's number one electricity producer (Wind Europe, 2020). An estimated 240-450 GW of offshore wind will be needed in Europe to meet the Green New Deal's standards by 2050 (European Commission, 2020).

The five wind developments in the Massachusetts-Rhode Island Wind Energy Area are: Vineyard Wind I, Mayflower Wind, Beacon Wind, South Fork Wind, and Revolution Wind. Of the five developments, Vineyard Wind I aims to be the first commercial-scale offshore wind farm in the United States and will sit 15 miles off the coast of Massachusetts. The project will generate 800 MW, enough energy to power 400,000 homes, that will be transmitted directly to Cape Cod. Construction will begin in 2021 (Vineyard Wind, 2021). Mayflower Wind is not as advanced in the development process as Vineyard Wind, and they have not made any final decisions on exact location, although it will sit in the area roughly 30 miles south of Martha's Vineyard. Mayflower Wind has not released the number of turbines or power generation that it will produce, but it has signed a power-purchase agreement with Massachusetts utilities for 804 MW, similar to Vineyard Wind in terms of capacity (Mayflower Wind, 2021). Beacon Wind will provide energy to that state of New York. The site is 60 miles east of Montauk Point, the eastern tip of Long Island, and 20 miles south of Nantucket. Equinor, a 50% owner of the project, says they plan for Beacon Wind to contribute 1,230 MW of clean energy to New York's Grid (Equinor, 2021). South Fork Wind also plans to contribute to New York's portfolio. It is expected to be operational by the end of 2023, with 15 turbines to generate 132 MW of clean energy. Enough to power 70,000 homes. South Fork Wind Farm will lie 35 miles east of Montauk point and the power will be

delivered directly to the town of East Hampton, NY (South Fork Wind, 2021). Finally, Revolution Wind is owned by the same two companies as South Fork Wind- Orsted and Eversource. Revolution Wind will Power Connecticut and Rhode Island. The farm will generate 704 MW- 304 MW of which will go to Connecticut and 400 MW of which will go to Rhode Island. The project is 15 miles south of Rhode Island and construction is planned to begin in 2023 (Revolution Wind, 2021).

1.3 Environmental Impacts of Offshore Wind

There are negative and positive environmental impacts of offshore wind developments. The construction phase of a wind farm is the most damaging. The sound produced from pile driving, the process of hammering the foundation of the turbine into the seafloor, has been seen to alter behaviors in marine species, and can cause physical damage in extreme circumstances (Andersson, 2011; Dunlop, Reid, & Murrant, 2016; Kikuchi, 2010). The high-voltage wires that transport the energy from the turbines to land have not been seen to have negative impacts on the surrounding fish and fishing communities (Dunlop et al., 2016). One instance of physical damage is severe hearing loss in fish during the construction phase of the wind farms, which can have significant consequences on the lifecycle of those affected (Kikuchi, 2010). Behavioral changes, such as swimming speed and swimming patterns, have been detected in cod and sole over ten kilometers from the construction site (Andersson, 2011). The constant hum of the turbines while in operation does not emit enough sound to affect species significantly unless they are within meters of the turbine (Andersson, 2011).

There are several strategies to reduce the environmental impact of offshore wind, including establishing environmental protections and laws. Leaving wind turbine foundations in the water indefinitely as artificial reef habitats presents one promising measure for mitigating the overall negative impact of wind farms, but does not address installation issues (Smyth et al., 2015). Monopiles, the most common design of turbines, can increase hard substrate by 2.5 times the natural amount (Wilson & Elliott, 2009). Moreover, leaving the

turbine foundations could eliminate the waste caused from retired turbines and would eliminate the damage to marine species from the explosions caused during the deconstruction phase. Alternatively, floating wind turbines can be used as they have much less of an impact on marine species and can be advantageous if a particular aquatic environment would be particularly affected by sound disturbance and gain little benefit from the monopile foundation (Gasparatos, et al, 2017).

1.4 Public Perception and Social Acceptance of Offshore Wind Farms

Although there are two wind farms currently in operation in the U.S., BIWF, and the Coastal Virginia Offshore Wind Pilot Project (CVOW), the CVOW is quite young. It was constructed during the summer of 2020 and did not start producing power until late 2020. Additionally, it consists of only 2 turbines and lies over 20 miles from shore, compared to 5 turbines within 5 miles of shore at the BIWF. Considering these circumstances, there is robust research on the acceptance of the BIWF, and little studying the CVOW. The majority of stakeholders around Block Island support the BIWF due to the clear community benefits (Klain, Satterfield, MacDonald, Battista, & Chan, 2017). Block Island is no longer reliant on diesel generators, its residents have access to faster internet speeds, and during particular windy periods in time they are able to sell excess energy to main land NY and RI as a result of the BIWF (Klain et al., 2017). Overall, the public has reacted positively to having the first commercially viable wind farm just miles off of their coastline. Prior to the BIWF installation 68% of Block Island residents supported the construction, after it was fully operational that number grew to 89% after the benefits were more directly realized. The percentage of those that adamantly opposed the project shrunk from 19% to 11% (Bidwell, 2017).

The first proposed commercial-scale offshore wind farm in the northeastern US was the Cape Wind project. Cape Wind was planned to be a 24 square-mile installment in Nantucket Sound with 130 turbines. The public on Cape Cod was evenly distributed amongst those that supported and those that opposed the project (Firestone & Kempton, 2007).

However, the public also felt that the negative impacts of the project would be much stronger than the benefits, citing aesthetics, fishing, recreational boating, and property values as facets of life that would be significantly damaged (Firestone & Kempton, 2007). None of the recorded positive impacts of Cape Wind were felt nearly as strongly as the negative impacts, with job creation and electricity rates having the best perceived improvements (Firestone & Kempton, 2007). The benefits of wind farms are not observed in the public opinion until after the wind farms come online.

Related to public perception is the concept of social acceptance. Public perception and social acceptance differ in that public perception refers to the public's belief or opinion about a particular issue from a very general viewpoint- that is to mean how the public feels towards an issue without a framework from which to measure it. Social acceptance concerns itself with a three-dimensional framework of assessing a problem and works with the specifics of the question. The three dimensions are socio-political, community, and market acceptance (Wüstenhagen, Wolsink, & Bürer, 2007). Here, we are primarily focused on the community aspect of social acceptance as the recreational sailing community is the study population, but the socio-political and market acceptance factors will certainly shape perception and acceptance.

Public perception is more of a historical framework. When renewable energy was first being developed there seemed to be little conflict with the public and implementation was thought to be easy, as seen in the results of the first public perception polls (Wüstenhagen et al., 2007). As these studies started to focus more on social acceptance- the need to work with the public, politicians and regulatory commissions on citing and operational procedures- it became clear that relying on local support was not going to be easy (Wüstenhagen et al., 2007). There was a demonstrated need to shift the focus of public opinion surveys to tackle ideological differences among user groups, thus the three-dimensional framework of social acceptance was born out of necessity.

The community aspect of social acceptance can be boiled down to three specific points: procedural justice, distributional justice, and trust (Wüstenhagen et al., 2007).

Community acceptance is the most important aspect of this project because it encapsulates the issues held by local user groups and residents (sailors), local authorities (developers and governments), and NIMBYism (not in my backyard- the idea that the general population supports a project they just do not want to see it or live near it). In 2010, when the Cape Wind project failed, opposing groups were able to influence local populations through NIMBYism. In this instance, wealthy and powerful voices, such as the Koch's and Kennedy's were able to convince local populations that Cape Wind was not a solution to the energy crisis and undermined the national effort to implement wind (Keller, 2010). Procedural justice focuses on the decision-making process of all relevant stakeholders equitably represented in the process; distributional justice on the equity of the costs and benefits of projects; and trust with the information and intentions of all individuals in positions of power relative to development.

1.5 Energy Justice

The framework of procedural and distributional justice extends to the energy sector and can be conceptualized through energy justice. Research surrounding energy justice challenges those involved to address energy systems with a justice-based framework, spanning production to consumption (Heffron, Stephan, & Jenkins, 2013). Opposition to wind energy has varied from historical opposition to other energy developments. For example, in Europe, most opposition to nuclear energy reactors has stemmed from large, national environmental movements and opposition to the budding wind sector derives mostly from local activism (Heffron et al., 2013). Procedural justice is manifested in wind energy through the desire to include all stakeholders in the decision-making process, and to seriously consider opinions offered by any stakeholder, no matter how powerful they are. One of the goals this study is to accomplish just that. The sailing community is not the largest ocean user group, it does not have the greatest political capital, and it is not the largest contributor to local economies, yet the opinions expressed by this group of people should still be taken as seriously as those in positions of power in the energy justice framework.

