2022

ANGLER'S SENSE OF PLACE AS AN INDICATOR FOR PERCEPTIONS OF VULNERABILITY AND LIFE SATISFACTION RELATIVE TO SHIFTING STOCK DISTRIBUTIONS

Elizabeth Conley
University of Rhode Island, e_conley@uri.edu

ANGLER'S SENSE OF PLACE AS AN INDICATOR FOR PERCEPTIONS OF VULNERABILITY AND LIFE SATISFACTION RELATIVE TO SHIFTING STOCK DISTRIBUTIONS

BY

ELIZABETH CONLEY

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

IN

MARINE AFFAIRS

UNIVERSITY OF RHODE ISLAND

2022

MASTER OF ARTS IN MARINE AFFAIRS

OF

ELIZABETH CONLEY

APPROVED:

Thesis Committee: Lisa Hiwasaki

Carlos Garcia-Quijano

Lisa Colburn

Major Professor Emily Diamond

Brenton DeBoef
DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND
2022

ABSTRACT

Geographic locations are a fundamental aspect to human life, but their impact on well-being is seldom accounted for and often not formally considered within assessment frameworks to monitor at-risk coastal communities. Climate change continues to warm ocean waters and cause fish stocks to redistribute to untraditional locations, prompting changes in angler behavior and destabilizing the connection they have built with particular places in order to fish successfully. This research evaluates recreational angler's sense of place in NY, CT, and RI, as an indicator to assess perceptions of vulnerability and life satisfaction in relation to shifting fish stock distributions through a mixed-methods research design. The findings of this research suggest that recreational angler's sense of place can be a significant predictor of vulnerability perceptions as environmental conditions continue to shift. Sense of place is a key component to an angler's identity, and therefore must be preserved to promote community resilience. This study assists in gaining a deeper understanding of a fishing population by recognizing the needs and values that anglers have in an effort to maintain their personal investment to their environment as changes continue to occur, and to encourage sustainable behavior and help anglers better adjust to change. Implementing sense of place as an indicator within vulnerability and well-being assessments may contribute to the robustness of the socio-cultural data collected within fishing populations to build holistic and adaptive ecosystem-based management plans, as well as assist with the movement towards climate-ready fisheries policy.

ACKNOWLEDGMENTS

First and foremost, I would like to thank my wonderful advisor Dr. Emily Diamond for her guidance, insightfulness, and genuine dedication to my research, as well as her patience and encouragement throughout this past year. Thank you also to my committee: Dr. Lisa Hiwasaki, Dr. Carlos Garcia-Quijano, and Dr. Lisa Colburn, for their thoughtful feedback during every stage of my thesis process, I truly have appreciated it.

In addition, I would like to thank E. Fachroni, M. Rao, and Dr. C. Mouw for providing edits to the initial draft of my thesis document, Dr. Jason McNamee for his help with my survey coding, and Dr. Jeremy Collie for serving as my defense chair. I would also like to acknowledge and sincerely thank the anglers who participated in this study for their time and enlightening conversations.

To my friends, classmates, and cohort – thank you for the laughs and reassurance along the way, I have learned so much from each of you and feel grateful to be surrounded by such good people. To my Mom & Dad – thank you for the unwavering support, for always encouraging me to pursue whatever brings me happiness, and for instilling a sense of place within me. You have made my dreams possible. To my sister Mary – there are never enough words to express how much you mean to me, but thank you for grounding me, for providing me perspective, for being my biggest source of inspiration, as well as my hero and best friend. I wouldn't be me without you. To my partner Kalin – thank you for being my rock, I could not have done this without you cheering me on and I am forever thankful to have you by my side.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

As climate change continues to affect and transform coastal areas, it is important to construct management plans that enhance recreational angler's ability to adapt, as well as maintain resilience. Recreational fishing populations can be classified as vulnerable by way of their close proximity to the coast, where the effects of climate change are more pronounced due to an increased susceptibility to risk imposed on the surrounding area (Cutter et al. 2003, Miller et al. 2010). An angler's[1] exposure, sensitivity, and adaptive capacity to climate change heavily depends on what part of the ocean they target, as their past experiences can pose limitations regarding where they are able to fish due to familiar ecological knowledge, boat size, and spatial conservation management (Rogers et al. 2019). In particular, important fisheries in the Northeast and Mid-Atlantic are experiencing a general northward shift and are progressively being invaded by an increased abundance of southern species due to the continued warming of ocean waters (Cheung et al. 2009, Pinksy et al. 2013, Sydeman et al. 2015). This effect driven by climate change has direct implications on human behavior, where anglers may have to relocate their efforts to non-familiar locations or diversify the catch they target, which is becoming increasingly difficult due to strengthened management measures to promote sustainable fishing (Stoll et al. 2017). This, in turn, can have an

[1] The use of angler, fisher, and fishermen are used interchangeably throughout this document.

impact on the cultural component of an angler, such as sense of place: an environmental identity that is expressed as strong place attachment anglers can have to the location anglers have fished for an extended period of time (Khakzad and Griffith 2016). As a consequence of shifting stock distributions, overall well-being of anglers may be affected (Figure 1).

Figure 1. Theoretical framework depicting the progression of how climate change can ultimately influence angler well-being.

Sense of place can be explained as a multidimensional concept constructed from an individual's beliefs, emotions, and behavioral commitments to a specific geographic setting (Jorgensen and Stedman, 2001). This attitude-based theory has shown complexity in the relationships between the experience of a place and attributes of that place, and how environmental perceptions can influence and predict sense of place dimensions (Jorgensen and Stedman, 2006). Due to how involved sense of place can be to a particular environment, the impact that climate change effects, such as shifting stock distributions, can have on an angler's attitudes towards their environment as well as a part of their own identity, may be significant. Considering angler's sense of place acknowledges a human component of an ecosystem, which is essential in building ecosystem-based management plans but is under-valued due to the difficulty of quantifying non-traditional market resources (National Ocean Economics Program 2009,

Mulvaney et al. 2020). As policy has traditionally overlooked sociocultural attributes to coastal communities, this research works to highlight the contribution sense of place can make towards maintaining and assessing components to the overall resilience and well-being of recreational anglers (Khakzad and Griffith 2016).

Climate change is predicted to continue to affect the distribution of all marine life, including species at the base of the food web as well as apex predators (Bindoff et al. 2019). In the Mid-Atlantic Bight and Georges Bank, species are exhibiting strong poleward shifts as opposed to species in the Gulf of Maine that are showing larger depth shifts instead of latitudinal shifts. In this area, there is projected to be a 4.1-degree Celsius surface to 5.0-degree Celsius bottom warming of ocean temperatures over the next 80 years, further contributing to an increased northward distributional shift of species (Kleisner et al. 2017). Changes in distribution to find ideal thermal habitats for targeted species in this region will disrupt traditional fishing patterns where fishing-dependent communities could experience negative economic impacts as a result of a decreased ability to access stocks that have shifted into separately managed regions, as well as a result of increased travel costs (Kleisner et al. 2017). Based on a trawl survey, the Mid-Atlantic Bight contains an array of species that are susceptible to losing preferable habitat. In turn, this will cause increased distances from routinely targeted areas, which is expected to impose additional limitations and hardships on both commercial and recreational fishermen (NOAA 2007; Young et al. 2019). Multiple locations in

New York, Connecticut and Rhode Island including Montauk, New London, and Point Judith are experiencing shrinking opportunities and increased exposure to risk, especially relating to their gillnet fisheries including some of the most important target species caught in these areas such as flounder, haddock and cod, which also has similar implications for the recreational fishing sector (Rogers et al. 2019). For example, the distribution of summer flounder, a main target species for commercial and recreational fishing within these states, is projected to shift 152 km from their traditionally fished target area within the next 60-80 years (Kleisner et al. 2017).

Climate change is expected to impact recreational angling in a multitude of ways. Under a high emission scenario, 20% of traditionally targeted recreational stocks have been classified as vulnerable to climate change (Nyboer et al. 2021). These climate change-based changes will lead to altered fishing behavior (Townhill et al. 2019, Nyboer et al. 2021). Emphasizing the social impact climate change will have on recreational fishing will lead to improved management decisions (Nyboer et al. 2021). Recreational angler's fish for a variety of different reasons, including for sport, leisure, and subsistence. Future research is needed to understand the motivations behind certain recreational angling practices, as well as how anglers themselves may be predicted to adapt to climate change-induced changes to recreational fisheries. Evaluating recreational angler's sense of place may provide a pathway to evaluate how climate change has, and will continue to, impact this population, and will contribute to the data collection within Northeast and Mid-

Atlantic based populations that have historically been overlooked within policy in comparison to the commercial sector (Bauer et al. 2016).

There is a manifesto in marine social science that has identified the need to study and analyze the significant implications climate change can have on coastal communities' social-ecological transformations and fishing livelihoods, in relation to their vulnerabilities (Bavinck and Verrips 2020). Insufficient consideration is being given to social indicators[2] as a basis for fisheries management decisions. Therefore, there is a need to incorporate and build upon the social data used within assessment frameworks in order to apply ecosystem-based policies, accurately monitor change, enable adaptive decision-making, and increase the ability to understand angler vulnerability and well-being. Using angler's sense of place as an indicator within management will help further sustainable harvesting practices as well as aid fisheries to better acclimate to changing environmental conditions in an effort to maintain a way of life. Incorporating marine social science in order to help anticipate impending trends in our rapidly changing environment can help promote further blue growth and sustainability (Arbo et al. 2018).

The questions this research worked to answer include: 1) How does an angler's sense of place influence their perceptions of vulnerability to shifting stock distributions? 2) Which components of sense of place affect which components of vulnerability perceptions? 3) How does an angler's sense of place impact their life satisfaction? 4) If anglers have seen a decrease in

[2] Indicators are a widely accepted means to model sustainability and well-being for marine fisheries (FAO 2008)

availability of traditionally fished species, how does this affect those angler's life satisfaction based on their sense of place? This study used a mixed-methods research design by distributing an online survey through Facebook groups dedicated to recreational fishing in Rhode Island, Connecticut, and New York, and conducting follow-up interviews. The findings of the study suggest that sense of place is an indicator of vulnerability perceptions, where the higher an angler's sense of place is, the higher their vulnerability perceptions are. Having fewer years of experience fishing also lead to increased vulnerability perceptions within anglers. An angler's background, including their demographics and family history with fishing contributes to building an angler's sense of place, as well as their life satisfaction. Fishing location also had implications where the inability or unwillingness to leave a preferred spot and fishing from shore contributes to higher perceptions of vulnerability, while being able to fish offshore contributes to life satisfaction positively. Finally, the influence of angler's environmental perceptions is significant; higher satisfaction with catch availability, and foreseeing a higher life satisfaction in the future associated with the challenge of adapting to shifts in target species habitat locations, contributes positively to an angler's current life satisfaction. These results provide key insight for management bodies to take into account when developing climate-ready fishery policies.

CHAPTER 2

REVIEW OF LITERATURE

2.1 *Overview of Recreational Fishing in the U.S.*

Recreational fishing can be defined as fishing done by individuals for sport or leisure, with the possibility of catching for personal consumption (FAO 1997). This differs from commercial fishing that is carried out to catch fish to sell for a profit (Smith 2002). Saltwater recreational fishing has been recognized as an essential part of U.S. coastal life and communities, as well as improving individual well-being (Townhill et al. 2019, NOAA 2022). One of recreational angling's largest contributions to society includes the socio-cultural value of installing a deep connection in individuals to the environment (Tufts et al. 2015). Recreational and commercial fishing has also been acknowledged as an important source of protein as well as a key contributor to local and national economies (Cowx, 2002, Hilborn et al. 2003). Counts of recreational anglers exceed the number of commercial fishers, with only 12% of the total United States population having never participated in recreational angling (Cooke and Cowx 2006, NMFS 2001). In 2002, recreational anglers accounted for 23% of total nationwide recreational landings (Coleman et al. 2004). Marine recreational fishing effort has increased by 20% in the past 20 years, and can compete with commercial effort for certain stocks, such as summer flounder (Coleman et al. 2004). Commercial and recreational fishing effort is comparable when accounting for the demographic and ecological effects on fish stock populations. Main differences in fishing practices include

recreational populations often fishing down the food web (targeting top level predators) as opposed to targeting both upper and lower levels of the food chain, like many commercial sectors do. Recreational anglers also have access to productive coastal zones that commercial fishermen are not able to target, and therefore can contribute significantly to the total catch of fishery targeted by the commercial sector, as well as exceeding commercial effort for stocks such as striped bass, bluefish, and sea bass (Cooke and Cowx 2006).

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, National Standard 8 requires that fishery resources important to fishing communities be taken into account through the use of economic and social data that can be provided for a community. Although the MSA's governing authority falls over both commercial and recreational fishing communities, it is hard to balance the interests of both populations, leading to the commercial fishing industry taking precedence due to its heightened contributions to the U.S. economy. Yet, there are close to 10 million anglers who participate in recreational saltwater fishing in the U.S., where the Atlantic coast serves as a hotspot for recreational fishing, contributing to 53% of that region's catch (Bauer et al. 2016). The demand for recreational saltwater fishing is predicted to double over the next generation as the overall population on the coast continues to grow (Bauer et al. 2016). There is an increasing acceptance that fisheries management is more about people management than fish (Ditton and Hunt 2001). Understanding angler's attitudes, motivations and goals are essential components to managing human

behavior and necessary for creating coherent fisheries management plans. Moving forward, it will be increasingly important to acknowledge recreational fishers as essential stakeholders for the sustainable management of resources, for the economic development of coastal communities, as well as to fill the gap in data collection within this population in order to best tackle climate change issues (Bauer et al. 2016, FAO 2017).

2.2 *Vulnerability*

2.2.1 Climate Change and Angler Vulnerability

Climate change can be expected to effect fishing populations differently due to varying elements of vulnerability based on context, scale, and perspective (Thiault et al. 2021). In particular, climate change is anticipated to pose serious threats to productivity and sustainability of recreational fisheries, and therefore impact recreational angling practices, but has not been effectively considered within risk assessments and management frameworks (Townhill et al. 2019, Nyboer et al. 2021). Climate change effects on recreational communities will include creating new opportunities, as well as imposing new challenges; a majority of these changes are due to shifting distributions of targeted stocks (Townhill et al. 2019). Anglers, by nature of their lifestyle, have to be in close proximity to the ocean as their way of life depends on this access. Due to their coastal location, fishing populations can be considered more exposed as a result of increasingly experiencing submergence, flooding, and erosion due to sea level rise, as well as relying on ocean waters that are warming and becoming more acidic (Wong et al. 2014).

This heightened level of risk pertaining to the physical location of fishing populations can also be seen as potentially problematic for the cultural landscape associated with fishermen in these areas, as many rely exclusively on one place to both live and work for generations (Khakzad and Griffith 2016).

Resilience can be defined as the degree of change a system can experience without losing its identity, structure and function, or its ability to continue to evolve (Nelson et al. 2007, Desjardins et al. 2015). When a vulnerable social-ecological system loses its resilience, this also implies the loss of adaptability (Folke 2006). Due to the pressure climate change is putting on ecosystems, the resilience of important natural resources and resource users to changing environmental conditions is important to consider in order to anticipate and prepare for change (Marshall et al. 2009). Therefore, resilience in coastal fishing populations should be taken into account when managing the effects of climate change. In order to enhance community resiliency, understanding both the social and ecological impacts of climate change is a critical topic for coastal resource societies. Having a strong awareness of the effects of climate change, such as a higher intensity and frequency of extreme weather events as well as sea level rise, has shown to provide a positive impact for self-efficacy, resilience, responsibility, and adaptive capacity of communities at risk (Mercado 2016). Additionally, a higher level of stakeholder engagement and compliance can be achieved by combating climate change induced changes in the environment through holistic approaches (Kontogianni

et al. 2012). When considering these different perceptions, it is also critical to contemplate the direct impact climate change can have on the public's outlook towards their surrounding environment, as well as the specific impact it may have on essential cultural aspects of the community. For example, some communities after extreme weather events have been seen to view certain ecosystem services, such as traditionally fished species, with more importance post-disaster (Rojas et al. 2017). Therefore, it is important to understand the way fishers perceive their surrounding environmental conditions over time in an effort to preserve the positive culture that surrounds fishing instead of potentially framing this activity in a negative manner due to unfavorable prior experiences.

Future studies must focus on facilitating community resilience by understanding significant social, economic, and ecological effects that can occur following climate change driven shifts in the environment, through gathering climate, ecosystem, and well-being perceptions of important stakeholders in natural resource communities. The human component of a fishery involves an entire network of community interactions, starting with the fishers themselves (Salas and Gaertner 2004). A fishing community can be defined as a social network of people who participate in fishing. With a heightened amount of climate change stressors, identifying as a fishing community has shown to help create resilience (Johnson el al. 2014). This has led to the intense need to better incorporate human dimensions into fisheries

management, as well as to use a “precautionary approach” for balancing both biological and social objectives (FAO 1995, Rice 2009, Cowan et al. 2012).

There is a demand for the diversification of research relating to vulnerability that will help disseminate a better understanding of the outcomes that can be expected as various climate change scenarios become a reality, as well as develop frameworks for promoting recovery and adaptive capacity. As studies have shown, various regions may see an increase in extreme weather event frequency, heighted storm surge, and sea level rise due to climate change. This provides an augmented prerequisite to help communities better acclimatize (Bergholt and Lujala 2012, Dunlap and Brulle 2015). As fisheries governance and regulations can alter socio-ecological resilience to climate change impacts, in an effort to promote resilience, regulatory measures should focus more on the long-term interest of the fishery as well as increase the willingness to implement specific adaptation strategies that would help to mitigate overall effects of climate change (Ojea et al. 2017).

2.2.2 Assessing Vulnerability within Fishing Communities

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as the magnitude to which a system is susceptible to, or unable to cope with, the adverse effects of climate change (IPCC 2007). Vulnerability can be properly assessed by measuring exposure, sensitivity, and adaptive capacity of a human system (Marshall et al. 2009). Exposure encompasses the extent to which an area, community, or resource experiences change due to climate variation, where a system has more exposure when weather related

events are higher in magnitude and frequency (IPCC 2007). Sensitivity can be defined as the strength of dependence on an ecosystem good or service, where a system is more sensitive if it depends on vulnerable resources (Marshall et al. 2007). Adaptive capacity refers to the ability for a system to cope with risk and respond to change, where a system can have a higher adaptive capacity with a stronger community network, knowledge, experience and flexibility (Marshall et al. 2009). Natural limits occur in communities through technological, economic, social and formal institutional barriers that become interrelated and can impede overall adaptation (Islam et al. 2013). These three components to vulnerability are context specific and vary between different populations and locations, which is a common challenge for vulnerability assessments within decision-making (Thiault et al. 2021). The International Union for Conservation of Nature (IUCN) has developed indicators to measure an individual's or community's capacity to adapt to change, and therefore help to assess overall vulnerability. This framework is a social-science measurement tool which offers an understanding of effects of climate change in relation to marine-based communities through analyzing impacts on ocean-centered ecosystem goods and services (Samah and Shaffril 2020).

