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BUILDING RESILIENCE: MARINA OWNERS' PRIORITES

BY

MATTHEW FREDIANI

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

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IN

MARINE AFFAIRS

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OF

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ABSTRACT

Increased storm intensity combined with rising sea levels and increased erosion will likely create new challenges for marina owners and policy makers. Climate change poses threats to infrastructure, navigability, and the general aesthetics of a marina. Observations show little action has been taken by Rhode Island marina owners towards increasing resilience to climate change, leaving the Rhode Island industry vulnerable.

This study investigates the perceptions and priorities of ten Rhode Island marina owners to gauge their priorities and perceptions towards increasing resilience at their facility to rising sea levels and future storms. Interviews were conducted with ten marina owners to address four research questions designed to examine why marina owners may or may not be adapting to climate change.

Results indicated that many marina owners do not have future expansion plans, which can limit the implementation of adaptation measures. Many marina owners interviewed do not believe the science behind climate change and do not directly see the impacts, therefore are not concerned. All the interviewees also believed it was the owners responsibility to prepare for storms and indicated they do not want outside assistance. Finally, the fourth conclusion indicates resilient marinas benefit the entire community, rather than individuals and groups directly related.

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CHAPTER 1

INTRODUCTION

Rising sea levels and future storms pose a threat to waterfront development. Marinas by nature are located in highly vulnerable locations, spanning from land into the water. Planning for the changing future can help ensure a sustainable marina industry, however increasing resilience to changing conditions may not be a priority for marina owners. This study observed the priorities and perceptions of ten marina owners and managers towards increasing resilience to future storms and sea level rise in Rhode Island to gain insight into their decision-making processes.

1.1 Problem Statement

Increased storm intensity combined with rising sea levels and resulting increased erosion will likely create new challenges for marina owners and policy makers. Climate change poses threats to infrastructure, navigability, and the general aesthetics of a marina. If customers perceive a marina is unsafe or unappealing, they may take their business elsewhere (Samples, 2014). Thus far, through my work at the University of Rhode Island Coastal Resources Center (URI CRC), I have observed little action taken by marina owners in Rhode Island towards adapting to climate change, leaving the Rhode Island industry vulnerable. Recreational boating is a large industry in the State and in the United States, generating over 100 billion dollars annually in the US (NMMA,2012). This research provides the groundwork for future investigation to determine feasible policy incentives that co-benefit marina owners, policy goals of governing agencies, and the public by investigating the priorities and

perceptions of marina owners. Understanding priorities of marina owners can help policy makers to tailor incentives to fit the needs of the industry, ultimately leading to more successful policies.

This research identifies perceptions and attitudes of Rhode Island marina owners towards increasing resilience to future storms and sea level rise. To this end, it addresses the following research questions through interviews with ten RI marina owners:

1. What are interviewees' business growth and expansion priorities?
2. To what level is increasing resilience a priority at their marina?
3. Do interviewees believe there are mechanisms by which policy makers and insurance companies could assist them in increasing resilience to future storms and a changing climate?
4. What are the potential societal co-benefits of the mechanisms identified by interviewees?

The first research question identifies business growth and expansion plans to help identify priorities of marina owners. Understanding the future development of the business helps determine if increasing resilience is on the agenda. Capital improvement projects are an opportune time to incorporate storm and sea level rise adaptation measures, however if a marina owner feels limited in building this may hinder adaptation progress. Determining limitations marina owners face, helps identify issues in policy and governance structures. This can help to create more effective policy and ultimately benefit the marina owners and policy makers.

The second research question investigates marina owners' priority levels for increasing resilience towards sea level rise and coastal storms, compared to other capital improvement projects. Determining where a marina owner prioritizes increasing resilience to future conditions amongst future plans, provides insight as to why they may or may not be implementing adaptation measures. Understanding their level of concern about sea level rise and future storms, their storm preparedness strategies, as well as if they have suffered past damages will help to inform this research question.

The third research question examines mechanisms by which policy makers and insurance companies could assist marina owners in building resilience to help address this issue. Mechanisms may be policy incentives, such as reduction in taxes or reduced insurance premiums for code plus building, waiving of permitting fees, or certification as a "Resilient Marina" resulting in positive publicity. Identifying the mechanisms important to the marina owners is the first step towards creating a collaborative working relationship between marina owners and policy makers to increase marina resilience.

Finally, the fourth research question analyzes whether the mechanisms, identified by marina owners in the previous research question, can also benefit the goals of the governing agencies or better serve the public. The term "mechanisms" is used to explore the feasibility to incentivize storm and sea level rise resilience. Identifying mechanisms that co-benefit the marinas and regulating agencies may prove to be more feasible compared to those that only benefit marinas. Marinas affect more

than the people directly related, therefore understanding ways the public may benefit can help begin the conversation towards policy incentives.

I first provide background information on the marina industry, climate change and some of the incentives and disincentives of adapting towards sea level rise and future storms. I then discuss my research methods, sampling strategy, and data analysis. Finally, I explain the results of the study, followed by a discussion of how the results add to the field of science. I explain where gaps in scientific literature exists and explain how this study is designed to address some of those shortcomings. Future research opportunities expanding on this topic are also discussed identifying where more data is needed to continue informing this field

CHAPTER 2

REVIEW OF LITERATURE

This chapter explains the role of the marina industry in New England and more specifically in Rhode Island, provides context on climate change, and is followed by a discussion of some barriers to adaptation that must be overcome to ensure a viable marina industry that can contribute to the public's enjoyment of the coast in Rhode Island. It begins with a background of the marina industry and definitions of some key terms, then moves to examine climate change disincentives and thresholds for action. Next, programs from around the country are introduced that address marina resilience and the section ends with an explanation of how this study seeks to advance the state of the science by providing insight to the perceptions and priorities of the Rhode Island marina owners, laying the groundwork to determine the feasibility of incentivizing climate change adaptation to increase resilience