1.6 Effects on the Fishing Industry

Commercial fishing is a historical and generational business in the Northeast United States. As climate change continues to worsen so do the historical fish stocks. Although lobster is now the most valuable fishery in New England, that accolade long belonged to Atlantic Cod. After the collapse of that fishery, and the subsequent declaration of economic disaster, many fishing captains fell into psychological distress (Scyphers, Steven Picou, & Grabowski, 2019). There is evidence to support the claim that wind turbines provide additional habitat for economically valuable fisheries that has helped increase the abundance of depleted species. The introduction of wind farms could benefit historically distressed fishers by bolstering fish stocks (Methratta & Dardick, 2019).

Interviews with commercial fishermen who have historically used the waters surrounding the new BIWF found that they have faced an increase in gear loss and competition with recreational fishers in the area. Recreational fishers approved of the project due to the increase in abundance of fish in the area of the wind farm (EcoRI, 2019; McLeish, 2019; Methratta & Dardick, 2019). Recreational fishing in Rhode Island accounts for approximately $400 million in economic output each year, roughly the same as commercial fishing (Webster & Porter, 2020). The additional substrate created by the underwater pilings of wind turbines acts as an artificial reef that increases species abundance, without altering species richness (Wilhelmsson, Malm, & Öhman, 2006).

1.7 Impacts on Shipping

The effects on recreational boating are not entirely understood because there are so few offshore wind farms in the United States. One area that has already been notably affected, and expects even more disruptions in the near future, is commercial shipping. Commercial shipping companies are already looking at rerouting many of their current lines (Samoteskul, Firestone, Corbett, & Callahan, 2014). Rerouting would actually allow wind developers to look at constructing closer to shore so as not interfere with these routes, and the new shipping lines would only increase by an average of 18.5 km along the eastern seaboard.

In total, due to the decreased distance from shore for wind farms, rerouting shipping lines would actually save wind developers approximately $13.4 billion in the coming years through construction costs- supporting wind energy development throughout the United States, without imposing an undue burden on shippers (Samoteskul et al., 2014).

1.8 Impacts on Recreational Boating

In order to look at the impact on recreational boating, sailing in particular, we must look abroad. Europe is further along in the process of adding wind energy to their electricity grid, and therefore has had experience dealing with the impacts turbines can have on recreational boating. The Royal Yachting Association (RYA, the governing body of the sport of sailing the UK) released a position paper on the development of offshore wind (RYA, 2019). In general, sailors are environmentally conscious, which makes them an interesting demographic to study. Sailors being environmentally conscious can lead towards support, but the general affluence of the population may decrease support. In a sport that relies so heavily on weather, climate change is a constant threat and sailors want to preserve the climate for future generations. However, wind energy poses a unique threat to sailors and carries implications. In order for sailing and wind energy to coexist harmoniously, the RYA proposes several issues that must be addressed: collision risk, navigational risks, and locational risks (RYA, 2019). They propose that windfarms must be sited sensitively, be well-marked and managed effectively, be constructed so that rotors are no closer than 22 meters from the surface of the water, maintain appropriate draft below the surface of the water to minimize keel collisions, have standardized lighting and spacing of turbines, and be placed more than 12 nautical miles offshore (RYA, 2019). If these provisions are met it is likely that safety concerns of sailors can be minimized, and the future of wind energy will experience no opposition from the RYA. US Sailing, the governing body of the sport of sailing in the United States, has not released such guidelines and did not respond to repeated attempts to interview them on their stance to wind development.

Beyond the scope of demands from the governing body of sailing in Europe, other aspects of recreational sailing have been affected. The White Paper on Offshore Wind

Energy was written in response to further wind energy areas getting developed in the North Sea off the coast of Holland. Under the policies in place at the time, recreational sailing vessels would not be allowed to transit the wind farms and would be pushed to busier routes on the outskirts of the exclusion zones (The Ministries of Infrastructure and the Environment & Economic Affairs, 2014). A practice which would not be allowed under the US Coast Guard's commitment to freedom of navigation.

At the time of writing, there was only one study found addressing the on-the-water experience of boaters and offshore wind farms, however it was focused mainly on motor boats and specifically recreational fishing (Dalton, Weir, Calianos, D'Aversa, & Livermore, 2020). This study indicates that boaters will actually be willing to pay to avoid wind farms, meaning that behavioral patterns will in fact change in the presence of turbines (Dalton et a., 2020). They acknowledge that it was unclear why boaters do not want to be in close proximity to wind farms, though. While the sample populations are not the same, it is valuable to know that boaters in the US do have opinions on wind farms already, and many of the areas we will be studying may impact sailors in similar ways.

More recently, the body of literature on recreational boaters has been expanded in some respects. In 2021, a paper was published that investigated recreationalists attitudes towards offshore wind development off the coast of New Hampshire. Although this study was not focused on recreationalists on-the-water perspectives it did reveal that perceptions of offshore wind were generally quite positive amongst their sample. This study was conducted concurrently with the present study and shows that this area of research is starting to attract more attention in the academic literature.

1.9 Sailing in the Northeast United States

Centuries old, sailing has been a means of relaxation, commercialization, and history on the northeast coast ever since Nantucket was a whaling hub in the 1700's. According to the most recent Northeastern Recreational Boater Survey, conducted in 2012, there were nearly 374,000 marine recreational boaters in the Northeastern US who contributed an

estimated $3.5 billion to the local economy during the year and employed nearly 27,000 individuals (Starbuck & Lipsky, 2012). Sailing is starting to decline, though. This can be seen in the data, as well as observed participation (Hayes, 2009). Participation has shrunk by nearly 50% in the last 3 decades nationally. Sailing also faces a crisis of demographics. Most sailors in the U.S. are white men in their fifties. The young population tends to leave the sport when they are 25, not to return until later in their life (Hayes, 2009). As the population of sailors continues to age, there may be increasing conflict with the arising potential of offshore wind farms in the favored sailing areas. Older generations- the silent generation, baby boomers, and generation X- tend to be more politically and economically conservative than their liberal counterparts in the millennial and generation Y categories. In particular, white members of older generations tend to be even more heavily conservative (Pew Research Center, 2018). Conservatives tend not to support wind energy as much as liberals, although the majority still support the advancement of wind farms (Pew Research Center, 2019). According to US Sailing, Sailors in the U.S. tend to be older and wealthier, which may skew the population towards increased opposition to wind farms than the majority of the U.S. (U.S. Sailing, 2010).

Sailors tend to be more affluent than the general population. The average price of a new 26’ sailboat, quite a modest size for boats today, is nearly $80,000. 36’ boats carry price tags of $150,000 and up (Buckles, n.d). Throughout the United States wealth offers outsized political power. The rich are able to skew a vote in both federal and state legislatures, but more importantly they can shape public opinion (*The Economist*, 2018)**.** In shaping public opinion, campaigns put on by the affluent members of society can alter narratives about particular issues, such as happened on the Cape Wind project in 2010. The headlines shifted from a new source of renewable energy capable of powering all of Cape Cod, to an environmental and economic disaster because those that cared most poured time and resources into shutting the project down.

Sailing is a more than an activity for those who participate. Sailing is a highly traditional and historical use of the ocean, especially in the United States. While some of the population is willing to spend large sums of money in search of winning a regatta, many

sailors choose to a simpler approach. For many sailors, it is not about the prestige or affluence of the sport, but rather the sense of freedom and relaxation that comes from spending time on the water with friends and family.

1.10 Research Questions

This study aims to gain a better understanding of how sailors will be impacted by offshore wind farms. In a comprehensive review of the literature we found significant representation of fishers and the shipping industry, two major marine user groups. We have seen far less representation of general recreationalists, and no understanding of sailors. It is the aim of this study to gain an understanding of how sailors will be impacted by offshore wind farms, and to determine the level of support for wind farms amongst sailors. An investigation into these factors can help policy makers understand implications for this user group, and identify any actions needed to mitigate those concerns. This study sought to address the following questions:

1. What are sailors' general attitudes towards wind farm development in Southern New England?
2. What factors are likely to influence the level of support from sailors, and how can those negative factors be mitigated?
3. Will the negative impacts from wind farms restrict individuals from sailing in ways they could before the introduction of wind farms?