Social capital, networks, social norms, leadership, learning, and access to political power are other significant factors that can affect community well-being and vulnerability (Cutter et al. 2003, Miller et al. 2010). The concept of community vulnerability relative to environmental change has largely evolved

from hazards and disaster research concerning social and ecological susceptibility to risk (Lavoie et al. 2018). Communities that have a higher dependency on fishing, resulting in lower socioeconomic diversification, have a greater level of vulnerability (Morzaria-Luna et al. 2014). To overcome difficulties associated with adaptation, there is a need to construct planned strategies with a multi-sectoral approach to increase the balance between stakeholder interests in order to construct effective management of fishing communities, as well as conduct continuous assessment of a fisherman's readiness to transform their fisheries skills and knowledge (Shaffril et al. 2013, Islam et al. 2014, Limuwa et al. 2018).

Social impact assessments are a component of an environmental impact statement required by the National Environmental Policy Act (NEPA) that describes the environmental, social, and economic impacts of management decisions on the human environment (Mengerink et al. 2014). In order to enhance the ability to conduct social impact assessments and better inform ecosystem-based management, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service has developed social-based fisheries engagement indices to characterize fishing community well-being at both national and regional scales (Lynn et al. 2011, Colburn et al. 2016). These indices help to evaluate community vulnerability and resilience to disturbance as well as management decisions and can include aspects such as fishery engagement and reliance, poverty, personal disruption, labor force structures, housing characteristics, sea level rise risk, revenue affected

by sea level rise, reliance on vulnerable species, and catch diversity. These social indicators were established to inform fisheries policy and guide management implemented under the Magnuson-Stevens Act, and to better identify impacts to fishery-dependent communities. These indicators provide an added layer of complexity to our understanding of fishing community well-being and their ability to adapt to change, as well as enable better predictions regarding the impacts of climate change at the community level. But, there is still a lack of social indicators that are adequately matched to ecological data and ecosystem processes to reflect behavioral responses to shifting environmental conditions, as well as social data considering the culture of communities dependent on fishing through the incorporation of attitudes, perceptions, and level of satisfaction regarding management (Mengerink et al. 2014, Colburn et al. 2016). There is also a need to continue to validate and modify existing social indicators, as quantitative social indices are useful rapid assessment tools for community vulnerability and should also be used in combination with qualitative data for the development of future indices (Lavoie et al. 2018). These indicators associated with vulnerability provide insights into the type of important policy actions that might be needed in different communities for appropriate adaptation and mitigation of climate change impact (Morzaria-Luna et al. 2014). Assessing vulnerability and building risk profiles can help decision-makers when considering infrastructure investment, community cooperatives, and the role of fishing in the local economy (Rogers et al. 2019).

2.3 *Well-being*

Well-being can be defined as the degree to which an individual or community can be characterized as being healthy (sound and functional), happy, and prosperous (Pollnac et al. 2006). With a proper assessment of well-being, monitoring of trends, identification of problem groups in a population, and an analysis of public happiness becomes possible. Thus, it is important for social science-based surveys to measure subjective well-being in order to soundly recognize what matters most to people and by how much (Oswald and Wu 2010). With this information, a better understanding of policy change implications can be generated to improve the overall quality of human lives (Oswald and Wu 2010, Smith and Clay 2010).

Historically, well-being has been assessed through variables such as income or educational level but there is a growing consensus that these objectively measured variables are poor indicators to properly measure well-being and should include individual perceptions based on the quality of their life (Seara et al. 2017). There is also an increased awareness that natural features can contribute to well-being through the array of ecosystem goods and services people enjoy (Faccioli et al. 2020). In particular, the ocean has been deemed to play a critical role in human well-being through providing livelihoods and recreational opportunities, as well as means to provide ocean users with a sense of place (Halpern et al. 2012). Well-being is regarded as a valuable indicator of community sustainability and therefore, is an important component to consider within natural resource policy frameworks in order to

achieve ecosystem-based management and increase compliance as well as pro-environmental behavior (Seara et al. 2017). When referring to coastal communities, there are a number of variables that can contribute to overall well-being such as an environmental identity, self-determination, subjective satisfaction with life, job satisfaction, economic resilience, enjoyment of the natural environment, enjoyment of family or community relationships, food security, and overall vulnerability (Himes-Cornell et al. 2016, Garcia-Quijano and Poggie, 2019). Within fisheries social impact assessments, well-being is considered a dependent variable with a number of attributes that have been understood to influence fisher well-being. These attributes can include external forces such as fish stock levels; activity attributes such as seasonal changes or gear; individual attributes such as physical health and personality traits; social and community attributes such as social stratification, social problems such as unemployment and non-compliance, and management regulations as well as structures (Pollnac et al. 2006). As people frequent certain areas in order to consistently gain benefits from the natural resources a place offers, this increases the attachment resource users have to locations within a community, therefore hindering their ability to move elsewhere due to the dependency on these resources. This attachment fishers can form to specific places can be seen as important insight for predicting responses to new management schemes (Marshall et al. 2007).

2.3.1 Life Satisfaction

One component of well-being that is important to consider is life satisfaction. Life satisfaction refers to an assessment of a person's quality of life according to his or her chosen criteria (Shin and Johnson 1978). This chosen criterion includes a standard that individuals set for themselves through personal judgment. It is a cognitive process with high internal consistency and temporal reliability that correlates well with other measurable components of well-being (Diener et al. 1985). The Satisfaction with Life Scale asks individuals to judge their overall satisfaction with life through determining their agreement with a series of five subjects which provoke consideration towards the conditions of their life (Diener et al. 1985). Through this assessment, a significant component to well-being can be accounted for and used to understand how individuals perceive components of life that contribute to their overall fulfillment and happiness. Few studies have taken into account the positive role in which the natural environment, and specifically the impact that places, can play in individual's self-assessments of life satisfaction and well-being (Vemuri and Costanza 2006, Florida and Rentfrow, 2011). Life satisfaction has been measured within fishing-based populations in order to account for cultural consonance as well as comparing coastal resource users to non-resource users but, it is also important to consider how life satisfaction can change as a result of shifts to the environment (Garcia-Quijano et al. 2015, Garcia-Quijano and Poggie 2019).

2.4 *Sense of Place as an Environmental Identity*

A person's identity describes a way of organizing information about oneself. Humans have multiple identities of varying importance levels according to their proximity to an environment, as well as past experiences (Clayton and Opotow 2003). One type of identity an individual can possess includes an environmental identity, which can be defined as the accumulation of a person's environmental perceptions and attitudes conceptualized to an everyday context. An element within an individual's environmental identity can include "sense of place". Sense of place was first defined as a social theory by Yi-Fu Tuan (1974) in which he argued that a place can hold a significant social meaning where through intimate personal encounter, a geographic space can evoke a sense of place. This idea of sense of place is also an indigenous concept stemming from the awareness of "caring for country", which has contributed to forming individuals' environmental identity as well as building eco-social capital (Huq and Burgin 2016).

Sense of place can be considered a type of social indicator, as well as a cultural ecosystem service, that connects an individual's meaning and attachment for a specific place with the attributes of that place such as amenities, site characteristics, and environmental quality (Farnum et al. 2005). This ecosystem service consists of three components: dependence, identity, and attachment (Mulvaney et al. 2020, Figure 2). Place dependence refers to the functional relationship associated with a location due to a particular resource, such as fish or access to the shoreline (Williams et al. 1992). Place

identity indicates a place's role in fabricating a person's self-identity (Manzo 2003, Farnum et al. 2005). Lastly, place attachment refers to the connection or the emotional bond a person forms with a place, beyond relying on a location for a resource or as a source of identity (Tuan 1974). Components of sense of place may act independently from each other, due to their differing psychological properties. For example, having a strong place identity has been seen to increase perceptions of environmental conditions as problematic, whereas the opposite has been observed for the place dependence component (Kyle et al. 2004). Fishermen present a unique population in which all three components of sense of place may hold separate and significant influence over their daily lives, occupation and culture. Consequently, the coastal location an angler relies on can ultimately define their environmental identity.

Figure 2. Sense of place components including place identity, place dependence, and place attachment (Mulvaney et al. 2020)

2.4.1 Management Implications for Sense of Place

Incorporating human dimensions into decision-making processes for natural resource management is critical for the long-term sustainability of marine resources (Fulton et al. 2011). In addition, collecting the given meaning

and values stakeholders link to an environment can positively contribute to natural resource policy by being able to better understand differing values and tailoring management accordingly (Kyle et al. 2004). A variety of studies have found a positive relationship between recreation and sense of place (Mulvaney et al. 2020). The majority of sense of place studies have targeted terrestrial recreational populations, such as use of parks and tourism, as opposed to marine recreational systems or working landscapes, where place meanings could potentially offer strong management implications (Mullendore et al. 2015, van Putten et al. 2018). A working landscape that has been targeted can include rural farming areas where strong place-based identities within these communities have been found due to their involvement and dependence on agriculture in the place that they live (Bonnie et al. 2020, Diamond et al. 2020). There is also a limited amount of research dedicated to assessing sense of place within marine environments, with the exception of coral reef tourism (van Putten et al. 2018). One distinguished use of sense of place as an indicator in a marine context is within the Ocean Health Index (Halpern et al. 2012). This index provided the means to quantitatively and comprehensively measure and monitor the health of coupled human-ocean systems, in order to create sustainable management plans. The sense of place attribute, in this case, was calculated based on “lasting species places” and “iconic species”, which were defined by the value that these aspects hold for people including aesthetic, spiritual, cultural, recreational, or existence reasons. Because fishers rely on a handful of places, such as accessible

fishing grounds, to support their way of life, sense of place within these communities can be considered an important environmental identity when trying to understand the human dimensions of a fishery. Sense of place can also help to anticipate vulnerability of fishers as strong ties between identity, place and cultural practices can affect resilience (Lyon 2014). Fishermen have been seen to form “communities-at-sea”, or a defined space in the ocean where a community is present, helping to further shape a fisher’s identity and the capacity to adapt to environmental change (St. Martin and Olson 2017). Because the social, or human, aspects of identity tend to be obvious, their nonsocial aspects, or non-human objects such as those relating to the natural world, are often overlooked (Clayton and Opotow 2003).

Assessing vulnerability, given how attached to a place a fisher can be, could provide an important social indicator to incorporate into management, ultimately helping to better understand, and therefore decrease, vulnerability to climate change within these communities. Additionally, understanding the drivers, feedbacks, and how sense of place can change over time within a social-ecological system can allow for a better understanding and quantification as to how varying management scenarios would perform under alternative environmental conditions (van Putten et al. 2018). Commercial fishermen have shown strong attachments to their occupation which has been associated with high levels of job satisfaction and social well-being (Seara et al. 2017). This could have implications for recreational fishers as well based on their attachment to the act of angling at favored locations, which could

potentially improve their overall well-being. However, studies have also shown that with a strong attachment to a job or a place, adaptive capacity, or the ability to adapt to change, can be hampered (Shaffril et al. 2017). One way fishing communities may be able to adapt to species distributional migrations will require anglers to target alternative locations in an effort to follow their target species, or begin targeting nontraditional species that are becoming more abundant in their traditionally fished areas. But, due to fishers' attachment to previously productive areas and patterns that are historically familiar, this implies that fishers overall will be slow to fully adapt to species distributional shifts (Rogers et al. 2019). Relying on intergenerational knowledge can become irrelevant and unpredictable due to a changing environment which can make it more difficult for anglers to adjust to new areas due to the burden of developing the depth of knowledge required about an area to successfully target certain species, as well as the added costs of logistics in finding alternative areas to target (Cinner 2005, Shaffril et al. 2017).

Sense of place has been seen to be constructed and strengthened by aspects of the physical environment, but shifts in the physical environment may increase threats to individual's self-identity (Stedman 2003, Marshall et al. 2007). Consequently, having a strong sense of place may lead to increased vulnerability perceptions due to shifts in the environment, which can be predicted to decrease an angler's overall well-being. A strong sense of place can also potentially increase angler's life satisfaction, which can be predicated to have an overall positive impact on well-being (Figure 3). Therefore, it is

important to understand how the effects of climate change on the environment will influence anglers' sense of place, and in turn, overall well-being, as this can have important implications for future generations of fishermen, as well as coastal communities.

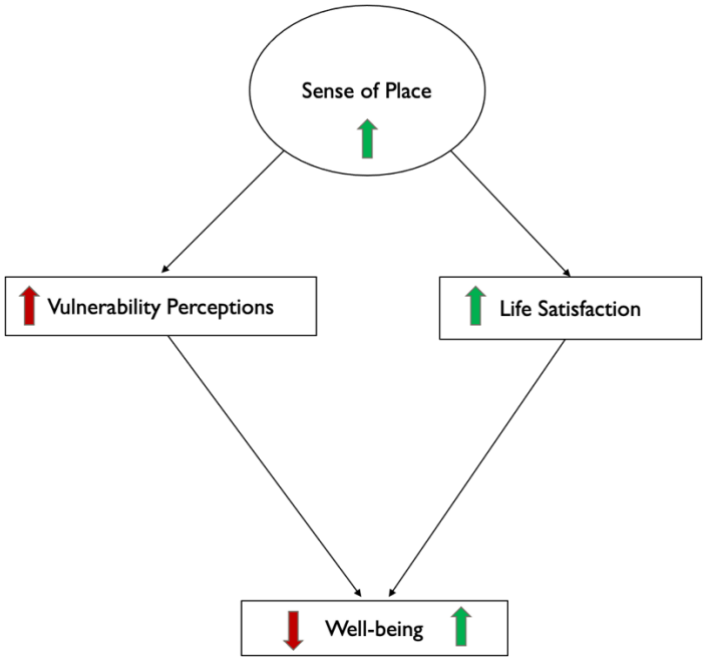

Figure 3. Potential relationship between angler's sense of place and their vulnerability perceptions and life satisfaction, which can have implications on their overall well-being.

2.4.2 Existing Policy Pathways for Sense of Place

The commercial and recreational industry in the United States contributes highly to the economy through employment, sales, and value-added impacts, as well as providing a cultural foundation for coastal communities (NOAA 2022). Consequently, it is imperative to devise polices that contribute to sustainable management, as well as aid in the adaption to climate change. The executive branch of the federal government in the U.S. has acknowledged that the distribution and abundance of marine species are shifting due to climate change-related effects such as warming ocean

temperatures, increasing acidification of ocean waters, and rising sea levels (NOAA 2021). Therefore, there is a need to make fisheries more resilient to climate change through applying changes to current management schemes in order to promote proper conservation of this essential natural resource. The National Oceanic and Atmospheric Administration (NOAA) has also recognized that these changes to the environment have social impacts on those individuals and communities that rely on marine species being impacted by climate change, and therefore must be considered when enhancing management to combat these effects. Implementing sense of place measurements within management frameworks could provide a pathway to expand the type of socio-cultural data collection with social-ecological assessments of fishing populations, helping to develop climate-ready fisheries policy by improving evaluations of vulnerability and well-being as the ocean environmental continues to change.

National Standard 8 within the MSA necessitates that conservation and management measures take into account the importance of fishery resources to fishing communities by utilizing available economic and social data in order to sustain participation and minimize adverse economic impacts on communities. This language permits the evaluation and consideration of important and relevant social indicators within fishery management plans (FMPs) devised by regional councils, therefore providing a pathway to include assessing angler's sense of place as a proxy for gauging community effects to climate change as well as overall engagement.

Likewise, in spring of 2021, NOAA fisheries released plans from each region that identified priority actions and milestones over the next five years in order to implement ecosystem-based fishery management (EBFM). EBFM can be defined as fisheries resources “managed to reflect the relationships among all ecosystem components, including human and nonhuman species and the environments in which they live” (USCOP 2004). Within each regional plan, numerous principles were defined that provide opportunity for the incorporation of assessing fishermen’s sense of place within regional management frameworks, and as a result, potentially increasing the ability to apply EBFM polices. For example, in the northeast’s regional plan, principle 2, which suggests to “advance understanding of the ecosystem process” though considering the “most relevant human dimension indicators”, would help assess social vulnerability to climate and support relevant ecological indicators. Principle 3 suggests the need to “prioritize vulnerabilities and risks of ecosystems” by conducting indicator-based assessments. Lastly, principle 6 suggests the need to “maintain resilient ecosystems” through evaluating community well-being where “community vulnerability analyses must be adapted to a broader range of cumulate factors/track community health, well-being and vulnerability socio-economic metrics”. These defined principles provide a pathway to use sense of place as an indicator in order to increase the ability to successfully apply EBFM plans due to providing a robust-social indicator that can be considered relevant in order to better understand how ecological changes might impact socio-cultural dimensions of fishing

populations as well as their vulnerabilities. The inclusion of sense of place in EBFM frameworks would provide for the incorporation of human perceptions within policy, consequently contributing to the collection of holistic ecosystem data to integrate into management, consistent with the EBFM scope in order to tackle climate-induced changes.

The last existing policy structure that could provide a pathway for the inclusion of a sense of place assessment is the social impact assessment (SIA), or one of the components within an environmental impact statement required by National Environmental Policy Act (NEPA). An SIA is a formal process that describes the environmental, social, and economic impacts of management decisions on the human environment (Mengerink et al. 2014). Data gaps have been identified as a limitation to conducting a thorough SIA. Specifically, data considering the culture of communities dependent on fishing through the incorporation of attitudes, perceptions, and level of satisfaction regarding management, is needed. Social indicators that are adequately matched to ecological data and ecosystem processes are also deficient within SIAs (Mengerink et al. 2014). Currently, variables regarding social values relating to environmental and cultural resources are analyzed the least within NEPA documents. These issues present an opportunity to continue to build up the socio-cultural indices considered within fishery management plans (FMPs) where angler's sense of place identity could provide a valid component to include within social impact assessments, helping to understand the impact fishery policies would have on the overall well-being of a community.

Moreover, understanding how sense of place may change over time could provide an improved understanding relating to how management scenarios would perform under shifting environmental conditions (van Putten et al. 2018).