2.1 Background on Marina Industry

Recreational boating generates economic impacts greater than 121 billion dollars annually in the United States (NMMA,2012). A nonprofit organization, Sea Plan, assessed the impact recreational boating has on the economy of the Northeast. They surveyed boaters from Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, and New York and found that marine recreational boating contributed 3.5 billion dollars to the Northeast economy in 2012 (Starbuck & Lipsky, 2012). The report estimates that in Rhode Island, recreational boating generated an economic

impact of 227 million dollars in 2012 and resulted in 2,000 year-round jobs (Starbuck & Lipsky, 2012). Recreational boating also contributes to the tourism industry, the second largest industry in the state after healthcare, which is included in the 227 million dollar economic impact (McDarris, 2015). Further, marinas benefit the public, not only those who participate in recreational boating, by also contributing to the tourism industry in the state. Out of state residents with recreational boats travel to Rhode Island to enjoy the salt ponds and waters surrounding the state. Some may keep their boats docked in Rhode Island marinas and others may trailer their boat and utilize launch ramps at marinas. The Rhode Island Marine Trades Association (RIMTA) conducted a survey of their members from 2013-2014 and based on business plans, respondents reported plans to increase total employment by 26% (Planning Decisions, 2014) over the next three years. For this industry to continue growing and generating jobs, marina owners must address changing climate conditions. Through interactions and work at marinas I learned the infrastructure used at marinas has a relatively long design life of two or more decades, depending on maintenance, and thus should be built to withstand the climate conditions projected for the future. Failing to address changes in sea level and potential for more severe storms may result in damages to marinas and frequent tidal inundation on land and docks.

2.2 Climate Change Background

Climate change is a complex, multidisciplinary problem that researchers, politicians, and the public all are working to address (IPCC, 2014; Lazarus, 2009). Due to the complex nature, implementing policies and adaptation methods towards climate change is proving to be very difficult (Frankhauser, Smith, & Tol, 1999).

There is a growing need to increase resilience through adaptation, however implementation of adaptation practices is not keeping the pace, creating an 'adaptation deficit' (Eisenack et al., 2014). Marinas by nature are in areas particularly vulnerable to an increase in storm intensity, rising sea levels, and increased erosion. For the purpose of this research, which focuses exclusively on marinas, I use the following definition of climate resilience:

> The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2012, p. 563).

For this study, the "system" identified in the definition includes infrastructure at the marina, the marina owners, employees, and customers. Defining the term "system" this way focuses directly on what is being investigated (the marina owner's priorities and perceptions) and it narrows down the "system" to what is directly impacted by an owner's decisions. This definition covers the structural aspect of building resilience and operational components of increased preparedness. Both of these are components of long-term climate adaptation, defined herein as, "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Parry, Canziani, Palutikof, van der Linden, & Hansen, 2007).

Marinas are a key component of the boating industry, providing essential services such as dockage, engine and hull maintenance, fuel, and pump-out stations.

Increasing resilience towards a changing climate is essential to ensure a long future of the industry. As evidenced by Hurricane Sandy in New Jersey, storms hitting underprepared marinas can result in tremendous damages to not only the marina but also its surrounding waterway and land areas. Vessels and docks may become floating debris, ending up miles inland creating issues with disposal due to property ownership and cost. Cleanup costs can stress government resources, ultimately affecting state tax payers. In an assessment of Hurricane Sandy's damage to recreational marine businesses in New Jersey, the Marine Trades Association of New Jersey assessed cleanup costs at approximately 7 million dollars. The cost of cleanup becomes a burden on tax payers because there is a need for government financial assistance, in most cases, to begin the recovery after a disaster. In addition to cleanup costs, there was damage to almost 4,000 vessels in New Jersey, with about 1,000 vessels damaged beyond repair. This scenario could have happened in Rhode Island if Hurricane Sandy made landfall further north. Scientists project that the intensity of Atlantic hurricanes is likely to increase due to warming oceans, with models projecting an increase in the number of Category 4 and 5 hurricanes (Melillo, Richmond, & Yohe, 2014)

Increasing resilience towards storms, sea level rise, and erosion, minimizes damage and costs to the public, while speeding up recovery after a storm. Determining feasible policy incentives for action, based off the perceptions of the industry and policy makers, can help motivate marina owners to act towards building resilience. To do so, policy makers must understand marina owner's priorities and perceptions regarding climate change. O'Brien (2009) discusses the importance of values and

perceptions in regards to barriers towards adaptation. This study intends to provide information about such barriers in the context of RI marinas.

The URI CRC, in collaboration with Rhode Island Sea Grant (RISG) and URI Ocean Engineering Department (OCE), has been studying marina resilience in Rhode Island. The OCE senior design class of 2015, together with CRC, created an assessment that provides a numerical score to marinas indicating their level if resilience. Through meetings with the Rhode Island Marine Trades Association (RIMTA) and various marina owners, URI CRC/RISG developed a preliminary screening tool to gauge the level of risk marinas face from storms and rising sea levels. This work provides insight to perceptions and attitudes of marina owners as well as the level of understanding of their risk. Computer models (STORMTOOLS) developed by the URI OCE display coastal inundation from various size storms coupled with sea level rise to property owners. When presented to marina owners during pilot tests and initial meetings, models sparked interest amongst the marina industry to learn more about their risk. This current study builds from work done at the CRC, which raised questions about the overall attitudes and perceptions of the industry. The following sections provide background on issues that may influence the decision-making process of marina owners.

2.3 Climate Change Disincentives and Thresholds for Action

Understanding disincentives and thresholds for action helps inform the reasoning behind inaction for climate change adaptation (Ekstrom, Moser, & Margaret, 2010). Major disincentives for climate change adaptation inaction emerging from the literature in this field stem from the following categories; government

fragmentation between policies (Bagstad, Stapleton, & D'Agostino, 2007); uncertainty of future climate change projections, (Biesbroek, Termeer, Kabat, & Klostermann, 2009); and social and individual factors, such as individuals personal views limiting adaptation action (Adger et al., 2008). When applied to marina systems, each category of disincentive can affect the decision-making process of a marina owner. The following sections provide explanations of the categories and examples of how they are relevant to this study.