2. METHODOLOGY

2.1 Geographic Scope

The waters south of Rhode Island and East of Long Island, NY are known as the Massachusetts-Rhode Island Wind Energy Area, and this is currently the most active area for offshore wind leasing in the nation. This area is epicenter of wind energy in the US, and will likely continue to develop over the next decade, coupled with the fact that it is some of the most densely populated waters in the United States for recreational sailors, it had great

potential for an impactful study that would include the important user group of sailors in the literature (Fig. 2.1)

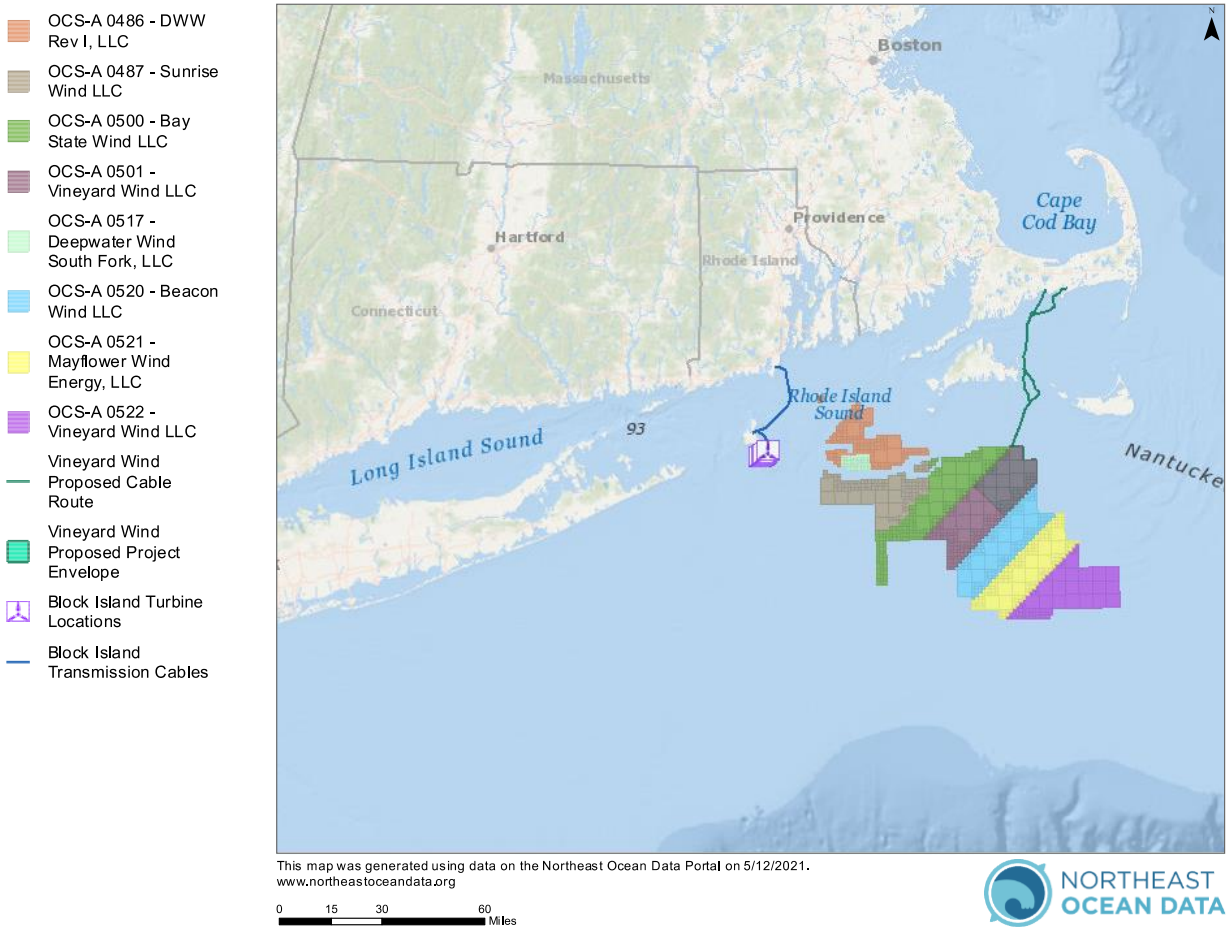


Figure 2.1 Connecticut, New York, Rhode Island, and Massachusetts shoreline showing locations of the BIWF (white and purple boxes) and active renewable energy leasing areas (colored areas) (Starbuck & Lipsky, 2012).

2.2 Data Collection

This study included both qualitative and quantitative data. Data collection was split into two parts: an online survey and virtual interviews with subject matter experts.

Online survey

The quantitative survey provided the majority of data used in this study. The survey was designed using the survey software Qualtrics in the fall and winter of 2020-21. The

survey was almost exclusively multiple-choice questions, with some options for free response where respondents saw fit. Multiple choice questions are the most mobile device-friendly, as one of the distribution channels was a QR code, the survey needed to be easy to use on a mobile device. Ultimately, the survey, "How are Sailors Impacted by Proposed Wind Farms in the Northeast United States", consisted of 26 content-oriented questions and 6 demographic questions (Appendix 1). Once the survey was completed it was sent to a random sample of 1,502 sailing vessel owners in New York, Connecticut, Massachusetts, and Rhode Island. The sample was purchased from the third-party data analytics company Info-Link, that partners with the United States Coast Guard and updates their registration logs every thirty days. The data included the owners name and mailing address. Responses were solicited from owners of marine sailing vessels of at least 25 feet in length and less than 60 feet in length. Target states (CT, NY, RI, and MA) were selected because individuals in those areas would be most familiar with the Mass-Rhode Island Wind Energy Area and have the highest likelihood of interacting with wind farms in the future. The sample from MA only included individuals south of Boston, as they are more likely to venture south of Cape Cod into our study site. Survey distribution was: CT (N=401), NY (N=399), RI (N= 299), and MA (N=401).

In order to finalize survey language and structure, we conducted pilot testing before the survey was sent to the study sample. Pilot testing began once the initial draft of the survey was complete. The size of the testing sample was n=12. The pilot sample included academic peers and individuals familiar with sailing in the study area. After the first round of testing certain questions were removed in favor of questions that were easier to answer on a mobile device, questions were reworded to improve flow and understanding, and questions were added in order to take a more holistic approach to our research question. A second round of testing was conducted to make sure the changes were friendly and improved the weaknesses identified in the first round.

Questions were split into three distinct categories: 1) previous knowledge of offshore wind, 2) sailing behaviors, and 3) the impact offshore wind may have on their sailing. Each question consisted of multiple-choice answers with between 2-6 potential responses. Some

questions included the option for the respondent to briefly explain their response. Two questions gave additional information in case the respondent was unfamiliar with the topic at hand. For example, one of these explanations was a brief paragraph on the BIWF explaining location, capacity, and a picture of the turbines and Block Island for reference. The other explained the costs associated with placing wind farms further offshore, as well as the takeaways from placing wind farms close to shore. Exact phrasing can be found in Appendix 1. Two questions asked the respondents to imagine a hypothetical scenario and answer how they would react if those were to be real situations in order to gauge how future developments would relate to their answers. Demographic questions including gender, education, employment status, income, and length of their vessel were asked at the end of the survey. This study was conducted during the COVID-19 pandemic, and we asked all information to be accurate to pre-COVID times so as not to include the pandemic as a factor in our variables. At the end of the survey, to act as an incentive in an attempt to increase response rate, respondents were asked if they wanted to include their email address for a chance to win one of six $125 Amazon gift cards. If they chose to do so they were directed to a different survey to maintain confidentiality of responses. 291 respondents chose to enter the raffle.

The survey invitations consisted of a brief letter explaining the research, a URL link, and a QR code. The letters were placed into individually addressed envelopes and sent via the United States Postal Service. After a two-week period, an abridged copy of the invitation letter was distributed, still including the URL and QR code, on postcards to the same sample of addresses. Prior to sending the reminder postcards responses were starting to slow, and the postcards generated a greater response rate. In total, 393 people used the provided QR code to access the survey and 45 individuals used the URL link for a total of 438 responses.

The first response was recorded on January 28, 2021 and the final response, before the survey closed, was recorded on March 1, 2021. A total of 438 individuals entered the survey. Respondents tended to be older, white, men which is consistent with the sailing population in the area and we did not weight the responses to be more representative because

precise sailor demographics were unknown. A summary of the sample statistics can be found in table 2.1

417 survey responses were completed for a total response rate of 28%. This differs from the 438-figure given above because not everyone that entered the survey chose to submit any answers. Nearly 94% of total responses were submitted by men, 6% women, and no respondents identified as non-binary. The sample was very well-educated, 88% earned a bachelor's degree or graduate/professional degree. More than half the sample was employed full-time before the outbreak of COID19 pandemic. 37% were retired. 60% of the total sample earned over $150,000 per year before the COVID19 pandemic. According to the U.S. Census 17% of residents in CT have professional or advanced degrees, 20% in MA, 15% in NY, and 14% in RI (Census Reporter, 2020). Our sample had achieved far higher levels of education that general public in their respective states.

The U.S. Census reports household income by state and in 2019 the 4 states in our study had the following median household incomes: CT- $87,281, RI- $70,151, MA- $87,707, and NY- $71,855 for an average of $79,248.5. The majority of our sample was higher than the average of their respective state. Finally, our study state's population breakdown of gender all leaned slightly towards higher female populations by 1-2% (Census Reporter, 2020).