2.4.3 Benefits of Using Sense of Place to Incorporate Angler Knowledge within Management

One of the stronger motivators that drives the development of more sustainable communities is the desire to care for a particular place, which contributes to the overall social capital of a community, where shared norms, values, and beliefs among a group lead to cooperation and action (Fukuyama 1999, Huq and Burgin, 2016). Environmental volunteerism has been driven by social-ecological meaning and memories associated with and heighted by locality of a place of work as well as familiarity of species worked with, contributing to an individual's overall sense of place (Krasny et al. 2014). Attachment to a certain environment has been seen to be a powerful motivator for environmental volunteering and uniting people over a common interest in caring for a place as well as the desire to develop an improved understanding of a place (Measham and Barnett 2009). An individual’s sense of place to local environments has also been seen to contribute to building environmental connections, stewardship, and engagement (McKinley et al. 2017). In order to improve understandings of environmental attitudes and concern, the context in which environmental perceptions are created is salient. In particular, attachment to local places has been seen to better predict attitudes and

variance in attitudes towards proposed changes to an environment, or towards local environmental issues, more so than sociodemographic variables (Vorkinn and Riese 2001). People who have more positive environmental attitudes and stronger place identities have also shown a higher willingness to pay for acts of restoration (Faccioli et al. 2020). Currently, there is a need to support socio-cultural informed research in order to better understand behavior and to engage and empower resource-dependent communities to take long-term ownership of their environment, as well as work collaboratively with management bodies to increase resilience and adaptability as the environment continues to change and impose challenges on communities (Mills et al. 2017).

The incorporation of angler perceptions within management is fundamental in determining community well-being. The participation of anglers within decision-making has been deemed an important component to forming transparent stakeholder-inclusive ecosystem-based policies (NOAA 2021). Increased involvement of stakeholders in natural resource management can lead to higher levels of acceptance and compliance, due to polices being perceived as more legitimate through increased engagement, which helps empower communities given a sense of ownership (Jentoft et al. 1998, Schreiber 2001, Aanesen et al. 2014, Goethel et al. 2019, Jones and Seara 2020). Currently, there is disagreement with the way management bodies conduct and communicate science due to the lack of angler participation within certain management council's decision-making process, such as in the

Northeast and Mid-Atlantic (Jones and Seara 2020). Participatory research with fishers has also shown that there is a disconnect between the academic sector that help provide data for management assessments, and the fishermen who are subject to the management goals set for them, where interests and concerns corresponding to each sector have not been properly communicated (Wiber et al. 2004). Dismissal of local concerns may be at the root of biological and social crises in fisheries, as when fisher's knowledge is emphasized, evidence shows that it can greatly improve natural science data sets (Schreiber 2001, Wiber et al. 2004). Including perceptions anglers have about the environment they depend on within management plans can allow for valuable local ecological knowledge to supplement traditional scientific data collected, as well as contribute to the overall social welfare of a community by understanding levels of preferences and satisfactions regarding important resources (Aanesen et al. 2014). Recreational anglers possess decades of local knowledge regarding how fish stocks have changed within their preferred fishing areas - including aspects like availability, size, and cyclic timing (Azzurro et al. 2019). The frequency at which recreational anglers observe marine ecosystems provides an opportunity for marine-based observations that would help to build upon fishery management plans through fisher knowledge and perceptions.

CHAPTER 3

METHODOLOGY

3.1 *Approach*

This research encompassed a mixed methods approach using a sequential explanatory design by beginning with the collection and analysis of quantitative data through an online survey, followed by the collection and analysis of qualitative data through in-person follow-up interviews. This mixed method design provided for the quantitative data collected and analyzed to be prioritized, but allowed the qualitative data to help explain and interpret the findings of the quantitative aspect to this study (Robson 2011, Creswell 2014).

3.2 *Study Population and Location*

This study collected responses of recreational anglers who fish in New York, Connecticut, and Rhode Island, located on the Mid-Atlantic Bight. Fishers within these states rely on the Long Island Sound, Rhode Island Sound, and the Atlantic Ocean for target species. Various communities within these states can be classified as having a high recreational fishing engagement, or level of people within the community who participate in fishing recreationally (Figure 4), with an extended traditional history of fishing communities, providing fishermen with intergenerational knowledge about the surrounding environment for which they live and fish. Recreational angler input is especially deficient within Northeast and Mid-Atlantic fisheries management, when compared to the commercial sector; therefore, there is a need to expand

the type of data looked at within these populations to help solve recreational management challenges, especially looking to future issues involving climate change (Bauer et al. 2016). In particular, the fishing communities located in NY, CT, and RI have not been as prioritized when trying to understand the impacts of climate change when compared to states like Massachusetts and Maine, due to the Gulf of Maine warming at a significantly faster rate than any other body of water (Pershing et al. 2015). However, this does not mean communities based in other regions are not experiencing environmental change or are not becoming more vulnerable because of these changes. Therefore, understanding alternative fishing populations, like the ones located in New York, Connecticut and Rhode Island, offers a different perspective.

New York, Connecticut, and Rhode Island are highly valued recreational fishing locations in the U.S. contributing to 20,000 jobs and bringing in $2.18 billion dollars in sales in 2017 (NOAA 2017). Locations like Montauk, Staten Island, Queens, Brooklyn, Freeport, Wantagh, Babylon, Huntington, Northport, Port Jefferson, and Hampton Bays within the state of New York; Clinton, Old Saybrook, and Waterford in Connecticut; and Narragansett in Rhode Island, can be classified as having high recreational fishing engagement, which suggests that many people in this community participate in recreational fishing (Jepson and Colburn 2013). The main target species associated with these states can include Winter Flounder, Striped Bass, Scup, Summer Flounder, Black Sea Bass, Tautog, Atlantic Cod, Bluefish, and Weakfish- which have all

been predicted to be experiencing a northward shift in species distribution as a result of projected climate change scenarios (Morley et al. 2018).

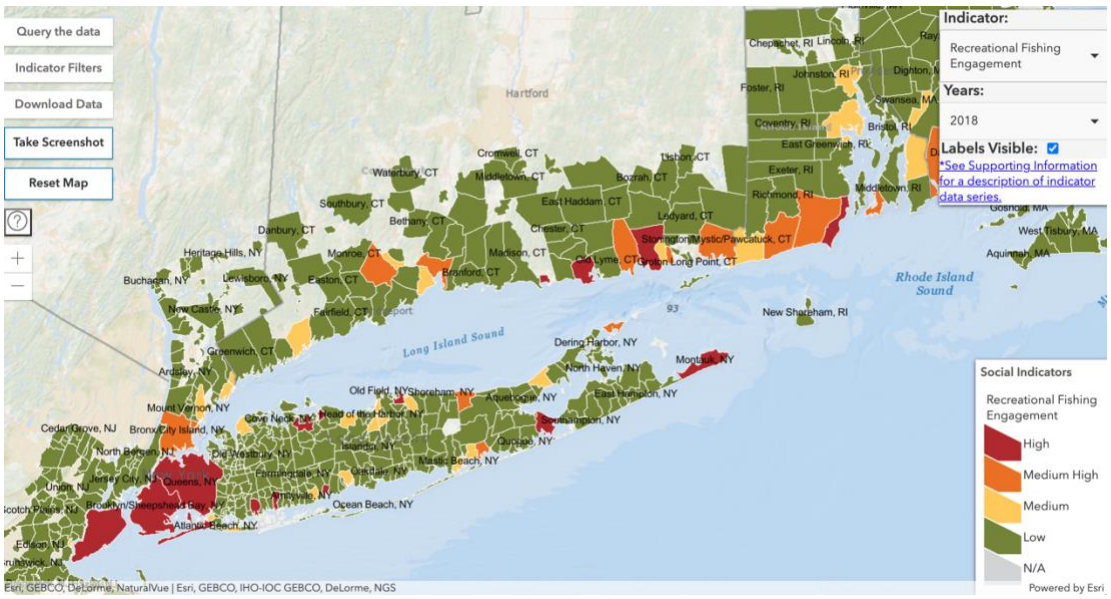

Figure 4. Recreational Fishing Engagement, or level of people within the community who participate in fishing recreationally, in Southern New England and Northern Mid-Atlantic regions (NOAA 2018).

3.3 *Survey*

3.3.1 Sampling Procedure

This research began with distributing an online survey through Qualtrics to recreational anglers who fished in Rhode Island, Connecticut, and New York. Surveys have been recognized as valuable data collection tool in order to determine stakeholder perceptions (Jones and Seara 2020). In particular, online surveys help to increase the ability to include more complex questions within the survey as respondents are given the opportunity to read over the questions multiple times and think about their answers for longer, leading to higher quality responses. Distributing a survey online also supports the capacity to ask participants about potentially sensitive topics due to the elimination of interview bias and the aptitude to keep responses anonymous

(Robson 2011). Finally, distributing this survey online allowed for gaining increased access to recreational anglers, leading to a larger overall sample size.

Participants were recruited through social-networking groups on Facebook that were dedicated to recreational fishing based in these three locations. Limitations associated with this method include only being able to target anglers with access to a computer, the internet, and those with a social-media presence. An advertisement was posted within these private groups to provide an overview of the purpose of the research, a link to take the survey, and an opportunity to enter a raffle for a chance to win a $100 gift card to Bass Pro Shops upon completing the survey. The advertisement was posted only after permission was given by an administrator of each group. After two weeks of the initial post, a reminder advertisement was posted. The survey was closed on October 25th, 2021, after being open for about a month. The winner of the raffle was chosen through a random number generator and sent an e-gift card through the email they provided.

3.3.2 Design

The survey was as short and concise as possible in order to be respectful of participants' time, and the gift card incentive as well as thoroughly explaining the overall goal of the study, was used to increase the perceived benefits of participating in this research (Dillman 2009). The online survey was designed through the platform Qualtrics and consisted of 24 quantitative questions (appx). It began with an introduction to the researcher distributing

the survey as well as the purpose behind the survey, followed by a consent form required by the University of Rhode Island Institutional Review Board (IRB approval # 1773660). Three main indices: sense of place, vulnerability perceptions, and life satisfaction, were each measured using a Likert scale, a commonly used survey technique providing a point scale which allows the respondent to express how much they agree or disagree with a particular statement. It is common practice to borrow and build off existing scales to increase reliability and validity of the measurement (Robson 2011). Towards the end of the survey, a series of angler behavior and background questions were asked, such as how many years the respondent had been fishing, what type of location they primary fish from, how many generations of recreational anglers have been in their family, and their current target species. The survey ended with a series of demographic questions that are standard for social-science based surveys, as well as a question to note interest in a follow-up interview and to enter an email for the gift card raffle.

3.3.3 Creation of Indices

Each survey question used to complete the measurements for perceptions of "sense of place", "vulnerability perceptions", and "life satisfaction" were combined into three distinct indicies, or groups of variables, that were then used to complete the analysis for this research (Table 1). In order to measure and justify the reliability of adding related survey questions to make a cohesive variable for each of these indices, a Cronbach's alpha analysis was run on each measurement. The Cronbach's alpha coefficient can

be used to measure the internal consistency of a set of questions that make up one group for a measurement (UCLA 2016). If the resulting coefficient was above 0.5, this indicated that the components used to make up each index were internally consistent, and therefore related enough to combine and use cohesively.

3.3.4 *Main Measurements*

3.3.4.1 Sense of Place

The first five set of questions were used to assess angler's sense of place using a moderated 7-point Likert scale from strongly disagree (1) to strongly agree (7), adapted from Mulvaney et al. 2020, which provided the ability to quantify the components to sense of place in order to better understand the impacts of environmental change at recreational sites. This measurement index produced a coefficient of 0.853, indicating that the survey questions pooled to create the total measurement were correlated enough to do so.

3.3.4.2 Vulnerability Perceptions

The second set of six questions was used to assess angler vulnerability perceptions of shifting stock distributions using a moderated 5-point Likert scale from strongly disagree (1) to strongly agree (5), adapted from the 2009 IUCN report published in Marshall et al. (2009), in which indicator questions were most applicable to shifting fish stocks were included. The sections used with this scale can include evaluating perceptions of risk and level of interest in

adapting to change. The equation: Vulnerability = [Sensitivity + Exposure – Adaptive Capacity] was used to calculate an angler's total vulnerability perceptions (Allison et al. 2009, Cinner et al. 2012, Cinner et al. 2013). The survey responses to "I am hesitant to explore new possible catching areas" were reverse coded in order for the total adaptive capacity score to have the same direction where the lower the score, the less ability an angler had to adapt. Therefore, with a higher sensitivity and exposure, but a lower adaptive capacity, an angler was considered more vulnerable to environmental change.

This measurement index produced a coefficient of 0.365, therefore suggesting the survey questions used to create this total measurement were not correlated enough to aggregate. Consequently, a Cronbach's alpha analysis was then run on each component of the vulnerability measurement including sensitivity, exposure, and adaptive capacity. Both the sensitivity and exposure components produced a coefficient greater than 0.5, but the coefficient for adaptive capacity was less than 0.5, suggesting why the total vulnerability measurement coefficient was low. Based on these results, two separate measurements of vulnerability perceptions were included in the analysis: one that included all three components (sensitivity, exposure and adaptive capacity), and another that only included the sensitivity and exposure components to vulnerability. This was done in order to compare the significance of results for both the correlation and regression analyses. When comparing these two measurements, the results did not change significantly. As the majority of the literature includes an adaptive capacity factor in

measurements of vulnerability, and the overall vulnerability index included additive measurements as opposed to mean values, the reported results from this study include the vulnerability score with the adaptive capacity component. The subsequent interview analysis concerning vulnerability perceptions was also used to fill in gaps to the quantitative measurement of the adaptive capacity component to vulnerability through the theme “ability to adjust to change”.

3.3.4.3 Life Satisfaction

The third set of five questions was used to assess angler life satisfaction using the Satisfaction with Life Scale created by Diener et al. 1985. This scale allowed the respondent to judge a component of their overall well-being through determining their level of agreement with a series of statements that evoked thoughts about the conditions of their life. This 7-point Likert scale from strongly disagree (1) to strongly agree (7) was then used to prompt survey respondents to relate how fishing at their preferred fishing spot contributed to their overall life satisfaction. This measurement index produced a coefficient of 0.861, indicating that the survey questions pooled to create the total measurement were correlated enough to do so.

Table 1. Measurements used within this study.

Measure	Components	Measure items	Item measurement	Measure range	Cronbach's alpha	Reference
Sense of Place			7-point scale: 1 = strongly disagree, 7 = strongly agree	5 (lowest) to 35 (highest)	0.853	Mulvaney et al. 2020
	Place Dependence	This fishing spot provides value to me that I can't obtain at other fishing spots				
		I get more satisfaction from visiting this fishing spot than other fishing spots				
	Place Identity	I feel most like myself when I am at this fishing spot compared to other fishing spots				
	Place Attachment	I am very attached to this fishing spot				
		Many important memories are tied to this fishing spot				
Life Satisfaction		In most ways my life is close to ideal	7-point scale: 1 = strongly disagree, 7 = strongly agree	5 (lowest) to 35 (highest)	0.861	Diener et al. 1985
		The conditions of my life are excellent				
		I am satisfied with my life				
		I have gotten the important things I want in life				
		If I could live my life over, I would change almost nothing				
Vulnerability Perceptions			5-point scale: 1 = strongly disagree, 5 = strongly agree	-6 (lowest) to 18 (highest)	0.365	Marshall et al. 2009
	Sensitivity	I primarily fish for one species			0.572	
		I primarily fish in one location				
	Exposure	I believe the environment for which I depend on for fishing is changing			0.802	
		I believe changes to the environment are affecting the community I fish in				
	Adaptive Capacity	I am hesitant to explore new possible catching areas (inversed)			0.08	
		I am continually monitoring the social/ecological conditions around me				

3.4 *Analysis*

3.4.1 Variables

Variables analyzed within the survey include anglers sense of place and its subcomponents (place dependence, place identity, place attachment), vulnerability perceptions and its subcomponents (sensitivity, exposure, adaptive capacity), their life satisfaction, their amount of satisfaction with availability of their target species at their preferred spot (availability satisfaction), how their satisfaction with catch at their preferred spot had changed over time (predicted life satisfaction with stock shift), if their preferred spot had changed over time (spot change), whether they fish onshore or offshore (fishing location), the number of years they have been fishing (years fishing), generations of recreational anglers in the family (generations of anglers) and a series of demographics (age, gender, race, education, income) (Table 2.). Variables were standardized by reverse coding when necessary, in order to normalize the analysis where lower numbers indicated less agreement and higher numbers indicated more agreement.

3.4.2 Statistics

The total population based on the number of members from each Facebook group was estimated to be 73,000. Considering a 95% confidence level and a 6% margin of error, the sufficient sample size for this study was 266 responses (calculated through a power analysis). After leaving the survey open for a month, 524 responses were recorded. After cleaning the data,

which consisted of deleted incomplete and duplicated survey responses, a total of 300 responses were considered valid to include in the final analysis.

Spearman's Rho Correlation was used to determine whether any component of an angler's sense of place (place dependence, place identity, place attachment) had a relationship with any component of their vulnerability perceptions (sensitivity, exposure adaptive capacity), the life satisfaction of all anglers and those that had experienced a decrease of catch at their preferred spot, as well as angler history (years fishing and generations of anglers) and a series of demographics (age, gender, race, education, and income). This correlation test was conducted due to the use of ordinal variables.

A multiple linear (OLS) regression was used to predict and analyze the impact particular variables had on life satisfaction and vulnerability perceptions of the respondent, including their sense of place, availability satisfaction, predicted life satisfaction with stock shift, spot change, fishing location, years fishing, generations of anglers, and a series of demographics (age, gender, race, education, and income) (Table 2). A stepwise AIC model selecting procedure was run on each model to determine the robustness of the variables included in each model.

Table 2. Description of variables included in analysis.