2.3.1 Government Fragmentation

Climate change affects all levels of government, creating a need for collaborative policies to begin to address the issue. Lack of collaboration between government agencies can result in policies with different goals depending on the level of government (Bagstad et al., 2007). For example, the Coastal Barrier Resources Act (CBRA) prohibits the federal government from funding roadways, water, and other infrastructure on barrier islands and spits. This Act was created to deter development in highly vulnerable areas, however local municipalities still may create their own incentives to counter this act to promote coastal economic growth (Bagstad et al., 2007). Rhode Island's 420 miles of coastline supports a robust tourism industry, making coastal development economically beneficial. A study in 2010 completed for the RI Economic Development Corporation showed that tourism and in-state visitor spending generated 2.3 billion dollars for the state. Due to massive economic impact of coastal tourism and tax revenue generated, local governments may choose not to limit development in vulnerable areas to boost the local economy.

Uniform goals and actions throughout all levels of government would be one way to truly enforce policies like the CBRA. Marinas fall in an area of multiple jurisdictions, between local, state, and sometimes even federal governments. Working with multiple levels of government simultaneously can prove to be a burden and potentially hinder the adaption process while it is still in the permitting phase.

2.3.2 Uncertainty of Future Projections of Climate Change

The scientific community is addressing the uncertainty of future projections and beginning to make more regional projections, however, there is still uncertainty between scientific understandings and the political, cultural, and institutional context (Biesbroek et al., 2009). Many projections for climate change are based on historical trends compared to observations made today. Through long term data collection, changes in the climate have been observed, however the difficulty falls in trying to project to the future. Because of this, there is not a 100 percent confidence in the projections, resulting in "uncertainty" or lack of belief of the issue. Climate change projection uncertainty is partially an issue of translation from the specialized jargon used by scientists to the conversational language of citizens (Rudiak-Gould, 2011). This disconnect can act as a barrier for increasing resilience because the policy makers and scientists are not working collaboratively on forecasting the potential changes in climate and creating policy that reflects the work of the scientists (Biesbroek et al., 2009). The scientists focus on physical changes in the climate, whereas planners and policy makers are focused on making regulations (Weaver et al., 2014). These two goals do not necessary align, having very different timeframes, and can cause a negative impact towards implementation of resilience measures (Weaver et al., 2014).

Physical changes in climate occur slowly over long periods of time, whereas regulations must be effective today and into the future. Any uncertainty associated with climate change makes it more difficult for policy makers to incorporate climate change adaptation and resilience into regulations.

Uncertainty regarding future climate projections is not only a concern of policy makers, but also affects the way a marina owner makes decisions. Uncertainty can result in doubt about the impacts of climate change and one must believe there is a need to increase resilience before spending the time and money to do so (Douglas et al., 2011; Lazarus, 2009). For example, if a marina owner does not believe the projections for increased sea level rise and storms, they may not install piles for their docks that are sufficiently tall or strong enough for extreme weather coupled with the force of a greater volume of water.

2.3.3 Social and Individual Factors Limiting Adaptation Action

Social and individual factors refer to people's perceptions and attitudes toward a situation. In this case, individual factors are examined as possible barriers towards climate change adaptation. At a local level, social and individual factors contribute towards understanding inaction towards climate adaptation (Douglas et al., 2011). The public reacts, or begins to address climate change issues at trigger points when social changes, not just environmental changes, were noticed (Barnett et al., 2014). For example, Barnett et al. found their first trigger point to be flooding on the main road of their study area for more than five days a year. This impacted schools, businesses, banks, and supermarkets and could potentially cause changes in insurance and property value (Barnett et al., 2014). People may not implement change until

something they know and value is affected. Implicit values, or values instilled within someone from their life experiences, contribute to how and why adaptation may be implemented (Adger et al., 2008). Coupling the embedded values of an individual with their perceived risk, knowledge, and experience can act as a limit to adaptation (Adger et al., 2008).

The perspectives of the people holding power, making decisions, and carrying out the adaptations directly relates to their willingness to respond to an issue, in this case climate change (O'Brien, 2009). Consideration of individual and community values is necessary for a community or group to create successful adaptation strategies (O'Brien, 2009). The same concept applies to marina owners. Individual values of a marina owner can affect their decision-making process. Planning annual repairs or future growth benefits from knowledge of what the future may hold. If a marina has not experienced flooding from large storms, the owner may doubt it will happen and continue using designs based off trends from the past. Eventually this may catch up if damage does occur and trigger the need for adaptation.

The following section introduces programs from various states that begin to address marina resilience to provide context of other relative work in the field of marina resilience

2.4 Programs Addressing Marina Resilience

Scientific literature pertaining specifically to marina resilience is limited. There has been some applied work conducted by Sea Grant programs, such as Michigan Sea Grant, which explored climate change ramifications for marinas in the Great Lakes (Dinse, Read, & Scavia, 2009). As with the URI CRC and RI Sea Grant,

the work done by Michigan Sea Grant primarily focuses on identifying future risks for marinas and suggesting alternatives and adaptation methods that can reduce risk. Understanding the perceptions and attitudes of marina owners has not been a priority for Michigan or other Sea Grant programs. Because Sea Grant programs do not have authority to mandate regulations to increase resilience, they must rely on the marina owners to take initiative in response to information provided by the Sea Grant program.