The most recent (2010) demographic data published by US Sailing, the governing body of sailing in the United States, reports over 50% of sailors are over the age 50, 89.5% have an annual household income of over $125,000, 52% have a college degree or higher, and 59% are male (US Sailing, 2010). The biggest discrepancy between our study sample and true sailing demographics is found in the distribution in gender. This may be attributed to the fact that the survey invitations were addressed to the individual named on the vessel registration. If the invitations were instead addressed to the household there may have been increased female representation. This is a recognized limitation in the data. Important note: these data represent *members* of US Sailing, which costs $65 per year and is required for most races, but not for casual sailors. Although this does not perfectly represent the

demographics of sailors, it is the only available census data for the sailing community that can be found. This sample is not representative of the US or northeast regional population. The entire sample consisted of registered sailboat owners and the total length overall of their vessel was categorized by length: 0-30ft, 30-45ft, and 45ft or longer. 76% of the sample owned vessels between 30-45ft.

Table 2.1. Sample Summary Statistics

Gender (n=397)	
Male	93.7%
Female	6.3%
Education (n=396)	
Grade School	1.2%
High School	0.5%
Some college, no degree	6.8%
Associate's Degree	3.4%
Bachelor's Degree	36.4%
Graduate/Professional Degree	51.7%
Employment Status (n=395)	
Out of work	0.2%
Student	0.5%
Part-time	5.8%
Full-time	56.5%
Retired	37.0%

Income (n=351)	
$0-$30,000	1.0%
$30,000-$75,000	7.3%
$75,000-$150,000	31.2%
$150,000 or greater	60.3%

Virtual Interviews

This study was conducted in the midst of the COVID-19 pandemic, therefore interviews were conducted via Zoom. The survey was aimed at individual responses and the perception that individual sailors have towards offshore development. The sailing community consists of more than just individuals. Most sailors keep their vessel at a marina or yacht club and we wanted to capture the opinions of individuals who represent these institutions. There are also recurring races every year in this area that attract hundreds of sailors per race. The routes of these races often originate in Newport, RI and finish along the American East Coast and transit the Atlantic Ocean to Europe. For these reasons, we wanted to speak with individuals who understand the institutional aspect of sailing. We conducted three interviews over the period of three weeks. Two interviews were with individuals who have significant experience with two of the most popular and prestigious races in the area (the Newport Bermuda Race and Block Island Race) and one interview was with a former member of the United States Coast Guard that was involved with the safety regulations surrounding the new offshore wind farms. Our goal was to interview more individuals, but we were limited by a low response rate to the requests to interview. The interviews were semi-structured and lasted roughly thirty-minutes. Questions are in Appendix 2. The transcripts of the interviews were coded in the qualitative data software Dedoose v8.3.45 used to identify trends, similarities, and differences among the responses given.

2.3 Survey Data Analysis

Date were downloaded from Qualtrics and analyzed with statistics software StataIC v15.1.

For several of the questions we grouped multiple variables together. The variables consisted of numerical responses, instead of string variables with values recorded in a separate code book to maintain organization. Each question had several potential responses, and for ease of analyzing, many of the responses were condensed into binary classifications. These classifications consisted of either affirmative or negative answers. The following changes were made:

- Question 17: Responses "I would stop sailing in this area and move to a new mooring/dock" and "I would not move to a new mooring/dock" were classified as negative responses and combined. Responses "my sailing behaviors would not change" and "I would be thrilled and enjoy sailing here more than I did before" were classified as positive changes and combined.
- Question 21: Any responses of 1.5 miles or greater were combined and any responses of 1 mile or less were combined.
- Question 22: Responses of "They are a nuisance no matter where they are located", "Within sight of shore", "Within 5 miles of shore", and "Within 1 mile of shore" were classified as wind farms are a nuisance and combined. The response "They are not a nuisance" was kept separate.
- Question 24: Responses of "They are a hazard no matter where they are placed", "Within sight of shore". "Within 5 miles of shore", and "Within 1 mile of shore" were classified as wind farms are a hazard and combined. The response "They are not a hazard" was kept separate.
- Question 32: All responses other than "Retired" were combined and "Retired" was kept separate.
- Question 33: Response up to and including $29,999 were combined for the lower income bracket. Responded from $30,000 up to and including $74,999 were combined for our lower middle-income bracket, responses from $75,000 up to and including $149,999 were combined for our upper middle-income bracket, and responses from $150,000 or greater were combined for our upper income bracket.
- Question 34: Responses up to and including 29ft were combined for our small vessel category. Responses from 30ft up to and including 44ft were included in our medium vessel category. Responses of 45ft or greater were combined into our large vessel category.

The majority of the statistical analyses were chi-square tests for association. In some instances, statistical softwares will include a Yates Correction for chi-square tests. That was not the case using this methodology. We were most interested in determining what factors were correlated with sailors' comfort sailing within 1 mile of a wind farm. We were also

interested in looking at what demographic traits among sailors were likely to influence the support sailors had for wind farms.

3. RESULTS

3.1 Demographics

Our typical respondent was an experienced sailor, with 66% of respondents sailing multiple days a week in the peak sailing season (April-November). Only 28% of respondents claim to sail at all in the offseason (December-March). 85% were comfortable navigating in rocky areas and 97% were comfortable sailing in areas with a density of other boaters in the area.

Knowledge of the existence of wind farms in the area was quite high, 80% of the sample was familiar with the Block Island Wind Farm prior to their participation in this study. Experience sailing in the vicinity of offshore wind farms, in this case the Block Island Wind Farm (BIWF) was evenly split with 55% of respondents having sailed within sight of the turbines south of Block Island. Support of wind farm development within 5 miles of the coast was evenly split, with 35% of respondents supporting near shore development and 35% opposing nearshore development. The remaining 30% claimed to be neutral on the matter of near shore development. Support increased for wind farm development further than 5 miles from shore, with 69% of respondents supporting development further from the coast, 10% opposed, and the remaining 21% reported neutral feelings toward development further from the coast.

3.2 Variable Associations

Initially, we believed that several of our variables would be significantly associated with one another. Associations that we were expecting included the following: previous exposure to BIWF increasing support for near shore wind farms, previous experience sailing near the BIWF increasing comfort sailing near a wind farm, frequency of sailing trips

increasing comfort near a wind farm, education level increasing support for wind farms near shore and offshore, believing wind farms are a nuisance or hazard increasing the concern that sailing is a threatened activity, and frequency of sailing reducing the likelihood of changing behaviors should a wind farm be developed near the respondents home port.

We asked respondents if they were in favor of wind farm developments close to shore- close to shore was defined as within 5 miles of the coast. BIWF lies 3.8 miles off of Block Island and qualifies as a near shore wind farm for the purposes of this study. Roughly half of our respondents have previously sailed around the wind farm (55%) and based on responses from our interview process, individuals who have sailed near the BIWF tend to approve of that development. After running an association analysis of the two variables we produced table 3.2.

Table 3.2 Of the respondents who have sailed within sight of the BIWF, what is the support level for wind farms within 5 miles of shore. Chi-square test for association p-value=.062. N=400.

Are you in favor of wind farm development within 5 miles of shore?	Have you sailed within sight of the BIWF?	
	Yes (n=223)	No (n=177)
Yes, I am in favor (n=138)	78	60
No, I am opposed (n=142)	88	54
I am neutral (n=120)	57	63

We tested the association between previous exposure of sailing near wind farms, using the BIWF as a proxy as it is the only real-world exposure in the United States (CVOW is too young to have attracted significant boater traffic at the time of data collection), and comfort sailing near a wind farm. Our discussion with a representative of Block Island Race Week led us to believe that sailors who sailed near the wind farm were not bothered by their

presence, and that there was in fact enthusiasm for the opportunity to race near the wind farm. We compared this knowledge, knowing that it represented the view point of many professional and racing-oriented sailors, to the results of our more representative survey.

Table 3.3. Of all respondents, regardless of previous sailing experience near the BIWF, we did not find a significant association between previous sailing experience and comfort sailing within 1 mile of a wind farm. A chi-square test of association results in a p-value=.828. N=377.

Are you comfortable sailing within 1 mile of a wind farm?	Have you sailed within sight of the BIWF?	
	Yes (n=209)	No (n=168)
Yes (n=287)	160	127
No (n=90)	49	41

We chose to set the distance threshold at 1 mile because of the existing safety protocols put in place by both developers and the United States Coast Guard. In the Mass-Rhode Island Wind Energy Area all wind farms will follow standardized safety features. One of those features will be uniform spacing between turbines of 1 mile. If an individual were to be sailing within the boundaries of a wind farm the furthest they would be from a turbine at any point would be roughly 0.5 miles, therefore we chose 1 mile to include sailing along the outer boundary of the development.

Hamilton, Bell, Hartter, & Salerno, 2018 found that support for renewable energy developments increases with education levels and continues to increase with advanced degrees. That study was not specific to any one population and we aimed to learn if education amongst sailors increased support as they would be a highly affected user group. We stratified our sample into two categories: those that have received a bachelor's degree or better and those that have not. We also stratified respondents overall support for windfarms by combining their support for nearshore and offshore wind farms. Those that supported both

or opposed both were included. Respondents who were neutral for either development were not included in this test for association.