Variables	Subcomponents	Definition
Sense of place		An environmental identity, socio-cultural indicator, and cultural ecosystem service, that connects an individual's meaning and attachment to a preferred fishing spot
	Place dependence	Functional relationship associated with a location due to a particular resource
	Place identity	A place's role in fabricating a person's self-identity
	Place attachment	Connection or the emotional bond a person forms with a place
Vulnerability perceptions		Magnitude to which a system is susceptible to, or unable to cope with, the adverse effects of shifting stock distributions
	Sensitivity	Level of dependence on an ecosystem good or service
	Exposure	Extent to which an area, community, or resource experiences change
	Adaptive capacity	Ability for a system to cope with risk and respond to change
Life satisfaction		Overall quality of life based on the standard that an individual sets for themselves through personal judgment
Availability satisfaction		Current satisfaction with availability of catch at preferred spot
Predicted life satisfaction with stock shift		Predicted life satisfaction if target species shifted habitat 50 miles northward
Spot change		If preferred fishing spot had changed over time
Fishing location		Primary fishing location onshore (pier, beach/surf, jetty) or offshore (kayak, personal boat, charter boat)
Years fishing		Number of years fishing
Generations of anglers		Generations of recreational anglers in family
Age		Age of angler (18-65+)
Gender		Identifying female/male
Race		Identifying race or ethnicity
Education		Highest education level
Income		Total annual income of 2020

3.5 *Interviews*

One hundred and twenty-six respondents noted they would be interested in having a follow-up conversation at the end of the online survey and provided an email to be contacted. Of those, 21 respondents were randomly selected through a random number generator to participate in a follow-up interview. The interviews stopped at 21 participants due to repeated themes being mentioned, leading to saturation, or a point when incoming data produces no new information (Guest et al. 2006). Interviews were scheduled at a convenient time for the respondent. Follow-up emails were sent weekly to those initially contacted in order to set up an interview time. If the respondent contacted did not respond to any prior emails after three attempts, another respondent was selected randomly to be contacted. The interviews were conducted through Zoom and lasted approximately 30 minutes. The one-on-one video conversation allowed for voice tone and body cues to be detected as well as for the researcher to build a more personal relationship with the respondents. This is inherently important in order to build trust within the population you are trying to connect with (Lofland and Lofland 1995). Many noted that they would be interested to see the results of the study and were happy to have been able to participate in this research. The interview consisted of 19 semi-structured questions, allowing for the participants to expand on each question and for the researcher to modify the wording order of the questions based on the flow of the interview (Robson 2011, appx). The interview guide consisted of questions designed to better understand how

angler's sense of place has been affected with shifting stocks, how much anglers value their sense of place as important for management to consider, how angler's sense of place contributes to their connection to the marine environment, and the extent that angler's sense of place influences their vulnerability perceptions and well-being. The interview was recorded and the tape was stored on a password protected computer until the completion of the researcher's study. Upon completion of the study the audiotape was permanently deleted from the researcher's files.

3.5.1 Analysis

Each of the 21 interviews were recorded using a Zoom audio transcript. These transcripts were then edited by the researcher to provide the most accurate transcription of the conversation. Each interview transcription was analyzed using NVivo, an online software that allows for the organization and coding of qualitative data. Analysis of the survey transcripts began with an inductive approach, where a framework was applied to the coding during the initial read to compile data within a working coding structure (Guest et al. 2012). Then, a deductive approach was applied to the second read through of all the transcripts to apply themes that appeared within the data but were not originally included in the initial framework. Overlapping codes that described similar themes were then grouped together to make the coding structure more concise. Subsequently, a codebook was created from evaluating each interview where key words and phrases were highlighted to establish reoccurring themes (appx). Within each theme, quotes were selected to be

representative of angler's thoughts and feelings towards a topic. Frequency and percentages of common themes were calculated in order to quantitatively describe components of the coding structure. These themes provided comprehension regarding the attitudes and perceptions each angler interviewed had towards their sense of place, environmental change, vulnerability, well-being, and management preferences, which were used to supplement and emphasize the quantitative results.

CHAPTER 4

FINDINGS

4.1 *Descriptive Statistics*

The median respondents were male (94%), white (88%), between the ages of 31-40 (26%), had a bachelor's degree (40%) and had a yearly income between $100k-$150k (19%). Some respondents were also female (5.6%), Asian (3.7%), were between the ages of 51-65 (22%), attended some college or received a 2-year degree (22%), and had a yearly income between $50k-$75k (14.7%) (Table 3). Majority of respondents fished for sport/leisure, or practiced catch and release (63%), with some fishing for subsistence (27%), or a mix of the two (9%) (Table 4). Forty-three percent of respondents said their preferred fishing spot was located in Rhode Island, and 31% said New York.

Table 3. Demographics of survey respondents.

Variable	Median Response	Percentage
Education	Bachelor's degree	40%
Income	$100k to $150k	19%
Gender	Male	94%
Age	31-40	26%
Race	White	88%

Table 4. Survey respondent's reason for fishing.

Variable	Number of Respondents	Percentage
Sport/Leisure	188	63%
Subsistence	82	27%
Profit	2	0.67%
Mixed	28	9%

The mean summed sense of place score of the respondents was 27 (out of a maximum of 35, SD=5.5), indicating that most respondents possessed a strong sense of place (Table 5). The mean vulnerability perceptions score of the respondents was 4.6 (out of a maximum of 18, SD=2.95), indicating that

most respondents perceived themselves as having a low level of vulnerability to shifting stock distributions (Table 6). Finally, the mean summed life satisfaction score of the respondents was 24 (out of a maximum of 35, SD=5.9), indicating that most respondents possessed a high satisfaction with life (Table 7).

Table. 5 Descriptive statistics for sense of place components.

Sense of Place Components	Mean	SD	Scale
Place Dependence	11	2.5	(2) Strongly Disagree (14) Strongly Agree
Place Identity*	5	1.4	(1) Strongly Disagree (7) Strongly Agree
Place Attachment	11	2.6	(2) Strongly Disagree (14) Strongly Agree
Sense of Place Index	27	5.5	(5) Low (35) High

*Note: scale for place identity is from 1-7, instead of 2-14. This is due only one question comprising this component, as opposed to taking the average of two questions as done for place dependence and attachment.

Table 6. Descriptive statistics for vulnerability perception components.

Vulnerability Perception Components	Mean	SD	Scale
Sensitivity	4.68	1.83	(2) Strongly Disagree (10) Strongly Agree
Adaptive Capacity*	7.88	1.38	(2) Strongly Disagree (10) Strongly Agree
Exposure	7.8	1.66	(2) Strongly Disagree (14) Strongly Agree
Vulnerability Index: Exposure + Sensitivity – Adaptive Capacity	4.6	2.95	(-6) Low (18) High

*Note: one question included in the adaptive capacity component score was reverse coded to accurately represent the direction for this category of measurement.

Table 7. Descriptive statistics for life satisfaction of all anglers surveyed and those that had experienced a decrease in availability of catch.

Life Satisfaction	Mean	SD	Scale
All Anglers	24	5.9	(5) Low (35) High
Anglers that had experienced a decrease in availability of catch	23	6.0	(5) Low (35) High

4.2 *Correlation Analysis*

Spearman's Rho correlation analysis was used to determine specific associations between sense of place components to components of perceived vulnerability, as well as to angler background and demographic information. Results from this analysis indicated that an angler's sense of place and an angler's vulnerability perceptions to shifting stock distributions had a slight positive correlation ($r=0.209$, $p<0.001$). Each component of sense of place including place dependence ($r=0.159$, $p<0.01$), identity ($r=0.248$, $p<0.001$), and attachment ($r=0.176$, $p<0.01$) all had separate and distinct positive associations with an angler's vulnerability perceptions. Specifically, an angler's sensitivity to changes to their surrounding environment had the strongest positive association with an angler's place identity ($r=0.309$, $p<0.001$). Likewise, an angler's sense of place ($r=0.131$, $p<0.05$), and more explicitly, their place attachment ($r=0.172$, $p<0.01$), also had a relationship with their exposure, a separate component of vulnerability (Table 8). The life satisfaction of all angler's surveyed was positively associated with sense of place ($r=0.136$, $p<0.05$), with place dependence showing the most significant relationship ($r=0.248$, $p<0.01$). Similarly, the life satisfaction of those anglers that had experienced a decrease in catch availability at their preferred spot had a positive correlation with sense of place ($r=0.183$, $p<0.05$) where place attachment was the most significant component ($r=0.229$, $p<0.01$) (Table 9). Lastly, the generations of anglers in a given family also had a positive

correlation to an angler's total sense of place (r=0.119, p<0.05), as well as specifically to their place attachment (r=0.135, p<0.05) (Table 10).

Table 8. Correlation between sense of place components and vulnerability perception components. Significant relationships are indicated with *** p< 0.001, ** p< 0.01, * p< 0.05.

Variables	Vulnerability Perceptions	Sensitivity	Adaptive Capacity	Exposure
Sense of Place	0.209***	0.248***	0.042	0.131*
Place Dependence	0.159**	0.203***	0.018	0.081
Place Identity	0.248***	0.309***	0.021	0.101
Place Attachment	0.176**	0.180**	0.072	0.172**

Table 9. Correlation between sense of place components and life satisfaction of all angler's survey, and those that had experienced a decrease in catch availability at their preferred spot. Significant relationships are indicated with *** p< 0.001, ** p< 0.01, * p< 0.05.

Variables	Life Satisfaction (all anglers)	Life Satisfaction (anglers that had experienced a decrease in catch)
Sense of Place	0.136*	0.183*
Place Dependence	0.157**	0.163*
Place Identity	0.047	0.051
Place Attachment	0.133*	0.229**

Table 10. Correlation between sense of place components, angler background and demographics. Significant relationships are indicated with *** p< 0.001, ** p< 0.01, * p< 0.05. Negative relationships are marked with (-).

Variables	Years fishing	Generations of anglers	Age	Gender	Race	Education	Income
Sense of Place	-0.005	0.119*	-0.079	-0.006	0.015	0.048	-0.015
Place Dependence	0.012	0.102	-0.059	-0.041	-0.003	0.054	-0.007
Place Identity	-0.089	0.067	-0.070	0.091	0.026	0.004	-0.056
Place Attachment	0.048	0.135*	-0.078	-0.034	0.027	0.043	-0.010

4.3 *Regression Analysis*

A multi-linear (OLS) regression analysis was used as the principle statistical technique in order to investigate, control for, model, and predict which variables may have the most significant impact on an angler's vulnerability perceptions and life satisfaction including their sense of place,

availability satisfaction, predicted life satisfaction with stock shift, spot change, and their fishing location (Table 2). An additional model (Model 2) was run for each dependent variable which including the same variables as Model 1, as well as elements of an angler's background included years fishing, generations of anglers, and a series of demographics (age, gender, race, education, and income). This was done in order to better understand which variables were true predictors of angler vulnerability perceptions and life satisfaction. After running a stepwise AIC model selecting procedure on each model, it was determined that the variables included within each model were relevant and contributed to the overall robustness of the model as the outcome levels did not change significantly.

4.3.1 Vulnerability Perceptions Model

Results from Vulnerability Perceptions Model 1 indicated that an angler's sense of place (β=0.066, $p<0.05$), spot change (β= -0.845, $p<0.05$), and fishing location (β= -1.03, $p<0.01$), were all significant predictors of an angler's vulnerability perceptions to shifting stock distributions. When demographic variables and angler background components were controlled for (Vulnerability Perceptions Model 2), year's fishing (β= -0.365, $p<0.05$) and their education level (β= 0.490, $p< 0.01$) became predictors of an angler's vulnerability perceptions. Specifically, a higher sense of place, education level, if an angler's preferred spot had not changed over time, if they fished onshore, and the less years they had fished, all indicated a higher level of perceived vulnerability (Table 11).

Table 11. Multiple linear regression results of vulnerability perceptions as the dependent variable. Model 1 consists of angler's sense of place as well as availability of catch and satisfaction with fishing spot components as independent variables. Model 2 consists of the same variables as Model 1, as well as angler background and demographics as added independent variables. Significant relationship indicated by *** p< 0.001, ** p< 0.01, * p< 0.05 with estimate variables represented and standard error provided in parenthesis. Inverse relationships are marked with (-).

Variables	Vulnerability Perceptions (Model 1)	Vulnerability Perceptions (Model 2)
Sense of place	0.066* (0.03)	0.063* (0.03)
Availability satisfaction	-0.104 (0.20)	-0.053 (0.19)
Predicted life satisfaction with stock shift	-0.123 (0.10)	-0.125 (0.10)
Spot change	-0.845* (0.35)	-0.804* (0.36)
Fishing location	-1.03** (0.34)	- 1.074** (0.35)
Years fishing		-0.365* (0.14)
Generation of anglers		0.034 (0.11)
Age		0.055 (0.14)
Gender		-0.398 (0.78)
Race		-0.062 (0.12)
Education		0.490** (0.16)
Income		-0.027 (0.08)
Constant	5.862***	5.669**
Adjusted R^2	0.076	0.112
Individuals (n)	300	300

4.3.2 Life Satisfaction (all anglers) Model

An angler's sense of place (β= 0.147, p<0.05), availability satisfaction (β =0.948, p<0.05), predicted life satisfaction with stock shift (β= 0.446, p<0.05), and fishing location (β= 1.742, p<0.05) were all positive predictors of overall life satisfaction. But, when angler background and demographic variables were added into the model, race (β= -0.578, p<0.05), education (β= 0.852, p<0.01), and income (β= 0.631, p<0.001) proved to be more significant predictors of an angler's life satisfaction over their sense of place or their fishing location. This therefore suggests that these demographic variables may be a more accurate predictors on an angler's sense of place and/or their primary fishing location, and as a result, their life satisfaction (Table 12).

Table 12. Multiple linear regression results of life satisfaction of all anglers as the dependent variable. Model 1 consists of angler's sense of place as well as availability of catch and satisfaction with fishing spot components as independent variables. Model 2 consists of the same variables as Model 1, as well as angler background and demographics as added independent variables. Significant relationship indicated by *** p< 0.001, ** p< 0.01, * p< 0.05 with estimate variables represented and standard error provided in parenthesis. Inverse relationships are marked with (-).

Variables	Life Satisfaction (Model 1)	Life Satisfaction (Model 2)
Sense of place	0.147* (0.06)	0.114 (0.06)
Availability satisfaction	0.948* (0.39)	1.047** (0.37)
Predicted life satisfaction with stock shift	0.446* (0.20)	0.435* (0.18)
Spot change	1.053 (0.71)	0.890 (0.68)
Fishing location	1.742* (0.68)	0.847 (0.66)
Years fishing		-0.069 (0.27)
Generation of anglers		0.195 (0.21)
Age		-0.163 (0.27)
Gender		-1.216 (1.49)
Race		-0.578* (0.23)
Education		0.852** (0.30)
Income		0.631*** (0.16)
Constant	11.890***	9.186**
Adjusted R^2	0.060	0.158
Individuals (n)	300	300

4.3.3. Life Satisfaction (anglers that had experienced a decrease in availability of catch) Model

This analysis was conducted in order to better understand how life satisfaction may be affected when anglers have already experienced a decrease in catch availability. This is an important factor to distinguish in order to represent a current shift in environmental conditions, and therefore, the potential real-time effects of this shift on well-being. Assessing the impact that sense of place can have on individuals experiencing environmental change has not yet been prioritized, therefore this analysis may offer impactful insight (Mulvaney et al. 2020). An angler's sense of place (β= 0.212, p<0.05) as well as their predicted life satisfaction with stock shift (β= 0.608, p<0.05), were all

positive predictors of the life satisfaction of those anglers who have already indicated experiencing a decreased availability of catch at their preferred spot. When demographics were also controlled for, an angler's availability satisfaction (β =1.188, $p<0.05$), their predicted life satisfaction with stock shift (β= 0.669, $p<0.05$), as well as their education (β= 1.119, $p<0.05$) and income levels (β= 0.564, $p<0.05$), had a significant positive relationship with life satisfaction. This indicates that these demographic variables, as well as an angler's availability satisfaction can impact an angler's sense of place and therefore are likely to influence an angler's life satisfaction (Table 13).

Table 13. Multiple linear regression results of life satisfaction of anglers who had experienced a decrease in availability of catch as the dependent variable. Model 1 consists of angler's sense of place as well as availability of catch and satisfaction with fishing spot components as independent variables. Model 2 consists of the same variables as Model 1, as well as angler background and demographics as added independent variables. Significant relationship indicated by *** p< 0.001, ** p< 0.01, * p< 0.05 with estimate variables represented and standard error provided in parenthesis. Inverse relationships are marked with (-).

Variables	Life Satisfaction (Model 1)	Life Satisfaction (Model 2)
Sense of place	0.212* (0.09)	0.148 (0.08)
Availability satisfaction	0.990 (0.54)	1.188* (0.52)
Predicted life satisfaction with stock shift	0.608* (0.27)	0.669* (0.26)
Spot change	1.735 (1.06)	1.089 (1.07)
Fishing location	0.902 (0.97)	0.817 (0.98)
Years fishing		-0.376 (0.47)
Generation of anglers		0.529 (0.33)
Age		-0.148 (0.40)
Gender		-2.772 (2.68)
Race		-0.491 (0.30)
Education		1.119* (0.43)
Income		0.564* (0.24)
Constant	8.371*	6.533
Adjusted R^2	0.064	0.175
Individuals (n)	148	148

4.4 *Interview Analysis*

Key phrases and words from each transcription were coded into 5 main nodes representing key themes discussed: fishing location, target species, sense of place, environmental change, vulnerability perceptions, well-being, and management. Within each of these parent nodes, child nodes were used to specify components of each of these themes. Out of the 21 interviews conducted, 9 interviewees were from NY, 8 were from RI, and 4 were from CT. Interviewees primarily targeted striped bass, fluke, black sea bass, bluefish, tautog and false albacore, which are traditional recreational fisheries in this region. Percentage of interviewees that suggested they like fishing.

4.4.1 Sense of Place

Majority of interviewees expressed a strong sense of place to their preferred fishing spot. On average, interviewees had been fishing at their preferred spot for 18 years, and went to one preferred spot as opposed to multiple spots due to the proximity and productivity. For example, one interviewee expressed this point by saying their preferred spot was a result of a “combination of accessibility and the ability to catch fish”. Seventeen, or 81% of interviewees, noted that their spot provided distinct value as compared to other spots (Figure 5), and 18 (86%) enthusiastically suggested that many memories were tied to this one spot by saying phrases like “definitely”, “absolutely”, and “of course” (Figure 6). Twenty (95%) interviewees suggested that frequently visiting their preferred fishing spot has led them to “without question” develop a stronger awareness to those surrounding areas’

environmental conditions. Twenty-one, or 100%, of interviewees said that they have developed a stronger connection to the area that they prefer to fish at over other areas they may fish occasionally. To that point, one interviewee suggested that with “fishing the same areas for long periods of time I’ve definitely learned the structure and patterns of fish with certain tides and you can kind of know when to expect certain species by fishing the same area over and over again” and another said “I enjoy where I go, I know it intimately, now I know what I can expect, I know when (the conditions) are good”.