In the southern United States, the five states bordering the Gulf of Mexico established the Gulf of Mexico Alliance (GOMA) in 2004, as a response to the President's Ocean Action Plan (GOMA, 2004). GOMA works on six priority issues identified by the five governors and with support from the White House's Council on Environmental Quality. This group responded to major storms like Hurricane Katrina by collaborating with more agencies, non-profits, and academic institutions, to work collaboratively to achieve the goals laid out by the Gulf of Mexico Alliance Governors' Action Plan for Resilient and Healthy Coasts (GOMA, 2004)

The GOMA created an initiative that certifies marinas in their region as a "Clean and Resilient Marina" if they meet the criteria of the program. The criteria are broken down into six sections - (1) marina design and siting, (2) emergency preparedness, (3) evacuation procedures, (4) stormwater management and erosion controls, (5) climate adaptation and sea level rise, (6) outreach – that require specific actions. This is the first program of its type in the country and only a few marinas have earned the certificate. The low percentage of marinas involved in the program indicates the lack of initiative of marinas, and can serve as an indicator for the science

and policy in terms of marina resilience. There are minimal scientific journal articles regarding marina resilience and even fewer policies addressing the issue. This program provides positive publicity for the marina and may lead to reduction in premiums in the future. The Clean and Resilient Marina initiative is slowly growing; however, it raises the question: Why are more marinas not applying for this certification? Studying attitudes and perceptions of marina owners will provide insight into the lack of initiative.

The GOMA Clean & Resilient Marina Initiative built upon a pre-existing Clean Marina Program in the participating states, like the existing Clean Marina Program in Rhode Island. Rhode Island's Clean Marina Program was developed by the Coastal Resources Management Council in February of 2007, implemented in collaboration with the RIMTA, RI Department of Environmental Management, and Save the Bay. This program focuses on improving water quality around the Narragansett Bay and other coastal regions, however it could act as a starting point for increasing marina resilience, just as the case with the GOMA. Marinas that take the initiative to apply for this certification may be more likely to participate in a resilient marina program. In addition, there are aspects of a clean marina program that could overlap with a resilient marina program. Having only four certified "Clean Marinas" in Rhode Island and over 50 marinas in the state shows a disconnect between government programs and the individuals who participate in them.

Due to the lack of literature regarding issues with marina resilience, this study set out to investigate the priorities and attitudes of ten Rhode Island marina owners towards increasing resilience to future storms and rising sea levels. The above section

explained the importance of the marina industry in Rhode Island and reasons why adaptation and resilience may be neglected. As previously stated, there appears to be a lack of implementation of adaptation measures relating to climate change amongst Rhode Island Marina owners. I explore this issue for marinas by interviewing ten Rhode Island marina owners. The next section explains the methodology to the data collection, followed by the results of the study, and finally a discussion on the implication of the results in presented

CHAPTER 3

METHODOLOGY

This study examined the perceptions and priorities of ten Rhode Island recreational boating marinas through a grounded theory approach (Glaser & Strauss, 1971). A grounded theory approach develops a theory which relates to the particular situation forming the focus of the study (Robson, 2002). The theory is said to be 'grounded' in the data obtained during the data collection (Robson, 2002).

3.1 Sample Selection

Initially, I used purposive sampling to generate a list of interviewees based on a categorization done of all 55 of the marinas in the state. Yacht clubs, shipyards, and sailing centers were excluded from this study because they have differing visions and purposes amongst the boating community. Yacht clubs are typically organizations of boaters that promote boating and sailing through lessons, racing, and social programs, whereas a marina houses vessels, provides basic amenities like fuel, moorings, and other necessities to boating. Yacht clubs tend to be more of a social club than a marina. Shipyards typically haul and dry dock vessels and most do not have many wet slips.

The average marina in Rhode Island contains 126 slips, with the largest marina having 726 slips and the next largest 380 slips. Due to this difference, the mean slip number was not reflective of the actual midpoint in the data. Instead of using the mean, the median slip number of 77 slips was used, reflecting the midpoint of the data

more accurately. The five marinas that fell above and below the 77-slip mark in size were selected. Table 1 displays the ten marinas that were grouped around the median.

Table 1: The ten marinas initially selected for interviews

10 Initially Selected Marinas											
Name	**Town/ City**	**Number of Slips**	**Vessel Size**	**Launch Ramp**	**Fuel Dock?**	**Pumpout ?**	**RIMTA member?**	**Deepwater Channel?**	**Hualing Capabilities?**	**Moorings?**	**Service Dept.?**
Wickford Marina	North Kingstown	60	100'	no	n/a	n/a	no	n/a	no	no	no
Marina Bay Docking	Wakefield	65	max. 50'	no	n/a	n/a	no	no	n/a	yes	n/a
Newport Onshore Marina	Newport	65	n/a	n/a	n/a	n/a	no	n/a	n/a	no	n/a
RI Mooring Services, Inc.	North Kingstown	69	60'	no	no	no	Yes	n/a	yes	no	yes
Warwick Cove Marina	Warwick	74	n/a	no	no	no	Yes	no	no	no	no
Lotteryville Marina	Westerly	75	n/a	yes	no	no	no	n/a	yes	yes	yes
Wharf Marina, Inc.	Warwick	80	40'	no	n/a	n/a	Yes	n/a	no	no	no
Block Island Boat Basin	Block Island	85	max. 100'	n/a	n/a	n/a	no	entrance - 14'	N/a	yes	yes
Conanicut Marine Services, Inc.	Jamestown	100	n/a	no	yes	n/a	no	55' draft to mooring	yes	yes	yes
Striper Marina	Barrington	125	n/a	yes	yes	no	Yes	no	n/a	no	yes

The geographic location of the ten selected marinas was considered, resulting in substitutions being made to account for marinas in all regions of Rhode Island. The state was divided into regions, north bay, east bay, west bay, salt ponds, and Block Island, and marinas from each area were incorporated. The figure below displays the breakdown of the specific regions.