Table 3.4 The sample was very well educated with 88.7% of the total sample having earned a bachelor's degree or greater. Of the respondents who either support or oppose both nearshore and offshore wind farms 77.1% were supportive of wind farms both nearshore and offshore. A chi-square test of association showed a p-value=.574. N=164.

Have you attained a Bachelor's degree or an advanced degree beyond a Bachelor's?	Are you in favor or opposed to both near shore and off shore wind farms?	
	In favor (n=127)	Opposed (n=37)
Yes (n=150)	117	33
No (n=14)	10	4

In table 3.4 only those who supported or opposed both offshore and nearshore wind farms were included. Any individual who responded that they were neutral towards a development at either distance from shore were excluded. Based on the findings in this table, those who hold the strongest opinions towards development tend to be in favor of wind farms, no matter where they are placed. Roughly four times the number of those who are opposed to wind farms report that they are in favor of development.

The variables we have investigated thus far can be classified into the theme of acceptance of wind farms by sailors. Whether or not they are supportive of wind farms at varied distances from shore, or are willing to sail near a wind farm can be used to describe future behaviors around wind developments and if they will generally be accepted by the sailing community. We also investigated the perception of the safety aspect of offshore wind. There are inherent safety concerns when introducing obstacles into other navigable waters that may increase the likelihood of collisions. In this case we are interested in turbines, but obstacles can take the form of boat traffic, breakwaters, ferries, and many other obstructions. Our respondents were asked if they believed wind farms were a hazard, and if so at what

distance from shore they believed wind farms remained a hazard. 30.3% reported that they are not a hazard at any distance from shore. 32.7% stated they are a hazard within 1 mile of shore, 18% stated they are a hazard within 5 miles of shore, 3.9% stated they are a hazard within sight of shore, and 15.2% believe that wind farms pose a hazard to sailors no matter where they are placed. In addition, we asked respondents if they felt that sailing is threatened by wind farm development. If they answered yes, sailing is threatened, they were given an opportunity to explain why. Of the individuals who do believe that sailing is threatened by wind farm development, 82% provided a brief explanation on their beliefs. The concerns expressed can be summarized into three categories: increased risk to navigation and safety concerns, increased regulation around the ability to freely navigate, and concerns over aesthetics and natural beauty. Table 3.6 illustrates the relationship between those who believe wind farms are a hazard and those who think sailing is a threatened activity. Our interview with an individual who was a chief in the U.S. Coast Guard and heavily involved in the management of waterway usage in Southern New England addressed the safety and regulatory concerns expressed by respondents. Details on that information may be found in section 3.5**.** Concerns over aesthetics and natural beauty were far less prevalent than the other concerns, but still represent a major barrier to many individuals' acceptance of offshore wind.

In addition to the belief that wind farms are hazardous, we gauged respondents' perception of wind farms in less extreme terms by asking if they believe wind farms are a nuisance. Again, those who responded that they believe wind farms are a nuisance were given a choice of distance from shore intervals to report their beliefs. We expected the number of respondents to report wind farms as nuisance to increase compared to the number that think they are a hazard as the term nuisance can include a variety of factors beyond safety concerns. 24.7% do not believe that they are a nuisance anywhere, down from 30.3% that believe they are a hazard. 36.8% find wind farms a nuisance within 1 mile of shore, 22.4% find them a nuisance within 5 miles, 9.1% within sight of shore, and 8.1% find them a nuisance at any distance, no matter where they are placed. Table 3.5 demonstrates the difference in each of these qualifiers and table 3.6 compares the belief that sailing is threatened with thinking wind farms are a nuisance and a hazard.

Table 3.5 In our sample, we found that more sailors find wind farms to be nuisance than find them to be a hazard, suggesting there are significant reasons beyond safety and navigational concerns that alter perception of wind farms. These other variables may include aesthetics, concerns surrounding regulation, amongst other factors.

Do you believe wind farms are a hazard? (n=389)	Percentage	85% Confidence Interval
Yes (n=271)	69.7%	(66.2%, 72.9%)
No (n=118)	30.3%	(27.1%, 33.8%)
Do you believe wind farms are a nuisance? (n=398)		
Yes (n=304)	76.6%	(73.4%, 79.6%)
No (n=94)	23.4%	(20.4%, 26.6%)

Table 3.6 As we saw in the explanations respondents provided, there is a clear association between those who think sailing is threatened by wind farms and those who expressed concern about them posing hazards. A chi-square test for association gives a p-value<0.00. N=387. Likewise, of those who believe sailing is threatened, 95.8% believe wind farms are a nuisance with a p-value<0.00. N=396.

Do you believe that wind farms are a hazard?	Do you believe that sailing is threatened by the introduction of wind farms?	
	Yes (n=116)	No (n=271)
Yes (n=270)	109	161
No	7	110

(n=117)		
Do you believe that wind farms are a nuisance?	Do you believe sailing is threatened by the introduction of wind farms?	
	Yes (n=118)	No (n=278)
Yes (n=302)	113	189
No (n=94)	5	89

The final association investigated was to determine if sailing frequency influences a potential change in behavior if a wind farm were to be introduced near a respondent's home mooring or dock. We asked respondents how their sailing behaviors would change if a wind farm was developed near their home port, without specifying what distance qualifies as "near" their home port. We left that ambiguous because the closest potential site to a port varies drastically depending on where it may be. A marina on the south side of Martha's Vineyard, for example, could realistically be far closer to a wind farm than a marina in Narragansett Bay. When asked how their sailing behaviors would change 69.9% said they would not change, 10.1% said they would sail in the same area but would likely sail less frequently, 14.7% reported that they would move to an entirely new location to sail to avoid the wind farm, and 5.3% responded that they would be pleased with the wind farm and may even sail in the area more than they did below. Table 3.7 investigates the association between these behavioral changes and the frequency with which the respondents sail. To test for this association, we categorized sailing frequency into two groups: those which sail as much as possible (multiple days per week or more), and those that may fall into the "weekend warrior" category and choose to sail a few times a month at most. We also stratified the behavior changes into those who would change their behaviors in a negative fashion (either move locations entirely or sail less) and those who would not feel impacted in a negative way (no change in behaviors or enjoy the wind farm).

Table 3.7 A chi-square test for association between sailing frequency and change of behaviors if a wind farm was developed near a sailor's home port. Those that sail most frequently appear to be more likely to change their behaviors. p-value=.075 N=395.

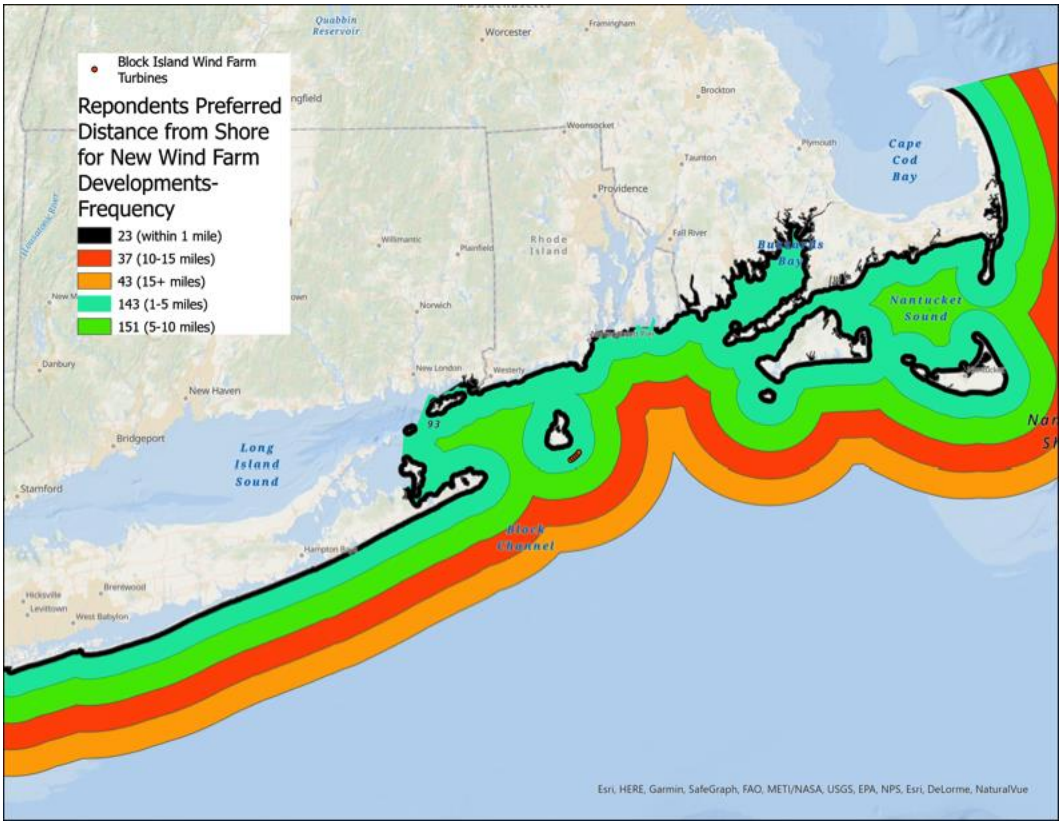
How would your sailing behaviors change if a wind farm was developed near your home port?	How frequently do you sail in the peak sailing season?	
	At least multiple times per week (n=261)	A couple times per month at most (n=134)
My behaviors would be impacted in a negative way (n=98)	72	26
My behaviors would not be impacted in negative way (n=297)	189	108

3.4 GIS Visual

In addition to interpreting the data statistically, we were interested in displaying some of the data through a visual medium. One question not yet addressed in our results asked respondents to choose the ideal distance from shore for a wind farm, regardless of their support or opposition of wind farms. In this question, we gave the respondents small additional pieces of information in order to allow them to make more informed decisions beyond the considerations of sailing. We informed them of the additional cost that is incurred as wind farms move further offshore, as well as the increased awareness and impacts that can arise with wind farms closer to shore. See Appendix 1. This question was asked after the two questions on support for near shore and offshore wind farms and respondents did not have the option to make changes to those answers.