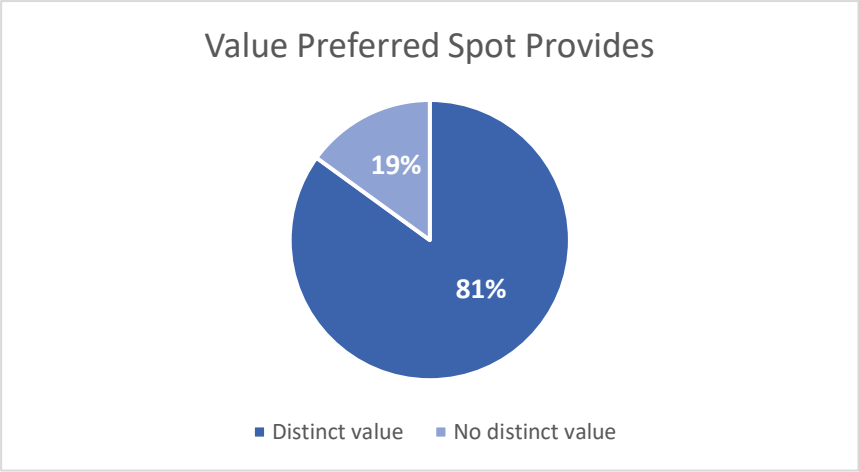

Figure 5. Percentage of interviewees that suggested their preferred spot provided distinct value.

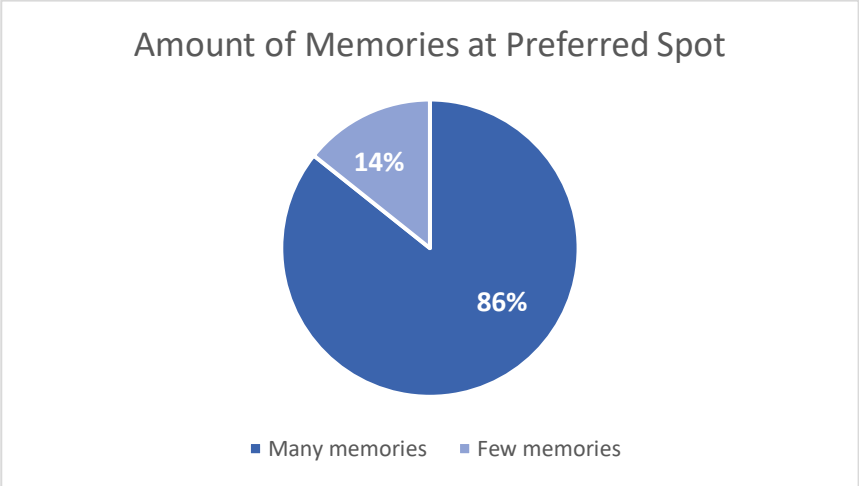

Figure 6. Percentage of interviewees that had many memories at their preferred spot.

4.4.2 Environmental Change

Interviewees expressed that they had witnessed a series of changes to the environment surrounding their preferred fishing spot, as well as their target species. These shifts lowered many anglers' overall satisfaction with fishing at their preferred spot. When asked if they had seen any shifting conditions relating to their primary target species, overall availability, size of fish, cyclic timing, and habitat locations were all mentioned as aspects that had decreased or shifted within the last 5-10 years. Due to environmental changes that have caused certain fish stocks to vary habitat locations and cyclic timings (Figure 7), 9 interviewees suggested that they had a lower satisfaction as a result of these shifting conditions. One competitive striped bass fisherman stated that "especially at my preferred spot that I fish a lot, there's a fair bit less satisfaction with knowing that you're not going to catch as well as you did, or as well as you have, or as well as your buddies did several years ago, so that's disappointing, and having to get up and move is pretty disappointing, especially when you know the spot has such great potential". Five interviewees noted that their satisfaction has remained the same with shifting environmental conditions, with one interviewee suggesting that "my satisfaction hasn't changed, but maybe my frustration has increased and maybe some more anxiety with hoping my kids get to have the same opportunities that I did with fish stocks and hoping that they still have the same opportunity in 10, 20, 30 years down the road with their kids as well, that's

what's important to me is that we will be able to maintain these fish stocks so future generations can enjoy them as well".

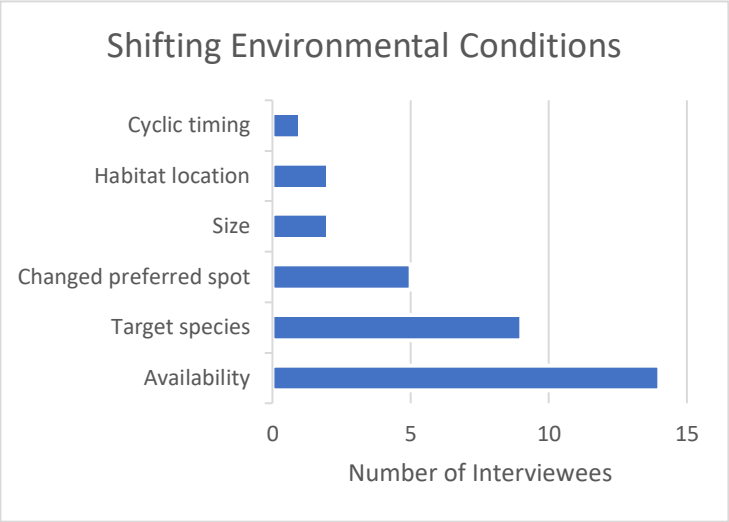

Figure 7. Counts of shifts in the environment cited in interviews.

4.4.3 Vulnerability Perceptions

Majority of interviewees suggested that they would adjust to a decrease in availability of catch at their preferred spot by finding a more productive location to fish at. But, many of these anglers expressed that it would inevitably be harder to make this adjustment, due to the strong connection they had established with their preferred fishing spot. This theme assisted with filling in gaps associated with the "adaptive capacity" component to the quantitative measurement of vulnerability. Eleven interviewees said that they felt it will be harder to adjust to changes in the environment due to their strong connections to their preferred fishing spot. For example, one interviewee said that, "it's nice fishing an area you know and you have history with, and that makes it more difficult to branch out to newer areas if you're not comfortable with those areas," with another stating that, "I think there's always that hopeful

belief that even if stocks did change, you would try to still stay there, because there's an attachment to it". Five interviewees indicated that it would not be hard to adjust to change, with one angler suggesting that "having a good boat makes all the difference, you just motor on to the next place, so yeah not a big adjustment other than, you know, the near shore" and another stating that "I think part of it is being flexible and identifying the right conditions and the right tides to know if a certain area is going to be good or not that day, and in that area there's enough diversity to almost always find fish somewhere" (Figure 8). At least 3 of these interviewees primarily fished offshore.

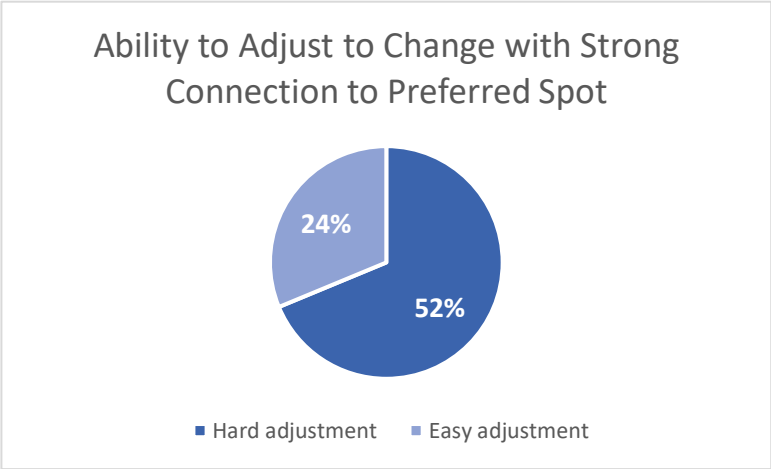

Figure 8. Percentage of interviewee's ability to adjust to change.

Although indicating how difficult adjusting might be, 17 (81%) respondents said that they would change spots if their primary target species was no longer available in those areas. For example, one angler said that "fish move, so you have to move too, you know, and I feel that no day is ever the same on the water, you have to adapt" and others suggesting that they "travel for fish" and that they're "happy to get up and go" but would "rather not because it's disappointing" to witness and respond to changes in the

environment. At least 5 of these interviewees primarily fished offshore. Five suggested that they would stay at their preferred spot and target a different species, primarily due to access and financial restraints, as one interviewee stated: “I would usually remain at the same area due to access purposes” (Figure 9).

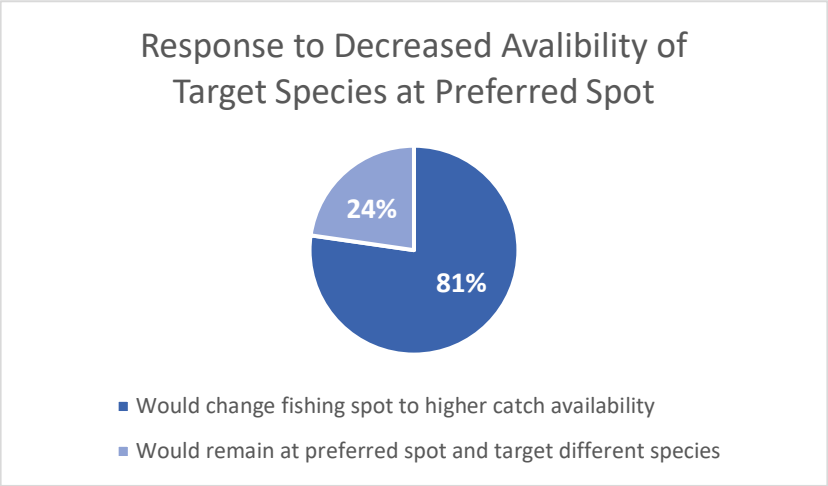

Figure 9. Percentage of interviewees response to decreased availability of catch.

4.4.4 Well-being

Interviewees were asked to define what well-being meant to them due to the level of subjectivity involved with this measurement, and in order to understand components of well-being that they felt were most important them. Majority of interviewees defined well-being as “just being happy and healthy” with an emphasis on both physical and mental health. A few also mentioned being financially secure and having hobbies to enjoy as main contributors. When asked what the impact of fishing at their preferred spot had on their overall well-being, a mix of responses were suggested including: providing a source of happiness, enabling family time, to have a sense of familiarity and

comfort knowing an area you have built a connection with, contributing to mental and physical stimulation, as well as a means to relax and have a moment of solitude. For example, one interviewee said “mentally, I think being in the same area all the time gives you more peace of mind and a familiarly with an environment and knowing what to expect as opposed to going into some place blind”, with another stating that “there’s a strong relationship between my happiness, well-being, and the water”.

Eleven interviewees indicated that having to find new spots to fish at or new target species to fish for would have a positive effect on their overall well-being, with one fisherman suggesting that “there's that thrill of the hunt kind of thing where you're, you know, exploring new areas, going new places and hoping to find something better, so I kind of enjoy that part of it” and another saying that there’s “nothing wrong with a new challenge”. But, nine indicated that it would have a negative effect with one suggesting that it’s “upsetting when things change so much and seeing that there is such environmental degradation, or lost, that's deeply concerning”, with another citing accessibility struggles by saying “let's say there's restrictions for residents only, you know, that’s a type of obstacle that is happening more and more these days”. Three indicated both a positive and negative effect. For example, one interviewee stated “it's sort of a mixed bag, it goes both ways, it's certainly fun to explore new spots, but I'd rather not to tell the truth”. Future research might explore what determines whether someone feels positive or negative about a change

in fishing location, and how fishing on or offshore may contribute to these attitudes.

4.4.5 Management

Majority of interviewees suggested that the inclusion of social data, such as gathering angler perceptions and attitudes, would result in more of a general level of understanding between management bodies and anglers. When prompted to think about what type of data they believed to be important for fishery management bodies to consider including within assessments, 10 interviewees suggested the importance of considering social metrics in order to increase engagement and collaboration between fishing communities and governing authorities. One angler stated that he thought “a more subjective, personal approach would be effective in raising awareness and engaging the community” and that “the community would likely respond better to nostalgia and attachment to fishing memories”. Another interviewee suggested that “if (management bodies) want to maintain a fishery, and maintain the collection of data from certain fisherman, then us being happy about fishing (at a preferred spot), and wanting to stay there will contribute to their data collection more positively”.

Six interviewees mentioned the importance of considering the economic contributions recreational fishing has on coastal communities, with one interviewee stating “there's also a huge economic impact of fishermen spending thousands and thousands of dollars on gear, gas, housing, space, access, there's a ton of money there that those fishermen are willing to spend,

and not only willing, but happy to for a lot of reward” and another saying that the recreational angling community “drives a lot of business, there are a lot of people making their livelihood at it and I mean, I bought this house and brought my kids here, they went to University of Rhode Island and now I'm working out of Rhode Island and that’s because of the coastal community here”.

Five interviewees mentioned the need for a heightened overall acknowledgement of recreational anglers as opposed to commercial fishermen within management. One fisherman suggested that “I would say the recreational fishing guy comes in last as far as their management of all fishing stocks”. Four interviewees noted that taking into account the connection that anglers can have to certain fishing spots would be useful to prevent decreased access or unproductive nourishment to traditional areas with one interviewee making the statement that “especially in New England, Rhode Island, Connecticut, and New York, sufficient access to coastal marine areas are limited every year. The few areas that we do have aren't exactly always amazing spots to go fishing, I mean they might provide access to a spot, but it could be too shallow or could not have proper structure. It could just be the wrong kind of area to target certain species of fish. So, having a large organization paying attention to this and focusing on the access to these (productive) areas to (maintain angler) well-being is definitely something that should be a priority”.

Five interviewees stated that data analyzed to create management plans should only consist of biological data to sufficiently understand the well-being of the stock as opposed to the community, with one angler stating that he thought “it should be the overall well-being of the stock species, I think that's what's more important”. Finally, three interviewees emphasized the need to work towards ecosystem-based management policies in order to properly account for the fluidity of stocks between regions, with one angler suggesting that he thought that “individual states have interests that affects other states” and that “we need comprehensive fisheries management for an entire species, not in a set location for that species”.

CHAPTER 5

DISCUSSION

5.1 *Overview of Findings*

Hypothesis one was confirmed; anglers who exhibit a high sense of place have higher vulnerability perceptions. Hypothesis two was partially confirmed; each component of sense of place had an association with overall vulnerability perceptions as well as the sensitivity component, with partial association to exposure and no association to adaptive capacity. Hypothesis three was not confirmed; angler's sense of place was not a predictor of life satisfaction. Lastly, hypothesis four was not confirmed; anglers that had experienced a decrease in availability of catch at their preferred spot still had a high life satisfaction, but sense of place was not a significant predictor. The descriptive statistics indicated that the median respondents were white males between the ages of 31-40 who had an online presence, were relatively well-educated, financially well-off, and fished for sport and/or leisure within the states of RI, NY, and CT. Consequently, it is important to emphasize that the findings of this study cannot be generalized to other fishing populations.

5.2 *Sense of Place as an Indicator*

5.2.1 Vulnerability Perceptions

The results from this study showed a significant positive relationship between sense of place and vulnerability perceptions, suggesting that when an angler has a stronger sense of place, they also are likely to have higher

perceptions of vulnerability to shifting stock distributions. This result confirms the hypothesis linked to the first research question posed in this study. This is potentially due to an angler's high level of dependency, investment and hypothetical unwillingness to leave a spot they have formed a connection with. Various anglers interviewed for this study expressed that it would be hard to adjust to changing environmental conditions due to having a strong connection and level of familiarity and comfort with fishing at their preferred spot. As climate change is causing traditional stocks to shift their habitat location, this will not only impact angler's vulnerability, but also the sense of place that they have developed to a preferred fishing spot.

This relationship between sense of place and vulnerability perceptions was especially prevalent when considering the relationship between an angler's place dependence and place attachment to their sensitivity, or their level of dependence on an ecosystem good or service. A higher level of sensitivity is usually exhibited when an individual is dependent on vulnerable resources (Marshall et al. 2007). These findings suggest that the more an angler depends on or feels attached to a location, the higher sensitivity they will have to shifting stock distributions. Qualitative results suggested that this connection may influence whether an angler chooses to rely on one target species or location to fish. The more connected an angler feels to a preferred spot, the more likely they are to stay at that spot and target a different species, as opposed to moving locations if their target species were to shift habitat locations. On the other hand, several interviewees also suggested that they

were more attached to their target species, and therefore would end up leaving their preferred spot in search of a more productive area for a particular stock. Both circumstances can lead to an increased sensitivity due to their sense of place, where one scenario increases the dependency on a location, and the other on a shifting environmental resource. Similarly, an angler's place attachment was associated with their exposure. This result suggests the more attached to a fishing spot an angler is, the more exposed they may feel to the changes in their surrounding environment or community. Almost all interviewees exhibited this attachment that led to an increased awareness to their surrounding environment, suggesting that the more they frequented their preferred spot, the more aware they became to that environment's conditions. Consequently, the hypothesis associated with the second research question was partially confirmed, where all aspects of sense of place (dependence, attachment and identity) did affect aspects of vulnerability perceptions including sensitivity and exposure, with the exception of adaptive capacity. This may be a result of the inconsistency between the variables used to measure adaptive capacity.

These findings suggest that an angler's sense of place can be consequential to their vulnerability perceptions. This provides evidence for the importance of considering and monitoring recreational angler's sense of place as climate change continues to transform coastal environments, potentially making individuals more vulnerable to shifting conditions. Variability in the attributes of a particular place, such as the availability of alternative fisheries,

can contribute to shaping fishermen perceptions of measuring vulnerability (Chen and Lopez-Carr 2015). Therefore, this finding provides meaningful reason to measure sense of place in order to gauge the level of impact moving from a preferred fishing spot in order to catch target species will have on an angler's environmental identity. Because preserving a sense of identity is a key factor to maintaining the resilience of a system, taking into account one of the main environmental identities that key resource users have will be important in promoting resilience as climate change continues to cause shifts in the ocean environment (Desjardin et al. 2015). The inclusion of demographics within this model showed that sense of place had a stronger influence on perceptions of vulnerability than the traditional demographic variables used within current vulnerability assessments. This provides evidence for the inclusion of more robust socio-cultural indicators, such as sense of place, within management frameworks to more accurately assess angler needs and well-being. Accordingly, sense of place is a clear indicator for angler vulnerability perceptions concerning shifting stock distributions.