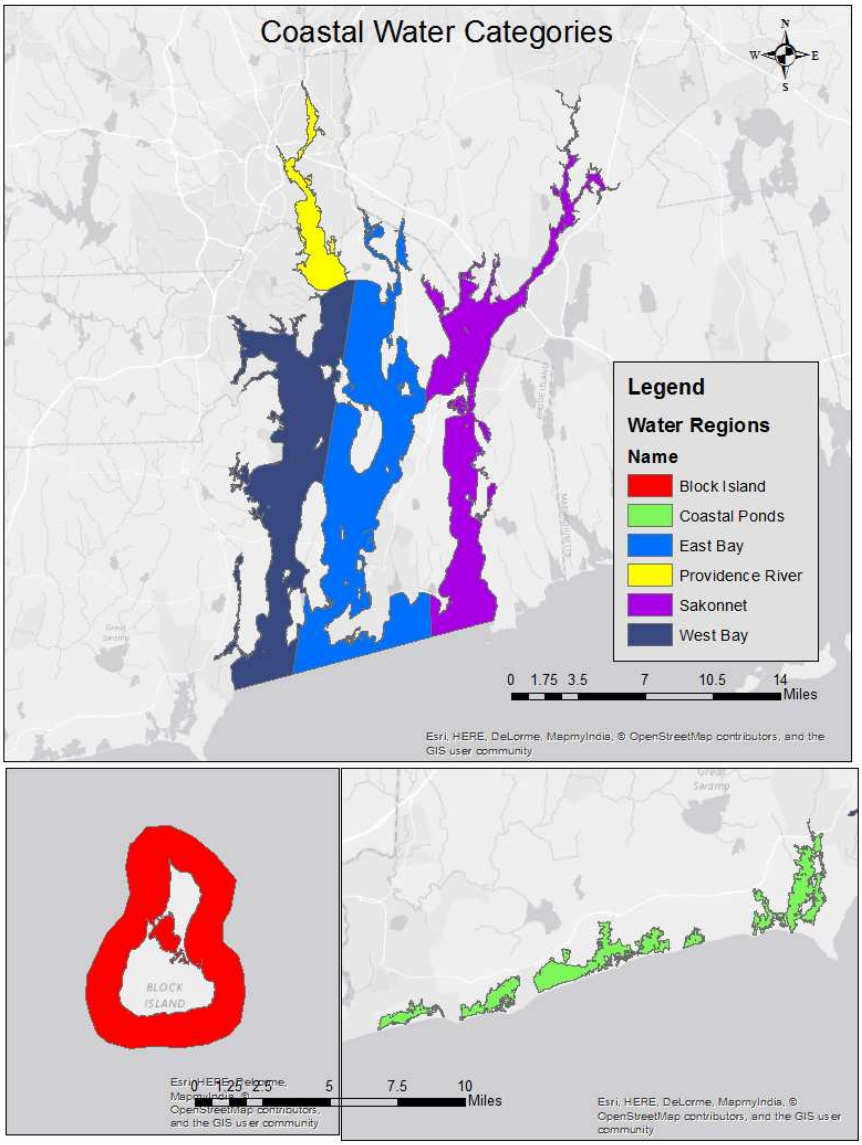


Figure 1: Regions of coastal waters in Rhode Island

Invitations to participate were emailed to the ten selected marinas, with an initial reply rate of zero. Follow up phone calls were made and one marina agreed to participate in an interview. From there, I changed the sampling method from purposive sampling, a non-probability sample selected based on characteristics of a population, to opportunistic sampling, when the researcher makes sampling decisions during the process of collecting data (Robson, 2002). Due to the low response rate to

emails and phone calls I expanded the sample size to not only include average sized marinas but instead, to include all the marinas in the state. I then sent emails to the new marinas added to the sample group.

Emails were sent out to 29 of the 55 marinas listed in Appendix A. The remaining 26 marinas did not have email contact information available online, only telephone numbers. Again, emails yielded zero responses. Next, I made follow up phone calls to all marinas emailed, which yielded three more interviews. Another round of phone calls was made to the marinas I was unable to email, yielding two more interviews. Finally, due to such a low response rate from emails and phone calls, I visited marinas in person to ask for participation in my study. This proved much more successful and the remaining seven interviews were conducted.

3.2 Interviews

Between April and July, 2016, I conducted ten in-person and over-the-phone semi-structured interviews with marina owners or managers. The interviews consisted of open-ended questions, which allow participants to voice their opinions while still keeping on target with the interview (Robson, 2002). Semi-structured interviews work well when participants are only interviewed once and when the target population consists of managers, bureaucrats, or other elite members of a community (Bernard, 2012). Semi-structured interviews give the interviewer full control to get what they want from the interview, while allowing both the interviewer and participant to follow new leads as they arise (Bernard, 2012). Open-ended questions are flexible and allow the researcher to better assess the respondents' perceptions or beliefs (Robson, 2002).

I conducted eight 10-20 minute interviews in-person, at the location of the marina for convenience of the participant. Due to time and opportunity, I conducted two of the ten interviews by phone. Questions used during the interviews focused on the four research questions set forth in Section 1. Both direct and indirect questions were used to illicit responses to gain an understanding of the interviewees perceptions and priorities towards future expansion, marina resilience, permitting and governing process, and potential for future incentives. Interviewees were prompted with open ended questions and encouraged to respond freely. The interview instrument can be found in Appendix B.

3.3 Data Analysis

3.3.1 Overview of Analysis and Coding

Interviews were recorded and transcribed using OTranscribe, a free online platform, and written into Microsoft Word documents. The individual transcripts were uploaded into the Nvivo software program for coding and analysis. Coding is a method of assigning interpretive tags to text based on categories or themes that are relevant to the research (Cope, 2010). Coding can be done by hand, however using software helps streamline and organize the results.

Beginning stages of data analysis were conducted by reading through the transcripts for primary themes. From this, primary nodes, or large categories, were developed to capture the overall themes of the four research questions through initial reading of the transcripts. The term "node" is used in coding to mean a category or group. When coding responses to interviews nodes are created to group similar responses or statements. A primary node can contain numerous sub-nodes, referred to

a secondary or sometimes even tertiary nodes. These emerge when there are themes for common responses found within a primary node. This system creates a hierarchy of sub-nodes housed within a primary node. Appendix A includes the full coding hierarchy for this research.

The following sections explain the development of the primary, secondary and tertiary nodes developed in this research.