Fig. 3.1
Here we see the respondents preferred distance from shore for wind farm developments. 74% of the sample stated that the optimal distance from shore for wind farms is between 1-10

miles. This is consistent with the proportion of individuals who support both offshore and near shore wind farms, which was 77.1%.



3.5 Interviews

During January 2021 we conducted 3 interviews: one with a former Chief in the U.S. Coast Guard (USCG) charged with waterway management, one with an individual who has vast navigational experience and holds a management position with races in the waters surrounding Block Island, and one with someone based out of Rhode Island who has a background in organizing some of the most prestigious long-distance sailing races in the world. Their identities and exact roles within their respective organizations will be kept confidential.

Interview 1

The individual with whom we spoke about the role of USCG focused heavily on the precautions and safety practices that will be implemented when many of the now in-development sites in Southern New England come online. A major decision the USCG chose to enforce, which is unique to the world, is the maintenance of freedom of navigation. There will be no restrictions on navigating within windfarms whatsoever- "The culture in America is that we don't restrict people from using navigable water." Even during the construction period, it is not the position of the USCG to limit navigation, so it has to work with developers to maintain the area in such a way as to allow for unrestricted passage. Our European counterparts have enforced restrictions to some degree across many of their installations. These restrictions may limit the site from commercial fishing, commercial traffic, and other as needed restrictions. With this policy in mind the USCG worked with developers and had them agree to a suite of navigation aids. These include: installing individual turbines in a north-south east-west grid pattern in 1x1 nautical mile pattern, synchronized visual aids on the towers, synchronized audio aids emitting from the towers, unique identifying codes on each tower to more easily report location to emergency services in a crisis situation, AIS signals on each towers, and inclusion in electronic charts that when selected on the chart provide important specifications about that specific tower to ease navigation.

As a former active member of the USCG safety is a top priority, and of course any introduction of potentially thousands of obstructions can cause alarm. However, it can be boiled down quite simply. With proper safety measures in place and effective charting these turbines are no different than any other obstructions in the water. It is up to the individual sailor to assess the risk incurred by entering the farm, but should they choose to do so it may be quite an enjoyable experience.

Interview 2

The interview with the manager of races around Block Island focused heavily on the relationship between wind farms and sailing races. In 2019, the BIWF was used as a turning mark for the Around Block Island Race, part of the annual Block Island Race week. According to participants in the race, the inclusion of the turbines as a turning point was

nothing but a positive. There was no concern of the air gap (that is the distance between the surface of the water and lowest tip of a blade) for any of the racers. Another concern expressed elsewhere was the wind turbulence that turbines can generate and create unpredictable wind patterns in the draft. This was not mentioned by any competitors and did not hinder their ability to run the race. They are a navigation concern, but no more than any other obstructions that are found in this area. Turbines are just something that navigators need to be aware of and no official complaints have been made to him.

Finally, sailors tend to be an environmentally sensitive group and are, for the most part, inclined to coexist with wind farms unless there is a bigger problem. As a representative for his organization, his attitude is that "it is what it is" and should be accepted going forward, given responsible planning and safety precautions. His biggest concern is that of environmental impacts. He has been actively involved in rerouting established races to avoid migratory patterns of the Right Whale through the Gulf of Maine and would support measures to aid in the conservation of marine ecosystems, even if it meant slightly increasing the inconvenience for the sailing community.

Interview 3

Our last interview shared many of the concerns as the previous one. As the most experienced sailor we interviewed, this individual is very familiar with the racing and recreational aspects of sailing in this area, in addition to organizing and participating in the most popular and prestigious sailing events in the world. He was, however, very interested in the outcome of this study because, like us, realizes that the sailing community has been relatively silent during the review phases of wind energy developments. There is a demonstrable need for conversations such as the one we had with him, and hopefully this review into the needs of the sailing community can continue to inform policy decisions as developments continue to increase. Perhaps the greatest things that can be done for the sailing community is the distribution of information to help people truly understand the scope of what these wind farms may look like and how sailors are able to interact with them in the future.

4. DISCUSSION

This study investigated the perceptions of and preferences for wind farms in sailors located in CT, NY, MA, and RI. Studies in the past have focused on ocean user groups experiences with wind farms (Alexander, Wilding, & Jacomina Heymans, 2013; Dalton et al., 2020; Ferguson et al., 2021; Samoteskul et al., 2014)**.** This, however, is the first study to focus exclusively on the experiences of sailors. The waters off the coast of CT, NY, MA, and RI are used heavily by sailors, and as a major user group in the management of waterways it is important to understand how they will be affected, and what their preferences are, in the face of new developments.

Results from this study show that most sailors in this area will be comfortable sailing within 1 mile of a wind farm. We define 1 mile as close to a wind farm because within a wind farm sailors would never be more than roughly 0.5 miles from a single turbine, and willingness of sailing along the outer boundary of a wind farm is just as pertinent in this study.

We did find that some characteristics of sailors increase or decrease the likelihood of that individual sailing within 1 mile of a wind farm. Many other variables had no impact on the willingness to sail within 1 mile. Those variables include willingness to sail within 1 mile include: comfort navigating in areas densely populated with other boats and areas with rocks, previously sailing near the BIWF, and frequency with which the respondent sails. All of these factors are related to a respondent's previous experience sailing. The fact that sailing experience had little influence on an individual's likelihood of feeling comfortable sailing near a wind farm was an unexpected result. Ladenburg, 2009 found that prior experience sailing near a wind farm increased support in individuals, especially those with regards to accepting the aesthetics of wind turbines. Additionally, Alexander et al., 2013 found that fishers who had experience fishing in areas with wind farms were generally more supportive of additional developments. In this study, we do not find that previous sailing experience has the same effect.

Although we are not able to identify why this is the trend in this sample, it may be due to the fact that many sailors still do not know what commercial wind farms may look like. As was stressed in our third interview. When the Mass-Rhode Island Wind Energy Area is fully developed it could be home to hundreds, maybe even over a thousand, turbines. Right now, the only wind farms that Americans knows are just test sites consisting of five turbines and two turbines. These farms are so small and relatively harmless that they do not require much prior knowledge or skill to navigate through safely. They are easy to avoid and navigating around them is barely an inconvenience, if at all. When more commercialized wind farms start to come online it will become a greater inconvenience to navigate around them. Sailing through them will be allowed, but maybe just the most skilled navigators will feel comfortable doing so. A trip around the wind farm will likely add hours onto a single trip. The bigger wind farms will simply be a larger presence unlike the BIWF and CVOW. Perhaps when this start to become more normalized and understood we will see prior sailing experience increase sailors' comfort sailing near the operations.

We did find that previous held beliefs about wind farms were correlated with someone's comfort sailing within 1 mile of a wind farm, namely supporting nearshore and offshore wind farms, and believing sailing is a threatened activity because of wind farms. This information is valuable in the face of differing findings from Ladenburg, 2009 & Alexander et al., 2013. It demonstrates that sailors are categorically different from motorboaters and fishers. Developers of wind farms have a breadth of knowledge on these two demographics, including others in the commercial industry (Samoteskul et al., 2014), we hope that showing not all ocean users share the same opinions provides additional insight moving forward.