5.2.2 Life Satisfaction

When demographics were added as constants to Life Satisfaction Model 2, sense of place was not significant. Therefore, this finding may suggest that race, education, and income are more accurate predictors of an angler's sense of place, and as a result, their life satisfaction. This could suggest that the different background anglers come from may influence their ability to find and form a connection to a specific fishing location due to

access, time, or financial restrictions. In turn, this could affect angler's flexibility to travel to new locations to successfully fish for a desired target species or adjust to shifting environmental conditions. For example, many of the anglers interviewed for this study mentioned the financial burden of searching for new spots, or purchasing a boat for the ability to fish for a larger variety of species offshore. Several also mentioned the limited access to shorelines that are able to provide the correct structure for fishing. Therefore, this finding is consistent with a previous study suggesting that an individual's age or position within life can be a predictor of sense of place dimensions (Cuba and Hummon 1993). Consequently, hypothesis three was not confirmed and the findings from this study suggest that demographic variables were stronger indicators of an angler's sense of place, and as a result, their life satisfaction.

However, the results from the correlation analysis between angler's life satisfaction and sense of place components did show a significant association. This finding implies that by having a strong component of their environmental identity present, this can have a generally positive impact on how satisfied an angler is with their life. This finding is understandable as there are a number of variables that can contribute to well-being such as an individual's overall sense of identity, which their environmental identity is a component of, and thereby their sense of place can contribute to (Garcia-Quijano and Poggie 2019). In particular, place dependence had the most association with angler's life satisfaction. This indicates that the more an angler depends on, or has a functional relationship to a location, the more satisfied they were overall with

their life. Of those anglers that had experienced a decrease in availability of catch at their preferred spot, place attachment had the most significance relationship to their life satisfaction. This suggests that the more attached, or the stronger emotional bond an angler feels to their preferred spot, they more satisfied they are with life. As sense of place can be considered a cultural-ecosystem service to fishing communities, this emphasizes the cultural ecosystem benefits this identity present in fishermen can provide, helping to increase overall well-being (Urquhart and Acott 2014, Khakzad and Griffith 2016).

5.3 *Impact of Angler's Background on their Sense of Place and Vulnerability Perceptions*

Generations of anglers was also significantly associated with an angler's sense of place, and in particular, their place attachment. The longer generational history that an angler's family had recreationally fishing, the stronger their place attachment was to a preferred spot. This could potentially be a result of fishing spots being passed down from previous family members that contain distinct memories and value compared to other areas, as many interviewees mentioned. In turn, this may make relocating to a different spot more difficult due to family traditions and knowledge attached to their preferred place. This finding provides a similar parallel to how commercial fishermen are less likely to look for other employment opportunities, due to the intergenerational nature of the occupation (Shaffril et al. 2016).

Another result from the Vulnerability Perceptions Model indicated that years fishing was a predictor of vulnerability perceptions. This suggests that the longer an angler had been fishing, the less vulnerable they perceived themselves to be to shifting stocks. This could be a product of being able to adapt more readily due to multiple years of experience adjusting to their surrounding environmental conditions. For example, communities of fishers have shown a higher capacity to adapt the older the head of the household was, emphasizing the importance of past experiences and distribution of knowledge (Limuwa et al. 2018).

5.4 *Environmental Perceptions Impact on Vulnerability Perceptions and Life Satisfaction*

The Vulnerability Perceptions Model also indicated that a changed spot was a predictor of vulnerability perceptions, where if an angler had not previously changed their preferred spot, they had higher perceptions of vulnerability to shifting stocks. This may be a result of developing a greater level of awareness to changing environmental conditions by frequenting the same fishing spot, which would contribute to an overall heightened consciousness to their perception of vulnerability. For example, one interviewee suggested that it was “definitely easy to see how populations change and are affected” by continuously visiting one spot. This result could also be connected to the number of years an angler has been fishing, where fishing for a shorter period of time could contribute to the inability to change locations, therefore contributing to overall heightened vulnerability perceptions.

Another result from the Vulnerability Perceptions Model indicated that fishing location can influence angler vulnerability perceptions, revealing that if an angler's preferred spot was onshore, this increased their perceptions of vulnerability. This may suggest the lack in ability to move spots when primarily fishing onshore due to being on foot as opposed to having a boat. For example, one interviewee suggested that "if I wasn't adapting and overcoming, I would have sold my boat this year". Therefore, this could feasibly cause issues with fishing at alternatively productive and accessible spots, further contributing to angler's overall perceptions of vulnerability to shifting stock distributions due to the inability to adjust to change.

Similarly, the results from the Life Satisfaction Model also indicated that fishing location was an indicator of life satisfaction, where those anglers that fished offshore showed higher satisfaction with life. This finding is similar to the Vulnerability Perceptions Model where fishing from a boat as opposed to onshore provides a level of flexibility that allows for more access to productive fishing areas and therefore can impact how satisfied an angler is with their life overall. Interviewees noted that "at the end of the day, you just turn the boat around and go towards where you know the fish are" and that "having a good boat makes all the difference, you just motor on to the next place". These findings suggests that onshore anglers may experience lower life satisfaction and higher perceptions of vulnerability when compared to offshore anglers, potentially due to having a harder time adapting to changes resulting from climate change.

Another result from the Life Satisfaction Model confirmed that availability satisfaction is an indicator of angler life satisfaction, where the more satisfied an angler is with the availability of catch at their preferred spot, the more satisfied they are with their current life overall. This is comparable to how commercial fishermen might exhibit lower job satisfaction due to changes in fish populations (Pollnac et al. 2015). In addition, one survey question asked anglers to reflect on their overall life satisfaction and indicate how important being able to fish at their preferred location was to maintaining their satisfaction with life. In response to this question, the majority suggested that it was “important”. This result emphasizes the positive impact that natural capital can have on life satisfaction (Vemuri and Costanza 2006). With climate change continuing to cause a decrease in availability of traditional species in the Mid-Atlantic Bight (Kleisner et al. 2017), this shift in the environment could potentially lead to an overall decline in angler life satisfaction. Considering sense of place as an indicator, as well as how the availability of catch has changed at fishing spots that local anglers have formed a connection with, can provide valuable insight as to how angler life satisfaction can, and has, changed, and therefore provide a general understanding of community well-being.

The Life Satisfaction Model also suggested that a higher predicted life satisfaction with stock shift indicated increased life satisfaction in anglers. This finding may be a result of anglers enjoying a sense of challenge when it comes to finding new areas to fish, or new target species to fish for, which

would in turn have a positive impact on the way they perceive their life. This result is consistent with previous findings associated with high levels of self-actualization, or the challenge, adventure, and independence, that fishing provides and contributes to angler well-being, by fulfilling the adventure and risk-taking personality type that many fishers hold (Pollnac et al. 2006, Pollnac and Poggie 2008, Pollnac et al. 2013). In addition, interviewees suggested that they would enjoy the mental challenge of finding new productive areas. For example, one interviewee suggested that they enjoyed “the thrill of the hunt kind where you’re exploring new areas, going new places and hoping to find something better”. This finding is consistent with Yi-Fu Tuan’s seminal work “Space and Place: The Perspective of Experience” in which he suggested that the idea of having a “place” provides us with a sense of security that we ultimately become attached to, whereas “space” provides us with a sense of freedom which we end up longing for (Tuan 1930). Anglers in this study expressed a deep connection to their current preferred fishing spot which has helped shape who they are, the memories they keep, and their overall dependence on an ecosystem service that is undervalued (National Ocean Economics Program 2009). But, in contrast to this strong sense of place that anglers possess to a certain fishing spot, many also suggested the future desire to explore new territories to provide for a mental and physical challenge, allowing them to express a sense of freedom, which has been acknowledged as a key dimension to fishing trip satisfaction (Holland and Ditton 1992). Perhaps this suggests that anglers, when forced to do so, will be

able to adapt and even enjoy shifting environmental conditions, provided they have the means to do so. But, this adjustment may come at the cost of potentially losing a part of their identity linked to a spot that no longer serves them.

As this survey question asked anglers to reflect on a future scenario as opposed to current circumstances, this may explain why this result is conflicting to their current satisfaction predictor. This finding exemplifies that short-term satisfaction may be a more realistic estimate of life satisfaction as opposed to long-term predicted satisfaction due to the challenges of conceptualizing and preparing for the future when current emotions can be the most prominent gauges of risk (Loewenstein et al. 2001). Due to the complexity associated with this contrast between current and future attitudes, continually monitoring angler's perceptions regarding their environment, which has implications to their satisfaction, sense of place, and therefore overall well-being, is crucial in fully understanding the depth to a fishing population and enabling the capacity for sound policy. This research provides evidence in support of understanding environmental perceptions of anglers, through gathering their place-based knowledge and attitudes in order to better recognize components that contribute to well-being in anglers.

5.5 *Impact of Decreased Availability of Catch on Angler's Life Satisfaction*

The hypothesis for the fourth research question posed for this study was not supported; even among anglers who had experienced a decline in target species availability, life satisfaction remained high, but angler's sense of

place was not a significant predictor. This finding is consistent with the anglers surveyed in this study that had not yet experienced a significant decrease in availability of catch at their preferred spot. When demographics were added as constants to the Life Satisfaction Model 2, sense of place lost significance. Consequently, this may suggest that the relationship between sense of place and life satisfaction in those anglers that have already experienced a decreased availability of catch at their preferred spot, is actually influenced by education and income levels on sense of place. Availability satisfaction also became significant in Model 2, signifying this variable's influence on angler's sense of place as well. This finding suggests that with a higher education and income level, as well as more satisfaction with their current spot, the more satisfied overall anglers can be predicted to be with their current life. This may relate to the fact that anglers would prefer to continue fishing at a spot they have established a familiarity and connection with, and would therefore find it would contribute negatively to their overall well-being if they had to put in effort to finding another productive spot, as multiple interviewees revealed (Shaffril et al. 2016, Rogers et al. 2019). But, predicted life satisfaction with stock shift was also an overall positive predictor of life satisfaction within this group of anglers. This result means that anglers who predicted their future life satisfaction would increase if their target species were to shift their habitat northward, have a higher current life satisfaction. This finding corresponds to previous results that included all anglers surveyed for this study. This research shows that recreational anglers who depend on the Mid-Atlantic Bight to fish in

the states of New York, Connecticut, and Rhode Island have already begun to experience and adapt to shifting fish stock distributions, which may impact their environmental identity of sense of place.

5.6 *Limitations of Study*

5.6.1 Positionality

It is important to recognize my positionality within this research to present the bias I may have brought to my data collection and interpretation. I am a young, white, woman, who is working towards my higher education and has never participated in fishing. As I was most likely perceived as an outsider to the recreational angler population I collected data from, this may have led to more closed off survey responses and interview conversations due to the lack of built trust and mutual understanding. Being a young woman and interviewing men may have also biased the data I collected, as interviewees might have felt pressure to answer the questions geared toward thinking more deeply about emotional connections to be polite as opposed to sharing their true thoughts. Being white may have also led to more white respondents as opposed to people of color, due to being an outsider to that community as well. Personally, I also have a strong sense of place to a location that I have built my self-identity around, and therefore may have brought bias into this data analysis in hopes of scientifically elevating this concept.

5.6.2 Subjectivity and complexity with creating main measurements

The challenges associated with this type of study include the vast level of subjectivity and complexity involved with creating measurements for components of well-being, including life satisfaction, vulnerability, and sense of place. Therefore, I used my discretion as well as existing literature to develop the best measures of these variables based on the research questions developed for this study. Measuring the vulnerability component of this study was particularly difficult as only *perceptions* of an angler's own sensitivity, exposure, and adaptive capacity could be evaluated, as opposed to external measures of objective vulnerability. Vulnerability assessments are also inherently difficult due to the sensitivity around the actual word "vulnerable", as no individual or community wants to be categorized as being vulnerable. Therefore, the word "vulnerability" was not used within this study and instead, thought provoking questions to engage respondents with subject areas that could potentially affect their perceptions of vulnerability were used instead of asking individuals about their vulnerability status outright. In addition, the variables used to measure "adaptive capacity" were not necessarily related enough to be combined into one measurement, therefore potentially affecting the results associated with this component of vulnerability.

5.6.3 Sampling

Sample limitations include initially trying to target commercial fishermen in Montauk, NY for intercept surveying, which was unsuccessful due to difficulty in making contact with this population as a result of the randomness

in their work schedule. I then attempted to conduct surveying by phone calling New York commercial vessel owners through a public database provided by NOAA. This sampling method was also unsuccessful after I was met with aggression and frustration by those commercial fishermen where contact was made. These fishermen expressed how they thought phone calling them was an invasion of privacy and expressed their discontent towards research practices in general as a result of feeling as if the knowledge they could provide to enhance management frameworks is continually disregarded.

The last sampling method attempted was successful, but due to conducting an online survey, only those anglers who had internet access and were members of social-networking groups (Facebook) were able to be sampled. This method led me to underrepresent many other types of anglers in these states that may have not been associated with online Facebook groups, such as anglers who were female, between the ages of 18-21 and 65+, people of color, and those who fished for subsistence, all of whom are known to participate in recreational angling within these state waters. Intercept surveying would have increased the diversity in my sample. The median of respondents were white males between the ages of 31-40 who recreationally fished in Rhode Island. The median income of the survey population was $100-150k, which is 2x above the national median (United States Census Bureau 2021). This could have contributed to the results of this study, where demographic factors may have played a strong role in determining perceptions of vulnerability, life satisfaction, and developing a sense of place. As the

majority of respondents fished for leisure as opposed to economic livelihood, results may have differed significantly if commercial fishermen were interviewed. Elements of vulnerability are not constant between contexts, and therefore it is important to note that the sensitivity and adaptive capacity among recreational and commercial fishers differ and therefore makes the results of this study non-generalizable (Thiault et al. 2021). Another limitation can include collecting responses to this survey during the late fall, which led to the majority of respondents targeting striped bass as their primary species. This again emphasizes that the results of this study cannot be generalized to broader populations of fishermen.

Due to this survey being conducted online, it is important to note the biases that could have occurred through collecting data in this environment. After posting the survey to Facebook groups, comments were usually made with regards to individuals' thoughts and feelings about the survey. If positive or negative comments were made, this may have biased potential respondents one way or the other when deciding whether to participate. For example, a comment on one survey post suggested someone felt disrespected by the term "fisher" that was used within the survey. This sparked a conversation about the preferred terminology "fisherman". It can be inferred that this discord might have deterred other potential survey respondents. Alternatively, a separate comment was made on a different posting of the survey where an individual suggested this survey was unlike anything they had previously seen and was actually enjoyable to take. This could have

persuaded other individuals to partake in this study. Lastly, being a student from the University of Rhode Island, posting the survey in Rhode Island based fishing groups could have potentially encouraged a higher level of engagement with this survey due to sharing a sense of community.

5.6.4 Political climate

It is also important to note the charged political climate this survey was conducted during, as well as the nature of the population targeted. As the data collection process started in the late summer of 2021, relatively close to when president Joe Biden was sworn into office, many anglers who supported Donald Trump expressed resistance to conversations around science and the environment. Furthermore, many fishermen are resistant to the idea of climate change as they are more inclined to believe that the changing conditions we are seeing today within the ocean is a result of pure environmental randomness that they witness and adapt to daily on the water. Therefore, the phrase “climate change” was not directly expressed in the survey in an effort to avoid conflict and prevent further bias.

5.6.5 Limited timeframe

Lastly, the one-year timeline to complete this research was also a limitation. This reduced the timeframe available to collect data, leading to a relatively small sample size. Limited time also impacted the type of statistical analyses that were able to be used within this study. With more time, the survey instrument would also have ideally been pre-tested and reviewed

through a focus group to eliminate any confusing wording or inappropriate terminology. Interviews conducted would also have been longer and more in depth.

5.7 *Policy Recommendations*

In summary, recommendations regarding this research can include implementing a similar quantitative evaluation of angler's environmental identity of sense of place through developing a Likert-scale based questionnaire modified from existing literature as exemplified in this study. It would be in NOAA's best interest to expand the type of socio-cultural indicators assessed within current management frameworks like MSA, FMPs, and NEPA in order to better assist fishing communities adapt to changes in the environment that they depend on to support their way of life. This type of assessment would contribute towards creating holistic vulnerability and well-being measurements, support the implementation of ecosystem-based fisheries management, provide the ability to account for the social impacts of polices on fishing communities, as well as collectively promote increased resilience of fisheries to climate change.

5.8 *Conclusions*

The findings from this study suggest that sense of place is a clear indicator for angler vulnerability perceptions concerning shifting stock distributions. A higher sense of place was associated with higher perceptions of vulnerability. This is a result of anglers having a higher sensitivity and level

of exposure to shifting environmental conditions. This result suggests that these anglers may exhibit less flexibility, less adaptability, and more awareness from developing a strong connection to a place. This place has likely been traditionally visited and therefore contains many memories and distinct value that is hard to find elsewhere. These are the anglers that will be most at risk from shifting stock distributions which could also end up affecting their sense of place, their life satisfaction, and therefore, their overall well-being. Angler's sense of place showed an association to their life satisfaction, where place dependence and attachment presented the strongest relationship. Sense of place can also be influenced by the number of generations of anglers in a family, as well as race, education and income. Theses demographic variables also played a significant role in influenceing an angler's life satisfaction.

In the case of this research, individuals were surveyed, but these methods could potentially be applied to account for the well-being of a community at large. Evaluating sense of place as well as perceptions anglers have regarding the conditions of their fishing spots, can be impactful in trying to understand the effects of shifting stock distributions as a result of climate change. This type of data collection can increase the effectiveness in devising climate-ready fisheries policy. In addition, maintaining angler's connection to their environment as changes continue to occur will help to increase personal investment in protecting and using the ocean sustainably. Through understanding fishermen's sense of place, management bodies will be able to

enhance social-ecological monitoring and perform assessments that account for important values anglers have, therefore increasing their ability to frame communication in a way that will increase compliance while maintaining environmental identities of fishermen. Furthermore, the contributions anglers can make to creating more dynamic, place-based, observations to evaluate and update management goals is salient. Based on the connection many anglers have to their fishing locations, as well as their regular visitation to these areas, this provides means to expand data collection through gathering perception-based evidence from anglers grounded in shifting coastal communities. As a result, this type of information can help to advance insight about current environmental conditions and overall well-being. Understanding components to well-being is essential in projecting trends and recognizing the needs and values that individuals have in order to build capacity within anglers to adjust to change.