3.3.2 Primary Nodes

I used conventional content analysis as my method to create the primary nodes. Conventional content analysis is appropriate in studies where existing theory or research literature on the topic is limited, which is the case with this study (Hsieh & Shannon, 2005). This process allowed me to immerse myself in the data allowing the initial categories to emerge. Initial readings of interview transcripts allowed me to gain knowledge on the overall trends and tone of the responses. Notes were taken on each transcript, followed by a thorough word for word reading of the transcripts, taking notes of words that appeared frequently or that appeared to directly answer the question at hand.

After an initial read of the transcripts four primary nodes were developed to categorize responses to the four research questions as seen in Figure 2. These included: “Growth and Expansion”, “Resilience”, “Outside Assistance”, and “Societal Co-Benefits”. Each node emerged due to the different goals of the four research questions. There were overarching themes tied to the responses that fell under the umbrella of the four research questions, therefore creating a label or node for each was fitting. Each research question was designed to investigate a different aspect of

resilience and created to illicit the priorities and potential setbacks of increasing resilience towards future storms and rising sea levels. The differences between research questions warranted the creation of individual nodes for each.

The “Growth and Expansion” node corresponds to the first research question and contain statements regarding recent renovations and future plans. The “Resilience” node parallels the second research question containing statements about storm and sea level rise awareness and concern, storm preparation, and design standards for docks and waterside facilities. The “Outside Assistance” node relates to the third research question and includes statements regarding the permitting process, limitations to building, and if there is a need for outside support. Finally, the fourth node, “Societal Co-Benefits”, consists of statements regarding the potential benefits a robust marina may have, outside the scope of those directly involved with the business. The responses categorized in this node discuss the potential for public benefit of having a more resilient marina industry. This node deviates slightly from the fourth research question due to how participants responded. The fourth research question was designed to build upon the third, however did not end up doing so based on responses to both the third and fourth research question. Further explanation of this can be found in the following section.

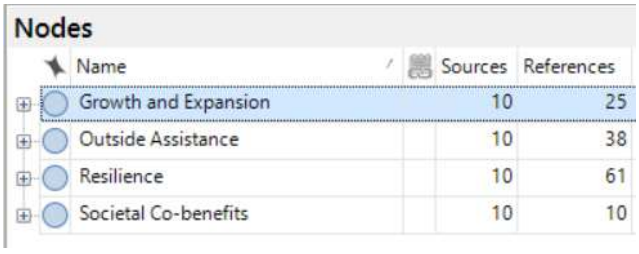


Figure 2: Primary nodes created within Nvivo

3.3.3 Secondary Nodes

Subsequent readings of the transcripts resulted in secondary, and in a few cases, tertiary nodes. A sample of this breakdown is seen in Figure 3. For example, the "Growth and Expansion" node was broken down into five secondary nodes, "Aesthetics", "Expansion", "Maintenance", "New Business", and "Rebuild". The "Aesthetics" node held statements referring to the improvement or need to improve of the overall aesthetics and green space for guests. The "Expansion" node contained statements of plans to expand or reasons why a facility may or may not be able to expand. "Maintenance" captured statements about such tasks as dock repairs, dredging, or landscaping. The "New Business" node contains statements regarding potential avenues for new revenue, such as increasing slip size to accommodate a larger vessel, or creating more slips. Finally, the "Rebuild" node captured statements from participants who were completely wiped out by a storm and had to rebuild their facility.

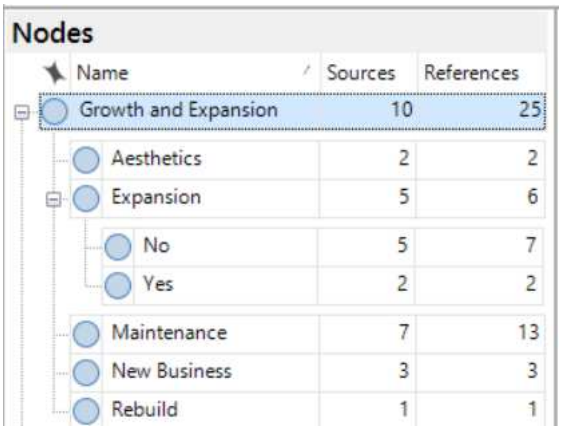


Figure 3: The coding hierarchy of the "Growth and Expansion" node

The "Resilience" node was broken down into four secondary nodes of "Design Standards", "Opinion and Awareness", "Previous Damage", and "Storm

Preparedness". "Design Standards" contained any statements about the dock systems, pile height, and overall design of the marina. The "Opinion and Awareness" node contained one tertiary node called "Skeptical". The "Opinion and Awareness" node encompassed all statements about future sea level and storm projections, however the "Skeptical" node was created due to the majority or responses doubting or being unconcerned with these forecasts. The "Previous Damage" node was developed to include statements from past storm damage or overall damage to the marina. The "Storm Preparedness" node included statements about how a marina prepares for a storm and their overall level of preparedness. This node contained two secondary nodes, "Elevate" and "Haul Vessels" because these were two emergent themes in the transcripts.

The "Outside Assistance" node held one secondary node called "Permitting Opinion", which was broken down into three tertiary nodes of "Negative", "Positive", and "Undecided". The primary node contained statements about receiving outside assistance for storm preparation and resilience and the secondary node of "Permitting Opinion" was used to gauge a respondent's perceptions towards the building and permitting process.

Finally, the "Societal Co-Benefits" node was made up of responses to the fourth research question. This question was more abstract to the respondents, however after some explanation could be answered. This node contains statements about whom else, besides marina personnel and clients, may benefit from a more resilient marina. It also contains statements of how marinas provide to the community and ways that they could be potentially damaging.

CHAPTER 4

RESULTS

This section discusses the results of the interviews. It provides statements by interviewees that were coded into the hierarchy discussed in the previous section and discusses the implications of these statements. The frequency a specific node was coded indicates how many times it was mentioned throughout the interviews. This chapter is broken into four sections that correspond with the four research questions and primary nodes coded. Summary tables are provided for each question to provide examples of the types of responses received and coded within each node.