It appears that preconceived notions about the relationship between wind farms and sailing are largely correlated with determining respondents comfort level sailing within 1 mile of a wind farm. We found that the associations between those who believe sailing is threatened and those who support the development of wind farms irrespective of the impact it will have on sailing are significant in respondents comfort levels. Those who think sailing is threatened are far less likely to feel comfortable sailing within 1 mile of a wind farm than

those who do not think sailing is a threatened activity. Initially, we thought that perhaps previously sailing near the BIWF would have an effect on whether or not respondents thought sailing was threatened as they would have had experience with which to make an informed decisions. However, that was not the case and previous exposure was not a correlative variable in thinking sailing in threatened ($p=.119$). We did not define what we meant by the term "threatened" and left it up to the survey takers to define the term for themselves. We were concerned that if we chose to define it for them we may exclude those who do feel it is threatened, but that our definition did not match their own attitudes. Based on voluntary responses, it appears that many of those who do think sailing is threatened interpret "threatened" as a threatening force to safe navigation, not necessarily to the activity itself. Wind farms do introduce excess obstructions and hazards into waters that were previously quite easy to navigate through. Exclusion from wind farms would be entirely voluntary on the part of sailors as the USCG is maintaining freedom of navigation within the farms, but if sailors feel threatened and do choose to avoid wind farms the effects can be felt as exclusionary. Sailors need to be made aware of the extensive safety measures and aids to navigation that will exist in the farms in order to maintain an unaltered way in which they sail.

Another prior held belief that changed respondents' willingness to sail within 1 mile of a wind farm was the support they held towards wind farms. Those who were in favor of developments both close to shore and offshore (put simply, supportive of wind farms anywhere) were far more comfortable sailing within 1 mile of a wind farm. Although we are not able to identify the precise underlying reasons in this study, we can look to Ferguson et al., 2021 in order to understand that those who support wind farms tend to be less worried that wind farms will negatively affect recreation in the surrounding area. Their study consisted of only 11.9% *non-motorized pleasure boating*, which includes sailors as well as other forms of boating like rowing, paddle boarding, etc., so we cannot conclusively say that sailors hold these same opinions. As we saw above, the opinions of sailors in this study have deviated from other sea-based activities. However, our data may be able to backup Ferguson et. 2021 to a certain extent. We found that those who support wind farms are less likely to believe that sailing is threatened ($p<0.000$). We are able to understand that sailors who are in

support of wind farms are less concerned about the negative effects they will have on recreational activities, such as sailing, but there may be additional underlying factors that will require future research to fully understand.

Only one other study has investigated recreational boaters' preferences for offshore wind farms from an on-water perspective. Dalton et al., 2020 used a stated-preference survey to determine boaters' preferences for boating trips in the vicinity of offshore wind farms. Their sample statistics very closely resembled ours, except for the fact that 46% of their respondents were motorboaters. Most recently Ferguson et al., 2021 published a study that investigated the influence of perceived impact on recreation and coping mechanisms upon recreationalists attitudes towards potential wind farm developments along the New Hampshire coastline. Ferguson et al., 2021found that recreationalists are not likely to change their recreational behaviors in the face of an increase in wind developments in the surrounding area. Our study is consistent with these results as ~25% of our sample reported that they would either move to a new port or sail with less frequency if a wind farm was developed near their home port and ~76% would feel comfortable sailing within 1 mile of a wind farm. In light of the fact that sailors do have many unique opinions to other ocean-user groups, they do share many beliefs that have the potential to influence future policy regarding wind development.

In addition to Dalton et al., 2020 & Ferguson et al., 2021 we have seen an increase in studies investigating the attitudes of recreationalists towards offshore wind energy. Studies like Ferguson et al., 2019 which focused on recreationalists on Lake Erie, Smythe et al., 2020 which investigated the conflict of tourism and recreation at the BIWF, and Smith, Smythe, Moore, Bidwell, & McCann, 2018 highlights the growing attention that marine recreationalists are getting in academic research. As the knowledge of the desires of this particular user group continues to increase it can help in informing Marine Spatial Planning (MSP) in the Northeastern United States.

MSP is a policy framework used to aid in access to public waters. It brings together groups of stakeholders- commercial, government, conservation, energy, recreation- and uses input from everyone to make informed decisions on how to manage waterways. In 2012, the Northeast Regional Planning Body (NERP) was formed and it consists of representatives from ME, NH, MA, RI, CT, NY, indigenous tribes, federal agencies, and the New England Fishery Management Council. The goal of this organization is to inform their MSP decision making through five pathways, two of which directly rely on research of the kind found in this paper: 1.) the use of current, sound science and data and 2.) changing the plan to account for changing conditions and new information (McGee, 2020). As has been demonstrated above, this study introduces new information on the sailing community that can be used in further development in the NERP, and other studies that have focused on recreationalists in general are now becoming a much larger focus in the literature that can also be expanded upon.

At the time of writing, the NERP has published the Northeast Ocean Plan. In its current state the Plan has introduced no new regulatory measurements, because as we know there may not be any restrictions on navigation in American waters, but it does intend to work with its member representatives to make the most informed decisions possible. The NERP has identified six priorities in further understanding the scientific body of literature to make the most informed decisions. The third priority reads "Improve understanding of human activities, coastal communities, socioeconomics, and interactions between users." (Starbuck & Lipsky, 2012). This study, and other like studies, should be utilized by the NERP to better understand human activities and how recreationalists, particularly sailors, may interact with the wind energy sector where they may overlap.

Ultimately, we find that, in general, sailors are quite supportive of wind farm development in Southern New England as long as they are responsibly sited. We found this through the statistical analysis in the results section, as well as in our qualitative interviews. In fact, based on the interviews we may be led to believe that sailors could support wind farms more than the general population- "As sailors, we are inclined to coexist with a wind farm unless there is a big problem. Sailors tend to be environmentally sensitive. We prefer

renewable energy over fossil fuels." However, just because sailors tend to support wind energy, does not mean it is a blank check. There are still many sailors who are either opposed to wind development, or in support but not comfortable sailing near the installations. Aitken, 2010 argued that individuals who have opposed wind farms in the past have been labelled as deviant and are either ignorant or misinformed, but that is not the case. Sailors who are opposed to wind development or feel as though they will be excluded from navigable waters near wind farms need to be understood. If the majority of sailors are unaffected by wind farms, but a proportion are not, then the sailing community will lose many valuable individuals which is unacceptable. We need to work with the entire community to meet the community's needs for a successful future.

While this study provides valuable insight into the sailing community, it is by no means comprehensive. We were limited in our scope in three facets: the COVID-19 pandemic made it impossible to travel and talk to interested parties in person, we were constrained in time as we only had nine months to complete this project, and we were limited by the number of people working on the project which necessitated the prioritization of work.

If we were not limited by the COVID pandemic, we would have been able to travel to hotspots of sailors and have discussions with people face to face and likely bolster out interview response data. We were not able to accomplish that, so we had to reach out to experts in the sailing community, and those results may not be representative of the sailing community.

As an honors thesis project for a senior undergraduate student, we were limited by time. We had to conduct the entirety of this project between September 2020-May 2021. This was especially apparent in the spring, as data analysis had to be a hurried project in order to meet writing deadlines. There was nothing significant left out of this study, but there was not much time to work with the data to study hidden findings.

Again, this was a senior project, so most of the work relied heavily on the student and faculty sponsor. In a study like this, there is only so much that two individuals, with the help

of others, can accomplish. We had to prioritize work based on the feasibility of completion which limited the possible scope of this project.

For future research, we suggest an expansion on this investigation. To start, our sample obtained from the third-party Info-Link contains over 3,000 registered sailing vessels. We did not utilize the samples from the north shore of MA, NH, and ME. Expanding this study to the entirety of New England would likely lead to more conclusive results. We would also like to see a more comprehensive survey, including more demographic questions and significantly more questions on the sailing behaviors of respondents. The final potentially limiting factor of this study is the membership of the author in the sailing community. Henry Harris is an active sailor in Long Island and has a vested interest in that population's opinions and longevity.

5. CONCLUSION

This study was just the first to focus exclusively on sailors as a user group in the face of increased wind development in the United States. There is evidence that studying recreationalists attitudes towards offshore wind energy is growing and will continue to grow in the coming years. Preliminary results, as shown in this study, demonstrate that sailors are quite receptive to offshore wind energy, especially between 5-10 miles from shore. Closer than that and offshore wind farms can be more easily construed as either nuisances are hazards, and further than 10 miles from shore becomes too costly and complicated. Furthermore, sailors respond to the introduction of wind farms in different ways than other ocean user groups, namely shippers, motor boaters, and fishers. Other user groups tend to become more comfortable sailing close to wind farms as they have more exposure to the installments, but sailors in the Northeast United States have not yet demonstrated that pattern. Since previous exposure was not likely to increase sailors' comfort level of sailing within 1 mile of a wind it is probable that previously held personal beliefs towards this energy source is an influencing factor, but future work will need to be done on that topic. The sailing population is entirely unique in the field of ocean user groups, and this study has demonstrated that sailors' perceptions of wind energy are a category of their own.