APPENDICES

Survey Questionnaire

Q_1: Thinking about your preferred fishing spot, please indicate your level of agreement with the following statements:

(1) Strongly Disagree – (2) Disagree – (3) Slightly Disagree – (4) Neither Agree nor Disagree – (5) Slightly Agree – (6) Agree – (7) Strongly Agree

Q1_1: This fishing spot provides value to me that I can't obtain at other fishing spots

Q1_2: I get more satisfaction from visiting this fishing spot than other fishing spots

Q1_3: I feel most like myself when I am at this fishing spot compared to other fishing spots

Q1_4: I am very attached to this fishing spot

Q1_5: Many important memories are tied to this fishing spot

Q2: Has your preferred fishing spot changed over time?

(1) Yes, my preferred fishing spot has changed
(2) No, my preferred fishing spot has remained the same

Q3: Why did your preferred fishing spot change? _____

Q4: How satisfied are you with the availability of catch at your preferred fishing spot?

(1) Highly Satisfied
(2) Satisfied
(3) Neither satisfied nor dissatisfied
(4) Dissatisfied
(5) Highly Dissatisfied

Q5: How has the availability of catch at your preferred fishing spot changed over time?

(1) Decreased availability (fewer fish of my target species)
(2) Availability has remained the same
(3) Increased availability (more fish of my target species)

Q6: For the next question, please indicate your level of agreement with the following statements

(1) Strongly Disagree – (2) Disagree – (3) Neither Agree nor Disagree – (4) Agree – (5) Strongly Agree

Q6_1: I primarily fish for one species
Q6_2: I primarily fish in one location
Q6_3: I am hesitant to explore new possible catching areas
Q6_4: I am continually monitoring the social/ecological conditions around me
Q6_5: I believe the environment for which I depend on for fishing is changing
Q6_6: I believe changes to the environment are affecting the community I fish in

Q7: Please indicate your level of agreement with the following statements

(1) Strongly Disagree – (2) Disagree – (3) Slightly Disagree – (4) Neither Agree nor Disagree – (5) Slightly Agree – (6) Agree – (7) Strongly Agree

Q7_1: In most ways my life is close to ideal
Q7_2: The conditions of my life are excellent
Q7_3: I am satisfied with my life
Q7_4: So far, I have gotten the important things I want in life
Q7_5: If I could live my life over, I would change almost nothing

Q8: Considering the statements on life satisfaction in the prior question, how important is being able to fish at your preferred location to maintaining your satisfaction with life?

(1) Not at all important
(2) Slightly important
(3) Moderately important
(4) Important
(5) Extremely important

Q9: If the fish species you currently target at your preferred spot shifted their habitat 50 miles northward, how do you predict this would affect your satisfaction with life?

(1) My satisfaction would decrease
(2) My satisfaction would slightly decrease
(3) My satisfaction would remain the same
(4) My satisfaction would increase
(5) My satisfaction would significantly increase

Q10: Where is your preferred fishing spot located?

(1) CT
(2) NY
(3) RI

Q11: How many years have you been recreationally fishing?
(1) 1-5
(2) 5-10
(3) 10-15
(4) 15-20
(5) 20+

Q12: How many generations of fishers are in your family?
(1) 0
(2) 1
(3) 2
(4) 3
(5) 4+

Q13: How many days a week do you typically fish?
(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7

Q14: What do you usually do with the fish that you catch?
(1) Release it
(2) Eat it
(3) Sell it
(4) Other _____

Q15: What type of location do you primarily fish from?
(1) Pier
(2) Beach/Surf
(3) Jetty
(4) Charter Boat
(5) Personal Boat
(6) Other _____

Q16: What is your current primary target species? (Check all that apply)
(1) Atlantic Cod
(2) American Eel
(3) Atlantic Menhaden
(4) Black Sea Bass
(5) Bluefish (including Snappers)
(6) Cobia
(7) Haddock
(8) Hickory Shad

(9) King Mackerel
(10) Monkfish (Goosefish)
(11) Oyster Toadfish
(12) Pollock
(13) Red Drum
(14) Scup (Porgy)
(15) Spanish Mackerel
(16) Striped Bass
(17) Summer Flounder (Fluke)
(18) Weakfish
(19) Yellowtail Flounder
(20) Other _____

Q17: What is your age?
(1) 18-21
(2) 22-30
(3) 31-40
(4) 41-50
(5) 51-64
(6) 65+

Q19: What is your gender?
(1) Male
(2) Female
(3) Non-binary
(4) Prefer not to answer

Q19_1: What is your race or ethnicity?
(1) White
(2) Black or African American
(3) Hispanic or Latino
(4) Asian
(5) Native Hawaiian or Pacific Islander
(6) American Indian or Alaska Native
(7) Other
(8) Prefer not to answer

Q20: What is your highest level of education?
(1) Less than high school
(2) High school diploma
(3) Some college or 2-year degree
(4) Bachelor's
(5) Mater's
(6) Law/MD/PhD
(7) Prefer not to answer

Q21: What was your total annual income last year?

(1) Less than 25k
(2) 25k-35k
(3) 35-50k
(4) 50-75k
(5) 75-100k
(6) 100-150k
(7) 150-200k
(8) More than 250k
(9) Prefer not to answer

Q22: Would you be willing to have a follow-up conversation with me?

(1) Yes
(2) No

Interview Questionnaire

1. How long have you been fishing?

2. Where do you go fishing most often?

3. Tell me a little more about that place…why do you choose to go there?

4. How many years have you been fishing at this place?

5. Would you say many important memories are tied to this place?

6. And would you say this place provides value that is hard to find elsewhere?

7. Has your primary target species ever changed during this current season over the years?

a) When did this change occur? (year)
b) What species did you previously target?
c) Why did you switch target species?

8. Have you noticed any changes to the fish stock you are currently targeting? Such as a shift in habitat location, size or availability…

9. Has your preferred fishing spot ever changed because of shifts in fish availability?

a) Can you elaborate more on why you chose to switch your spot during a time like that?
b) When in particular did you make this change?

10. As stocks continue to shift habitat locations, how do you believe your connection to certain fishing spots will affect your ability to adjust to this change? For example, do you believe having a strong connection to an area makes it more difficult to adjust to change like this…

11. If the fish stock you are currently targeting had decreased availability at one of your preferred fishing spots, would you change your fishing spot to an area with higher catch availability for that species or would you remain at your preferred spot and target a different species?

a) Can you elaborate more on why you would make that choice?

12. Do you believe frequenting the same fishing spots has led you to *develop a stronger connection* to that surrounding environment as opposed to other areas?

a) and do you believe frequenting the same fishing spots has led you to *develop a stronger connection* to the marine environment as a whole?

13. Do you believe frequenting the same fishing spots has made you *more aware* of changes to that area's environmental conditions?

a) and has frequenting the same fishing spots made you *more aware* of changes to the marine environment in general?

14. What does well-being mean to you?

15. How does fishing at your preferred spots contribute to your well-being?

16. Do you think having to find new spots to fish, or new target species to fish for, influences your well-being in a positive or negative way?

17. As some fish stocks that have traditionally been caught in RI, CT, and NY have shifted their distributions to new areas, do you feel this has affected your satisfaction with fishing at your preferred spot?

18. Do you feel like management bodies, such as NOAA, are *currently* taking your attachment to certain fishing spots into account when characterizing fishing community well-being?

19. Do you think management bodies, such as NOAA, *should* take into account the connection fishing communities have to certain fishing spots, when determining fishing community well-being?

a) and do you mind elaborating a little more on why you think this is important?

Table 14. Interview Codebook.

Parent Nodes	Child Nodes	Sub-child Nodes	Number of Interviewees
Environmental Condition Perceptions			
	No change		4
	Satisfaction with fishing at preferred spot		
		Both	1
		Lower with shifting conditions	9
		No change	5
	Shifting		1
Fishing Location		Availability	14
		Habitat location	2
		Preferred spot	5
		Size	2
		Target species	9
		When	1
		Number of years	21
		CT	4
		NY	9
		RI	8
		Why	21
Management			
		Biological data	3
		Commercial v. Recreational	5
		Connection to locations	4
		Ecosystem-based Fisheries Management	3
		Economy	6

		Social data	10
Sense of Place			
	Strong		
		Distinct value	17
		Many memories	18
	Weak		
		Few memories	3
		No distinct value	3
Target Species			
		Black Sea Bass	5
		Bluefish	5
		False Albacore	2
		Fluke	6
		Striped Bass	18
		Tautog	4
		Tuna	2
Vulnerability Perceptions			
	High		
		Harder to adjust to change with strong connection to spot	11
		Stronger connection to surrounding environment	21
		Weaker awareness to surrounding environment by frequenting the same spots	1
		Would remain at preferred spot and target different species	5
	Low		
		Fish by boat	8
		Not hard to adjust to change with a strong connection to spot	5

		Stronger awareness to surrounding environment by frequenting the same spot	20
		Would change fishing spot to higher catch availability	17
Well-being			
	Definition		16
	Finding new spots and target species		
		Both	3
		Negative effect	9
		No effect	2
		Positive effect	11
	Impact of fishing at preferred spot		
		Comfort	3
		Family	4
		Happiness	5
		Learning	2
		Physical health	3
		Relaxation	6
		Solidarity	5

REFERENCES

Aanesen, M., Armstrong, C. W., Bloomfield, H. J., and Rockman, C. (2014). What does stakeholder involvement mean for fisheries management? *Ecological and Society*, 19(4), 35.

Allison, E. H., Perry, A. L., Badjeck, M. C., Adger, E. N., Brown, K., Conway, D., Halls, A. S., Pilling, G. M., Reynolds, J. D., Andrew, N. L., Dulvy, N. K. (2009). Vulnerability of national economies to the impacts of climate change on fisheries. *Fish and Fisheries*, 10, 173-196.

Arbo, P., Knol, M., Linke, S., and St. Martin K. J. (2018). The transformation of the oceans and the future of marine social science. *Maritime Studies,* 17, 295-304.

Azzurro, E., Sbragaglia, V., Cerri, J., Bariche, M., Bolognini, L., Souissi, J. B., Busoni, G., Coco, S., Chryssanthi, A., Fanelli, E., Ghanem, R., Garrabou, J,, Gianni, F., Grati, F., Kolitari, J., Letterio, G., Lipej, L., Mazzoldi, C., Milone, N., Pannacciulli, F., Pesic, A., Samuel-Rhoads, Y., Saponari, L., Tomanic, J., Topcu, N. E., Vargiu, G., and Modschella, P. (2019). Climate change, biological invasions, and the shifting distribution of Mediterranean fishes: A large-scale survey based on local ecological knowledge. *Global Change Biology*, 25(8), 2779-2792.

Bavinck, M. and Verrips, J. (2020). Manifesto for the marine social sciences. *Maritime Studies*, 19, 121-123.

Bergholt, D. and Lujala, P. (2012). Climate-related natural disasters, economic growth, and armed civil conflict. *Journal of Peace Research,* 49 (1), 147-162.

Bindoff, N.L., Cheung, W.W.L., Kairo, J.G., Arístegui, J., Guinder, V. A., Hallberg, R., Hilmi, N., Jiao, N., Karim, M. S., Levin, L., O'Donoghue, S., Purca Cuicapusa, S. R., Rinkevich, B., Suga, T., Tagliabue, A., and Williamson, P. (2019). Changing Ocean, Marine Ecosystems, and Dependent Communities. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [Pörtner, H. O., Roberts, D. C., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E., Mintenbeck, K., Alegría, A., Nicolai, M., Okem, A., Petzold, J., Rama, B., Weyer, N. M. (eds.)]. In press, 450-545.

Bonnie, R., Diamond, E. P., and Rowe, E. (2020). Understanding Rural Attitudes Toward the Environment and Conservation in America. *Nicholas Institute for Environmental Policy Solutions of Duke University,* Report 20-03, 1-40.

Chen, C., and Lopez-Carr, D. (2015). The importance of place: Unraveling the vulnerability of fisherman livelihoods to the impact of marine protected areas. *Applied Geography*, 59, 88-97.

Cheung, W. W. L., Lam, V, W, Y., Sarmiento, J. L., Kearney, K., Watson, R., and Pauly, D. (2009). Projecting global marine biodiversity impacts under climate change scenarios. *Fish and Fisheries*, 10, 235–251.

Cinner, J. (2005). Socioeconomic factors influencing customary marine tenure in the Indo-Pacific. Ecology and Society, 36(1), 1-14.

Cinner, J. E., McClanahan, T. R., Graham, N. A. J., Daw, T. M., Maina, J,, Stead, S. M., Wamukota, A., Brown, K., Bodin, O. (2012). Vulnerability of coastal communitites to key impacts of climate change on coral reef fisheries. *Global Environmental Change*, 22, 12-20.

Cinner, J. E., Huchery, C., Darling, E. S., Humphries, A. T., Graham, N. A. J,, Hicks, C. C., Marshall, N., McClanahan, T. R. (2013). Evaluating Social and Ecological Vulnerability of Coral Reef Fisheries to Climate Change. *PLoS ONE,* 8(9), e74321.

Clayton, S. and Opotow, S. (2003). *Identity and the Natural Environment: The Psychological Significance of Nature*. Cambridge, MA: MIT Press.

Colburn, L., Jepson, L., M., Weng, C., Seara, T., Weiss, J., Hare, J. A. (2016). Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States. *Marine Policy,* 74, 323-333.

Coleman, F. C., Figueira, W. F., Ueland, J. S., and Crowder, L. B. (2004). The Impact of United States Recreational Fisheries on Marine Fish Populations. *Science*, *305*(5692), 1958–1960.

Cooke, S. J., and Cowx, I. G. (2006). Contrasting recreational and commercial fishing: Searching for common issues to promote unified conservation of fisheries resources and aquatic environments. *Biological Conservation*, *128*(1), 93–108.

Cowan, J., H., Rice, J. C., Walters, C.J., Hilborn, R., Essington, T. E., Day Jr. J. W., and Boswell, K. M. (2014). Challenges for Implementing an Ecosystem Approach to Fisheries Management. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science,* 4, 496-510.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed), Thousand Oaks, CA: Sage.

Cuba, L., and Hummon, D.M., (1993). A place to call home: identification with dwelling, community and region. *Sociological Quarterly*, 34, 111–131.

Cutter, S. L., Boruff, B. J., and Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly,* 84 (2), 242–61.

Desjardins, E., Barker, G., Lindo, Z., Dieleman, C., and Dussault, A. C. (2015). Promoting Resilience. *The Quarterly Review of Biology*, 90(2), 147-165.

Diamond, E., Bonnie, R., Rowe, E. (2020). Rural Attitudes on Climate Change: Lessons from National and Midwest Polling and Focus Groups. *Nicholas Institute for Environmental Policy Solutions of Duke University,* Report 20-06, 1-21.

Diener, E., Emmons, R.A., Larsen, R.J., and Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49(1), 71-75.

Dillman, D. A., Smyth, J. D., and Christian, L. M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed). John Wiley & Sons Inc.

Ditton, R. B., and K.M. Hunt. (2001). Combining creel intercept and mail survey methods to understand the human dimensions of local freshwater fisheries. *Fisheries Management and Ecology*, 8, 295-301.

Dunlap, R. E. and Brulle, R. J. (2015). *Climate Change and Society: Sociological Perspectives*. New York, New York: Oxford University Press.

Faccioli, M., Czajkowski, M., Glenk, K., and Martin-Ortega, J. (2020). Environmental attitudes and place identity as determinants of preferences for ecosystem services. *Ecological Economics*, *174*, 106600.

Food and Agriculture Organization of the United Nations (FAO). (1995). *Precautionary Approach to Fisheries, Part 1, Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions.* FAO Fisheries Technical Paper, 350, Part 1, 1-52.

Food and Agriculture Organization of the United Nations (FAO). (1997). *Inland fisheries*. FAO Fisheries Department Technical Guidelines for Responsible Fisheries No 6.

Food and Agriculture Organization of the United Nations (FAO). (2008). *Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts tools, and methods.* FAO Fisheries Technical Paper No. 489.

Food and Agriculture Organization of the United Nations (FAO). (2017). *The role of Recreational Fisheries in sustainable management of marine*

resources. Retrieved from https://www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/1013313/.

Farnum J., Hall, T., and Kruger, L. E. (2005). Sense of place in natural resource recreation and tourism: An evaluation and assessment of research findings. *United States Department of Agriculture General Technical Report* PNW-GTR-660, 1-59.

Florida, R. and Rentfrow, P. J. (2011). Place and Well-being. In K. M. Sheldon and T. B. Kashdan, (Ed). In *Designing Positive Psychology: Taking Stock and Moving Forward*. Oxford University Press.

Folke, C. (2006). Resilience: The Emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16, 253-267.

Fukuyama, F. (1999). *The Great Disruption: Human nature and the reconstitution of social order*. New York: The Free Press

Fulton, E., Smith, A. D. M., Smith, D. C., and Van Putten, I. E. (2011). Human behavior: the key source of uncertainty in fisheries management. *Fish and Fisheries*, 12, 2–17.

Garcia-Quijano, C.G., Poggie, J.J., Pitchon, A., and Del Pozo, M.H. (2015). Coastal Resource Foraging, Life Satisfaction, and Well-being in Southeastern Puerto Rico. *Journal of Anthropological Research*, 71(2), 145-167.

Garcia-Quijano, C., and Poggie, J.J. (2019). Coastal resource foraging, the culture of coastal livelihoods, and human well-being in Southeastern

Puerto Rico: consensus, consonance, and some implications for coastal policy. *Maritime Studies*, 19(5), 53-56.

Goethel, D. R., Lucey, S. M., Berger, A. M., Gaichas, S. K., Karp, M. A., Lynch, P. D., Walter III, J. F., Deroba, J. J., Miller, S., and Wilberg, M. J. (2019). Closing the feedback loop: On stakeholder participation in management strategy evaluation. *Canadian Journal of Fisheries and Aquatic Sciences,* 76(10), 1895–913.

Guest, G., Bunce, A., and Johnson, L. (2006). How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability. *Field Methods*, 18(1), 59-82.

Guest, G., MacQueen, K. M., and Namey, E. E. (2012). Themes and Codes. In *Applied thematic analysis*. Thousand Oaks, CA: SAGE Publications.