4.1 What are interviewees' business growth and expansion priorities?

The results found to support this question fell into the primary node of "Growth and Expansion" which was coded a total of 25 times making it the second least coded node. When asked about the short and long term growth and expansion plans of their marinas, responses fell into five different subcategories, thus making up the secondary nodes in the coding hierarchy. Each of the secondary nodes will be addressed further in this section. Below is a summary table providing examples of the types of responses coded within each node.

Table 2: Examples of text coded under "Growth and Expansion"

Growth and Expansion			
	Aesthetics (2)		"Well I mean most recently we've done some landscaping improvements. We've put in some more green area for our guests. Marinas are turning into country clubs more and more" (P2)
	Expansion (6)		
		No	"We cannot. We do not have the room. You need a certain amount of parking per slip and we do not have any room on the landside." (P6)
		Yes	"Were the second largest in the bay with the number of slips until the Brewer yards started combining theirs. We actually have land around this point, about 3 acres of water that if I was going to live to be 100 could be developed. It would be expensive but could be worth it in the long term." (P1)
	Maintenance (13)		"We do annual maintenance, off season maintenance prior to every spring season which includes piling replacement. We kind of address the worst of the worst, structural, safety issues. Sometimes they involve a lot more than others. Survey the damage from the offseason and go from there. " (P3)
	New Business (3)		"3 years ago we did a big dredge project. It was to accommodate larger vessels to keep up with the demand." (P1)
	Rebuild (1)		"Sandy, 2012 it happened. We got wiped out and had to rebuild. " (P4)

4.1.1 Aesthetics

When discussing future plans with the owners and managers' aesthetics of the marina were brought up two times. Even though this was not frequently discussed, some managers and owners believe aesthetics are something the customers care about, which can help promote their business. For two marinas, improving aesthetics was

either the most recent renovation, or was something the respondents wish to do soon. When the aesthetics of the marina are a priority it can take the focus off improving resilience. If customers are more concerned with aesthetics, then owners will likely divert their money to improving the appearance and amenities of the facility before spending money to adapt to changing climate conditions. A customer may not notice if a marina spends money to fortify docks and increase resilience, however do tend to notice the aesthetics of the facility. Developing a more aesthetically pleasing marina with more amenities can improve marketability and help to increase revenue.

Although, this does not necessarily relate to resilience, owners and managers can find ways to incorporate green infrastructure when working on the landscaping and aesthetics of the marina. The Environmental Protection Agency defines green infrastructure as,

> *…a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits…green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits. (EPA (Environmental Protection Agency), 2016)*

Green infrastructure can help to address issues with runoff and flooding by maximizing impervious surfaces and providing stormwater a natural path back into the ecosystem. Utilizing methods of green infrastructure can increase the aesthetics of the facility by incorporating more green space and natural vegetation enhancing the overall appearance of the facility. As mentioned during an interview, marinas are turning more and more into country clubs, therefore improving the landscaping with green infrastructure serves a dual purpose.

4.1.2 Expansion

The "Expansion" node was the second most coded secondary node under "Growth and Expansion". It was further broken down into tertiary nodes of "Yes" or "No". Many marinas were unable to expand their dock systems or number of slips due to marina perimeter lines delineated by the CRMC and DEM. A marina perimeter line is based off the in-water facilities and defines and limits the area for structures to be located. Inside a perimeter line, marinas need minimal permitting for construction and maintenance. Due to the nature of the business and constant need for maintenance on docks and piles, this was designed to make the permitting process easy and limit the oversight from various governments. The CRMC oversees the activities within a marina perimeter line.

The perimeter lines provide leeway for the marinas to conduct their business, however hinder expansion. Strict zoning limitations like this can hurt the overall resilience of a marina. With limited space, an owner may choose to maximize the slips to increase revenue, therefore may be less likely to install protective measures such as breakwaters or wave attenuators because they take up valuable space.

Not every marina was confined by their perimeter line. One was had available space, however they did not plan to expand.

The cost of development also limits the potential for expansions and growth, which in turn can limit increasing resilience. The upfront capital needed to expand may be too great for a small family run facility. In addition, if a facility undergoes a major expansion project they may not have the capital to construct other resilience measures, such as fortifying their facility with breakwaters or bulkheads.

4.1.3 Maintenance

The most commonly coded secondary node, coded 13 times, was "Maintenance," meaning that it was discussed frequently in interviewees. In terms of recent renovations and on-going projects at the marina, most interviewed were conducting some sort of routine maintenance. These facilities are constantly being worn down by the elements of nature and a tremendous amount of upkeep is necessary.

> *"We always have something ongoing every week in-season. This week we cleaned all the gardens and mulched. I mean we repair the floats as needed and we try to stretch out their life as long as possible" (P5).*

Proper maintenance can increase the design life of dock systems and increase the structural integrity. Conducting routine maintenance is essential to help increase the resilience of a marina. A well-maintained facility will have stronger docks and piles, providing a better chance to withstand a storm.

In addition to repairing docks and other infrastructure, a few interviewees mentioned dredging projects that they are either proposing or have recently completed as a form of maintenance.

> *"We're looking in the next year to dredge. It's maintenance dredging so we can haul all the boats we have here. We can't haul during low tide right now" (P2).*

Dredging to increase depth for vessel hauling contributes to the resilience of a marina. Hauling vessels is an essential part of storm preparedness plans of marinas. This is further discussed in the further section about storm preparedness. If a facility is unable

to haul vessels during low tide they are very restricted when trying to haul vessels in an emergency. Leaving vessels on the docks because they were unable to haul puts added force and stress on the dock system.

4.1.4 New Business

Two interviewees discussed plans to generate new business in the short-term future. This was coded differently than "Expansion" because the "Expansion" node was focused on expanding the number of slips or constructing new facilities in the long term. The "New Business" node refers to statements about creating new revenue streams for the business. Repurposing docks to accommodate larger vessels is one way to generate new revenue in a changing market, evidenced by the following statement.