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Appendix 1- Survey Questions

1. Thank you for your willingness to participate in this study. This survey should take no longer than 10 minutes and at the end you will have the opportunity to submit your email address to enter a raffle for a $125 Amazon gift card. As you saw in the invitation, this survey is entirely confidential, and all data will be released in summary form and no individual responses will be identifiable.
   Before you start the survey, we ask that agree to the terms on the next page. Thank you again for help in gaining an understanding of how sailors may be impacted by wind turbines.
2. We are collecting responses to the survey below as part of a research project. The survey asks questions about offshore wind farms and takes approximately 10 minutes to complete. If you choose to complete the survey, your responses will be recorded confidentially and you are free to leave any of the questions unanswered. Your responses will be kept separate from your individual identification code to improve confidentiality.

   If you would like to learn more about this research project, please feel free to contact me: Henry Harris at hbharr21@colby.edu; you may also contact my faculty sponsor Dr. Alison Bates at alison.bates@colby.edu. If you have any concerns about your rights as a research participant, please contact the Chair of the Colby Institutional Review Board for Research with Human Subjects, Tarja Raag (tarja.raag@colby.edu).
   a. I wish to continue to the survey
   b. I do not wish to continue
3. Do you consider yourself a sailor in the northeastern US, specifically in the areas near Long Island Sound and Rhode Island Sound?
   a. Yes
   b. No
4. Please consider your "typical" day sailing. Do you typically sail:
   a. Close to shore (stay within about 1 mile from shore)
   b. Up to 5 miles from shore
   c. Offshore (more than 5 miles from shore)
5. How often do you sail from April-November?
   a. Everyday
   b. Multiple days a week
   c. A few times a month
   d. Once every few months
   e. A few times a year
6. How often do you sail from December-March
   a. Everyday
   b. Multiple days a week
   c. A few times a month
   d. Once every few months
   e. Rarely
   f. Never
7. The Block Island Wind Farm is the only sea-based wind farm in the United States. A wind farm is a collection of wind turbines set on the ocean floor that rise hundreds of feet off the surface of the water. The blades of the turbines spin with the wind and generate electricity which is transported via undersea cable to land. The Block Island Wind Farm consists of 5 turbines and is located 3.8 miles southeast of Block Island. Please see the picture below.

(Photo by PR team for Block island Wind Farm)

8. Prior to this survey were you familiar with the Block Island Wind Farm?
    a. Yes
    b. No
9. Have you ever sailed within sight of the Block Island Wind Farm?
    a. Yes
    b. No
10. Have you ever sailed within 1 mile of the Block Island Wind Farm?
    a. Yes
    b. No
11. Below, please indicate how comfortable you are navigating around near obstructions
    a. Rocky Areas
        i. Comfortable
        ii. Not Comfortable
        iii. Not sure
    b. Other Boats
        i. Comfortable
        ii. Not Comfortable
        iii. Not sure
    c. Piers
        i. Comfortable
        ii. Not Comfortable
        iii. Not sure
12. Please describe your geographical preferences for sailing on a **typical** day:
    a. I prefer to sail in a few known locations
    b. I sail to new locations about half of the time
    c. I mostly try to sail to new locations
13. What is your opinion about wind farm development near the coast (within 5 miles of shore)?
    a. I am in favor of future wind farms closer to shore
    b. Opposed to future wind farms closer to shore
    c. Neutral on whether or not wind farms are developed closer to shore
14. What is your opinion about offshore wind farm development off the coast (greater than 5 miles from shore)?
    a. I am in favor of future offshore wind farm development further from shore
    b. I am opposed to future offshore wind farm development further from shore
    c. I am neutral on whether or not offshore wind farms are developed further from shore
15. Do you feel that sailing is, or could be, threatened by the development of wind farms?
    a. Yes
    b. No
16. If Yes, why do you believe sailing is threatened?

17. Let's assume a hypothetical wind farm was proposed near your home mooring/dock. How would the presence of this wind farm affect your willingness to sail in that area?
    a. I would stop sailing in this area and move to a new mooring/dock
    b. I would not move to a new mooring/dock, but I would likely sail less
    c. My sailing behaviors would not change
    d. I would be thrilled and enjoy sailing here more than I did before
18. Think about the areas in which you most commonly sail. There are certain areas that are much more popular amongst sailors than other areas. Regardless of how far from shore these favorable spots are, what distance should wind farms maintain from the most popular of sailing areas?
    a. Less than 1 mile
    b. Between 1-5 miles
    c. Between 5-10 miles
    d. More than 10 miles
19. There are pros and cons to locating wind farms close to shore, and far from shore. On the one hand, it can be very expensive to place wind turbines far from shore. The cables transporting energy from the turbines to land can cost as much as $100,000 per foot ($528 million per mile). Cables are not the only cost that increases with distance from shore - construction, foundations, and turbines type all become more expensive as the water depth increases. Energy companies and municipalities will likely recover these costs through taxes and energy costs.

    On the other hand, most ocean recreation occurs close to shore, and if turbines are placed near shore, they will be more visible and may overlap with popular recreation areas. At what distance from shore does it make the most sense to develop wind farms?
    a. Less than 1 mile from shore
    b. Between 1-5 miles from shore
    c. 5-10 miles from shore
    d. 10-15 miles from shore
    e. 15-20 miles from shore
    f. 20+ miles from shore
20. If a wind farm was built in an area where you regularly sail, how would your sailing behaviors change?
    a. They would not change. I would still sail in and around the wind farm
    b. I would not sail in or around the wind farm, but I would still sail in the same general area (within 1 mile)
    c. I would not sail within 1 miles of the wind farm and would seek to sail elsewhere
21. How close to a wind farm would you be comfortable sailing?
    a. *Indicate response in 0.5-mile increments from 0 miles-5 miles*
22. How close to shore do you believe wind farms are a NUISANCE?
    a. They are not a nuisance
    b. Within 1 mile of shore
    c. Within 5 miles of shore
    d. Within sight of shore
    e. They are a nuisance no matter where they are located
23. Why are they a nuisance?
24. How close to shore do you believe wind farms are a HAZARD?
    a. They are not a nuisance
    b. Within 1 mile of shore
    c. Within 5 miles of shore
    d. Within sight of shore
    e. They are a hazard no matter where they are located
25. Why are they a hazard?
26. Do you sail at night?
    a. Yes
    b. No
27. Do you think wind farms pose a unique danger to vessels sailing night more so than to those that sail during the day?
    a. Yes

b. No

28. Please feel free to use this section to add any further comments you wish to make:
29. What is your gender?
    a. Male
    b. Female
    c. Non-binary
30. What is the highest degree or level of schooling that you have completed (or are currently enrolled)?
    a. Grade School
    b. High School
    c. Some college (no degree)
    d. Associate's degree
    e. Bachelor's degree
    f. Graduate/Professional degree
31. Is the address at which you received the invitation to participate in this survey your primary address?
    a. Yes
    b. No
32. What is your employment status (pre-COVID)?
    a. Student
    b. Part-time
    c. Full-time
    d. Homemaker
    e. Retired
33. Which category best describes you household income before taxes (pre-COVID)?
    a. Less than $10,000
    b. $10,000-$19,999
    c. $20,000 - $29,999
    d. $30,000 - $49,999
    e. $50,000-$74,999
    f. $75,000-$99,999
    g. $100,000-$149,999
    h. $150,000-$249,999
    i. $250,000 and above
34. What is the length overall (LOA) of your sailing vessel?
    a. Less than 25 feet
    b. 25-29 ft
    c. 30-34 ft
    d. 35-39 ft
    e. 40-44 ft
    f. 45-49 ft
    g. 50-54 ft
    h. 55-59 ft
    i. 60 feet or longer
35. Do you wish to enter your email address for a chance to win a $125 Amazon Gift Card?
    a. Yes
    b. No

Appendix 2- Semi-Structured Interview Format

Based on the experience of our interviewee we asked a combination of the following questions. Depending on their answers the interview then went "off-script" to develop the most useful and interesting interview.

Wind farms are a form of renewable energy in which turbines rise hundreds of feet off the surface of the water and capture wind energy. In 2016 the Block Island Wind Farm started operation as the only offshore wind farm in the United States. It consists of 5 turbines and is situated roughly 4 miles off the southern coast of Block Island. This project came off the heels of the failed Cape Wind Project in Nantucket sound that would have been comprised of 130 turbines. Now, there are more proposed wind farms in the waters between Block Island and Martha's Vineyard, with Vineyard Wind being the furthest along in the development process. The goal of this interview is to understand institutional responses to Wind Energy Development in some of the busiest sailing areas in the United States.

Can you tell me what your personal experiences have been towards wind energy with regards to sailing and any concerns you may have as a professional?

- Expand on that more?
- Is this what you are hearing from those that you represent? Do you agree?

Tell me about the biggest concerns you have about wind farms.

- Will it impact racing?
- Do they pose a threat as obstructions?

How do you envision a future with sea-based renewable energy systems and sailing?

As significant stakeholders in the future of ocean usage why might you think the sailing community will, or will not, endorse further development of wind energy?