Halpern, B. S., Longo, C., Hardy, D., McLeod, K. L., Samhouri, J. F., Katona, S. K., Kleisner, K., Lester, S. E., O'Leary, J., Ranelletti, M., Rosenberg, A. A., Scarborough, C., Selig, E. R., Best, B. D., Brumbaugh, D. R., Chapin, F. S., Crowder, J. B., Daly, K. L., Doney, S. C., Elfes, C., Fogarty, M. J., Gaines, S. D., Jacobsen, K. I., Karrer, L. B., Leslie, H. M., Neeley, E., Pauly, D., Polasky, S., Ris, B., St Martin, K., Stone, G. S., Sumaila, U. R., and Zeller, D. (2012). An index to assess the health and benefits of the global ocean. *Nature*, 488 (7413), 615-620.

Hilborn, R., Branch, T. A., Ernst, B., and Magnusson, A. (2003). State of the World's Fisheries. *Annual Review of Environment and Resources*, 28 (1), 359-399.

Himes-Cornell, A., Maguire, C., Kasperski, S., Hoelting, K., Pollnac, R. (2016). Understanding vulnerability in Alaska fishing communities: A validation methologdy for rapid assessment of indices related to well-being. *Ocean & Coastal Management*, 124, 53-65.

Holland, S., and Ditton, R. (1992). Fishing Trip Satisfaction: A Typology of Anglers. *North American Journal of Fisheries Management*, 12(1), 28-33.

Huq, R., and Burgin, S. (2016). Eco-social Capital: A proposal for exploring the development of cohesiveness in environmental volunteer groups. *Third Sector Review*, 22(1), 49-68.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate Change 2007 - Impacts, Adaptation and Vulnerability - Contributions of Working Group II to the Fourth Assessment Report of the International Panel on Climate Change*. Cambridge: Cambridge University Press.

Islam, M. M., Sallu, S., Hubacek, K., and Paavola, J. (2014). Limits and barriers to adaptation to climate variability and change in Bangladeshi coastal fishing communities. *Marine Policy*, 43, 208-216.

Jepson, M and Colburn, L. L. (2013). *Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S Southeast and Northeast Regions*. U.S. Dept. of Commerce., NOAA Technical Memorandum, NMFS-S/SPO-129, 1-64.

Johnson, T., Henry, A. M., Thompson, C. (2014). Qualitive Indicators of Social Resilience in Small-Scale Fishing Communities: An Emphasis on Perceptions and Practice. *Society for Human Ecology,* 20(2), 97-115.

Jones, K., and Seara, T. (2020). Integrating Stakeholders' Perceptions into Decision-Making for Ecosystem-Based Fisheries Management. *Coastal Management*, 48(4), 275-288.

Jorgensen, B. S., and Stedman, R. C. (2001). Sense of Place as an Attitude: Lakeshore Owners Attitudes Toward Their Properties. *Journal of Environmental Psychology*, *21*(3), 233–248.

Jorgensen, B. S., and Stedman, R. C. (2006), A comparative analysis of predictors of sense of place dimensions: Attachment to, dependence on, and identification with lakeshore properties. *Journal of Environmental Management*, 79, 316-327.

Khakzad, S. and Griffith, D. (2016). The role of fishing material culture in communities' sense of place as an added-value in management of coastal areas. *Journal of Marine and Island Cultures*, 5, 95-117.

Kleisner, K. M., Fogarty, M. J., McGee, S., Hare, J. A., Moret, S., Perretti, C. T., and Saba, V. S. (2017). Marine species distribution shifts on the U.S. Northeast Continental Shelf under continued ocean warming. *Progress in Oceanography*, 153, 24-36.

Kontogianni, A. D., Papageorgious, E. I., and Tourkoliasm, C. (2012). How do you perceive environmental change? Fuzzy Cognitive Mapping

informing stakeholder analysis for environmental policy making and non-market valuation. *Applied Soft Computing,* 12, 3725-3735.

Krasny, M., Crestol, S., Tidball, K., and Stedman, R. (2014). New York City's oyster gardeners: Memories and meanings as motivations for volunteer environmental stewardship. *Landscape and Urban Planning*, 132, 16-25.

Kyle, G., Graefe, A., Manning, R., and Bacon, J. (2004). Effects of place attachment on users' perceptions of social and environmental conditions in a natural setting. *Journal of Environmental Psychology*, *24*(2), 213–225.

Lavoie, A., Sparks, K., Kasperski, S., Himes-Cornell, A., Hoelting, K., and Maguire, C. (2018). Ground-truthing social vulnerability indices of Alaska fishing communities. *Coastal Management,* 46(5), 359-387.

Limuwa, M. M., Sitaula, B. K., Njaya, F., and Storebakken, T. (2018). Evaluation of Small-Scale Fishers' Perceptions on Climate Change and Their Coping Strategies: Insights from Lake Malawi. *Climate*, 6(34), 1-23.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., and Welch, N. (2001). Risk as Feelings. *Psychological Bulletin*, 127(2), 267-286.

Lofland, J. and Lofland, L. H. (1995). *Analyzing Social Settings: A Guide to Qualitative Observation and Analysis*. Belmont, Calif: Wadsworth.

Lynn, K., MacKendrick, K., and Donoghue, E. M. (2011). *Social Vulnerability and Climate Change: Synthesis of Literature*. United States Department of Agriculture, 1-70.

Lyon, C. 2014. Place Systems and Social Resilience: A Framework for Understanding Place in Social Adaptation, Resilience, and Transformation. *Society & Natural Resources*, 27(10), 1009-1023.

Manzo, L. C. (2003). Beyond house and haven: Toward a revisioning of emotional relationships with places. *Journal of Environmental Psychology*, 23, 47-61

Marshall, N. A., Fenton, D. M., Marshall, P. A., and Suton, S. G. (2007). How resource dependency can influence social resilience within a primary resource industry. *Rural Sociology*, 72(3), 359–390.

Marshall N.A., Marshall P.A., Tamelander J., Obura D., Malleret-King D. and Cinner J.E. (2009). *A Framework for Social Adaptation to Climate Change; Sustaining Tropical Coastal Communities and Industries*. Gland, Switzerland, IUCN. 1-36.

McKinley, D.C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Cook-Patton, S.C., Evans, D. M.; French, R.A., Parrish, J. K., Phillips, T. B., Ryan, S. F., Shanley, L.A., Shirk, J.L., Stepenuck, K. F., Weltzin, J.F., Wiggins, A., Boyle, O. D., Briggs, R. D., Chapin III, S. F., Hewitt, D. A., Preuss, P.W., and Soukup, M. A. (2017). Citizen Science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*, 208, 15-28.

Measham, T., and Barnett, G. (2009). Environmental Volunteering: motivations, modes, and outcomes. *Australian Geographer*, 39(4), 537-552.

Mengerink, K., Hausman, N., and Roche, D. (2014). *Review of Social Impact Assessment Included in National Environmental Policy Act Documents Relate to Marine*. Retrieved from https://media.fisheries.noaa.gov/dam-migration/reviewofsociaimpactassessmentreport.pdf

Mercado, R.M. (2016). People's Risk Perceptions and Responses to Climate Change and Natural Disasters in BASECO Compound, Manila, Philippines. *Procedia Environmental Sciences*, 34, 490-505.

Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., Walker, B., Birkmann, J., Van Der Leeuw, S., Rockstro€m, J., Hinkel, J., Downing, T., Folke, C., and Nelson, D. (2010). Resilience and Vulnerability: Complementary or Conflicting Concepts? *Ecology and Society,* 15(3), 11.

Mills, J., Gaskell, P., Ingram, J., Dwyer, J., Reed, M., and Short, C. (2017). Engaging farmers in environmental management through a better understanding of behavior. *Agriculture Human Values*, 34, 283-299.

Morley, J. W., Selden, R. L., Latour, R. J., Frolicher, T. L., Seagraves, R. J., Pinsky, M. L. (2018). Projecting shifts in thermal habitat for 686 species on the North American continental shelf. *PLoS ONE,* 13(5), e0196127.

Morzaria-Luna, H., Nalini, Turk-Boyer, P., and Moreno-Baez, M. (2014). Social indicators of vulnerability for fishing communities in the Northern Gulf of

California, Mexico: Implication for climate change. *Marine Policy,* 45, 182-193.

Mullendore, N. D., Ulrich-Schad, J. D., Prokopy, L. S. (2015). U.S. farmers' sense of place and its relation to conservation behavior. *Landscape and Urban Planning*, 140, 67-75.

Mulvaney, K., Merrill, N., and Mazzotta, M. (2020). Sense of Place and Water Quality: Applying Sense of Place Metrics to Better Understand Community Impacts of Changes in Water Quality. In J. K. Summers, (Ed). In *Water Quality – Science, Assessments, and Policy*. IntechOpen

National Marine Fisheries Service (NMFS). (2001). *Fisheries of the United States 2001.* Retrieved from https://www.st.nmfs.noaa.gov/st1/fus/fus01/2001-fus.pdf

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2017). *Fisheries Economics of the United States*. Retrieved from https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2018). *Social Indicators for Coastal Communities*. Retrieved from https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2021). *Give Us Your Input on Making Fisheries and Protected Resources More Resilient to Climate Change*. Retrieved from

https://www.fisheries.noaa.gov/feature-story/give-us-your-input-making-fisheries-and-protected-resources-more-resilient-climate?utm_medium=email&utm_source=govdelivery.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2021). *Northeast Regional Implementation Plan of the NOAA Fisheries Ecosystem-Based Fishery Management*. Retrieved from https://media.fisheries.noaa.gov/dam-migration/northeast_implementation_plan.pdf

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2022). *Recreational Fishing*. Retrieved from https://www.fisheries.noaa.gov/insight/recreational-fishing.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. (2022). *Fisheries Economies of the United States*. Retrieved from https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states.

National Ocean Economics Program (NOEP). (2009). *Environmental $ Recreational (Non-Market) Values – What You Should Know (FAQs)*. Retrieved from https://www.oceaneconomics.org/nonmarket/NMFAQs.asp.

Nelson, D. R., Adger, W. N., and Brown, K. (2007). Adaptation to Environmental Change: Contributions of a Resilience Framework. The *Annual Review of Environment and Resources*, 32, 395-419.

Nyboer, E. A., Lin, H. Y., Bennett, J. R., Gabriel, J., Twardek, W., Chhor, A. D., Dalyl, L., Dolson, S., Guitard, E., Holder, P., Mozzon, C. M., Trahan, A., Zimmermann, D., Kesner-Reyes, K., Garilao, C., Kaschner, K., Cooke, S. J. 2021. Global assessment of marine and freshwater recreational fish reveals mismatch in climate change vulnerability and conservation effort. *Global Change Biology*, 27, 4799-4824.

Ojea, E., Pearlman, I., Gaines, S. D., and Lester, S. E. (2017). Fisheries regulatory regimes and resilience to climate change. *Ambio,* 46, 399-412.

Oswald, A. J., and Wu, S. (2010). Objective Confirmation of Subjective Measures of Human Well-Being: Evidence from the U.S.A. *Science,* 327(5965), 576-579.

Pershing, A. J., Alexander, M. A., Hernandez, C. M., Kerr, L. A., Le Bris, A., Mills, K. E., Nye, J.A., Record, N. R., Scannell, H. A., Scott, J. D., Sherwood, g. D., and Thomas, A. C. (2015). Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science*, 350(6262), 809-812.

Pinsky, M. L., Worm, B., Fogarty, M. J., Sarmiento, J. L. and Levin, S. A. (2013). Marine taxa track local climate velocities. *Science,* 341, 1239–1242.

Pollnac, R.B., Abbott-Jamieson, S., Smith, C., Miller, M. L., Clay, P.M. and Oles, B. (2006). Toward a Model for Fishers Social Impact Assessment. *Marine Fisheries Review,* 68(4), 1-18.

Pollnac, R. B., and Poggie, J. J. (2008). Happiness, well-being and psychocultural adaptation to the stresses of marine fishing. *Human Ecology Review,* 15(2), 194–200.

Pollnac, R. B., Seara, T., and Colburn, L. L. (2015). Aspects of Fishery Management, Job Satisfaction, and Well-Being among Commercial Fishermen in the Northeast Region of the United States. *Society & Natural Resources*, 28(1), 75-92.

Rice, J. (2009). A generalization of the three-stage model for advice using the precautionary approach in fisheries, to apply broadly to ecosystem properties and pressures. *ICES Journal of Marine Science*, 66(3), 433-444.

Robson, C. (2011). *Real world research: A resource for users of social research methods in applied settings* (3rd ed): Oxford, UK: Blackwell Publishers.

Rogers, L.A., Griffin, R., Young, T., Fuller, E., St. Martin, K., and Pinsky, M. L. (2019). Shifting habits exposed fishing communities to risk under climate change. *Nature Climate Change*, 9, 512-516.

Rojas, O., Zamorano, M., Saez, K., Rojas, C., Vega, C., Arriagada, L., and Basnou, C. (2017). Social Perception of Ecosystem Services in a Coastal Wetland Post-Earthquake: A Case Study in Chile. *Sustainability*, 9, 1-17.

Salas, S., and Gaertner, D. (2004). The Behavioral Dynamics of Fishers: Management Implications. *Fish and Fisheries*, 5(2), 153-167.

Samah, A.A., and Shaffril, H.A.M. (2020). A comparative study between mainland and islander small-scale fishermen's adaptation towards climate change. *Environmental Science and Pollution Research*, 27, 11277-11289.

Schreiber, Dorothee K. (2001). Co-management without involvement: the plight of fishing communities. *Fish and Fisheries,* 2, 376-384.

Seara, T., Pollnac, R. B., and Poggie, J. J. (2017). Changes in Job Satisfaction Through Time in Two Major New England Fishing Ports. *Journal of Happiness Studies*, 18(6), 1625-1640.

Shaffril, H. A. M., Hamzah, A., D'Silva, J. L., Samah, B. A., and Samah, A. A. (2016). Individual adaptive capacity of small-scale fishermen living in vulnerable areas towards the climate change in Malaysia. *Climate and Development,* 9(4), 313-324.

Shin, D. C., and Johnson, D. M. (1978). Avowed happiness as an overall assessment of the quality of life. *Social Indicators Research*, 5, 475-492.

Smith, T.D. (2002). A history of fisheries and their science and management. In: Hart, P., Reynolds, J. (Eds.), Handbook of Fish Biology and Fisheries, vol. II. Blackwell Science, Oxford, 61–83.

Smith, C. L. and Clay, P. M. (2010). Measuring Subjective and Objective Well-being: Analyses from Five Marine Commercial Fisheries. *Human Organization,* 69(2): 158-168.

St. Martin, K., and Olson, J. (2017). Creating space for community in marine conservation and management: mapping communities-at-sea. In *Conservation for the Anthropocene ocean: Interdisciplinary Science in Support of Nature and People*, eds M. R. Poe and P. S. Levin (Cambridge, MA: Academic Press), 123–141.

Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources,* 16(8), 671-685.

Stoll, J. S., Fuller, E., and Crona, B. I. (2017). Uneven adaptive capacity among fishers in a sea of change. *PLoS ONE*, 12(6), e0178266.

Sydeman, W. J., Poloczanska, E., Reed, T. E., and Thompson, S. A. (2015). Climate change and marine vertebrates. *Science*, 350, 772–777.

Thiault, L., Jupiter, S. D., Johnson, J. E., Cinner, J. E., Jarvis, R. M., Heron, S. F., Maina, J. M., Marshall, N. A., Marshall, P. A., and Claudet, J. (2021). Harnessing the potential of vulnerability assessment for managing social-ecological systems. *Ecology and Society*, 26(2), 1.

Townhill, B. L., Radford, Z., Pecl, G., van Putten, I., Pinnegar, J. K., and Hyder, K. (2019). Marine recreational fishing and the implications of climate change. *Fish and Fisheries*, 20, 977-992.

Tuan, Yi-Fu, 1930 *Space and Place: The Perspective of Experience*. Minneapolis: University of Minnesota Press, 1977.

Tuan, Yi-Fu. 1974. *Topophilia: A Study of Environmental Perception, Attitudes and Values*. Englewood Cliffs, NJ: Prentice-Hall.

Tufts, B. L., Holden, J., and DeMille, M. (2015). Benefits arising from sustainable use of North America's fishery resources: Economic and conservation impacts of recreational angling. International Journal of Environmental Studies, 72(5), 850–868.

U.S. Commission on Ocean Policy Report (USCOP). (2004). *An Ocean Blueprint for the 21st Century*. Final Report. Washington, D.C.

United States (U.S.) Census Bureau. (2021). *Income and Poverty in the United States: 2020.* Retrieved from https://www.census.gov/library/publications/2021/demo/p60-273.html#:~:text=Median%20household%20income%20was%20%2467%2C521,median%20household%20income%20since%202011.

University of California, Los Angeles (UCLA). (2016). *What does Cronbach's alpha mean?* Retrieved from https://stats.idre.ucla.edu/spss/faq/what-does-cronbachs-alpha-mean/.

Urquhart, J., and Acott, T. (2014). A Sense of Place in Cultural Ecosystems Services: The Case of Cornish Fishing Communities. *Society & Natural Resources*, 27(1), 3-19.

van Putten, I. E., Plagányi, É. E., Booth, K., Cvitanovic, C., Kelly, R., Punt, A. E., and Richards, S. A. (2018). A framework for incorporating sense of place into the management of marine systems. *Ecology and Society*, 23(4), 4.

Vemuri, A. W., and Costanza, R. (2006). The role of human, social, built, and natural capital in explaining life satisfaction at the country level: Toward a National Well-Being Index (NWI). *Ecological Economics*, 58, 119-133.

Vorkinn, M., and Riese, H. (2001). Environmental Concern in a Local Context: The Significance of Place Attachment. *Environment and Behavior*, *33*(2), 249–263.

Wiber, Melanie, Berkes, F., Charles, A., and Kearney, J. (2004). Participatory research supporting community-based fishery management. *Marine Policy,* 28, 459-468.

Williams, D. R., Patterson, M. E., and Roggenbuck, J.W. (1992). Beyond the community metaphor: Examining emotional and symbolic attachment to place. *Leisure Sciences*, 14, 29-46.

Wong, P.P., Losada, I. J., Gattuso, J. P., Hinkel, J., Khattabi, A., McInnes, K. L., Saito, Y., and Sallenger, A. (2014). Coastal systems and low-lying areas. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge, United Kingdom and New York, NY: Cambridge University Press, pp. 361-409.

Young, T., Fuller, E. C., Provost, M. M., Coleman, K. E., St. Martin, K., McCay, B. J., and Pinsky, M. L. (2019). Adaptation strategies of coastal fishing communities as species shift poleward. *ICES Journal of Marine Science*, 76, 93–103