> *"Three years ago we did a big dredge project. It was to accommodate larger vessels to keep up with the demand" (P1).*

This type of dredging was differentiated from maintenance dredging because it was not trying to restore the benthic layer to a depth it once was, but rather increase depth to bring new opportunities. Dredging conducted as maintenance is a result of sedimentation from currents, rivers, or storms. Dredging to accommodate larger vessels may be done in areas that do not have sedimentation issues, but rather would like deep water adjacent to their docks and in the channels to accommodate mega-yachts. Other responses that fell into this category discussed renting out portions of office space to tenants to generate more revenue from unused space.

These plans do not directly relate to increasing resilience and show that owners may choose to spend money elsewhere to increase revenue, rather than investing

money for long term adaptation. If capital is limited, generating new revenue can help fund larger adaptation projects in the future.

4.1.5 Rebuild

One interviewee had recently rebuilt a large portion of their facility due to damage from Hurricane Sandy in 2012. This was the most recent renovation done on the facility and there were no plans to expand further. This statement was unlike others and did not fit into the previous nodes. Rebuilding an entire facility provides the best opportunity for an owner to increase resilience and correct vulnerabilities that may have existed with the prior facility. This interviewee did just that by elevating their office and restaurant out of the flood zone. This type of project requires upfront capital; however, insurance can help alleviate some of the burden after a loss. This situation is not ideal, but a total rebuild does allow for new design and a chance to learn from the disaster.

4.2 To what level is increasing resilience a priority at their marina?

The second research question investigates the participants' priorities towards increasing resilience at their marina in regards to sea level rise and future storms. The responses to the corresponding interview questions were coded under the primary node "Resilience", which was coded a total of 61 times, making it the most coded primary node. To organize and sort responses four secondary nodes were created. Below is a summary table of responses coded that contribute to answering this research question.

Table 3: Examples of text coded under "Resilience" node

Resilience		
Design Standards (15)		"Just anecdotally over the years we know how high the water gets during a given storm. During Sandy, we had a couple of short piles and we knew they were short and some docks actually floated off the piles. We have since replaced those after the storm." (P7)
Opinions and Awareness (17)		"Yeah, it hasn't been a huge effect here at this facility but other facilities we have are lower to the high tide line and they have flooding areas." (P2)
	Skeptical	"No, I don't really believe that. We just set ourselves up to be ready for whatever happens. We don't do it on a specific basis." (P10)
Previous Damage (10)		"Yeah absolutely, we have a lot of cement docks and we have cement attenuating docks along the outside. We had fingers get damaged, we've had a couple get torn off. Most the damage we've suffered recently has been from ice. You know, cold winters have been the biggest damage recently" (P2)
Storm Preparedness (19)		"I've got a storm preparedness plan, certain protocols that we take. Forecasting is so intense now that we have ample time to either relocate our vulnerable areas and just preparation in general. There's something written because our insurance company wanted. I've been here so long I know if it's going to be southeast what we need to do. Northeast... etc." (P3)
	Elevate	"Over the last few years we built some new ramp landings that are elevated a few feet higher than the old ones. The old ones were prone to going under water. We still have one more to retrofit." (P7)
	Haul Vessels	"We can haul all the vessels if needed. All the little ones go on trailers and we haul the

	larger ones. We have hauled 75 boats in a day and that is including vessels coming from all over the bay." (P6)

4.2.1 Design Standards

The secondary node "Design Standards" contained responses about the standards used when constructing and installing pilings and dock systems. Many of the marinas used old designs passed down by family members or previous owners.

"We came up with the design, well actually my dad did…" (P6).

Per interviewees, marinas tend to be family businesses with a lot of the maintenance and construction done by the staff, therefore it is not unrealistic for a facility to design and construct their own docks. In addition, many marina owners and managers use their own local knowledge to determine the height needed for pilings for floating docks. Understanding previous storms impacts, such as that of the 1938 hurricane is essential, however this backwards forecasting may not prove to be the best when deciding on piles for the future with increasing water levels. Responses also proved that nine of ten respondents utilized majority floating docks, if not all floating docks. Floating docks tend to withstand storm surges better than fixed piers by easily adjusting to fluctuating water levels provided the piles are sufficiently tall (Great Lakes Clean Marina, 2013).

Since marinas are not required to replace piles through regulations, there are often piles that are too short because they were designed 20-30 years ago before the threat of sea level rise was understood. With increased knowledge, marina owners can install taller piles as they replace their piles. This is an easy solution, compared to

other adaptation measures, because it can be done when replacing old piles however it takes time to implement. The cost per pile does not dramatically change by making it a few feet taller. If an owner or manager is only replacing one pile at a time it can take a few years to for the marina to have all the piles a sufficient height.

4.2.2 Opinion and Awareness

Interview responses that provided insight to the perceptions and attitudes held by interviewees regarding sea level rise and future projections of storms were coded under the "Opinion and Awareness" secondary node. The results yielded statements indicating many owners and managers were skeptical about the science or did not believe it at all. Others understood the science, however, they did not feel concerned due to their marina's location or design. A tertiary node of "Skeptical" was created to code the responses indicating skepticism towards the changing climate conditions. Some interviewees who have spent their life on the water are skeptical about future projections because they have not observed any significant change first hand. For example, one owner stated,

> *"I've been down here for 43 years. Everyday I'm down here. I have not seen any sign of sea level rise, that's the truth. That's the way it is. I look at that water everyday… according to the journal, over my period of time I should have seen a 4-5-inch sea level rise. I would see 4-5 inches, I might not see a ½ inch or an inch but I would see 4-5 inches and I haven't seen it" (P9).*

This owner is unconcerned because they deny the existence of sea level rise. Another reason some interviewees were skeptical was because they believe their marina can handle what the future has in store. They feel their design is strong enough to

withstand changing conditions or they were not concerned because they know they cannot plan for everything. The overall impression gained from the interviews are a general lack of concern about rising sea levels and future storms. Only one out of the ten interviewees were truly concerned and beginning to address the issues. This manager stated,

> *"We're concerned with it and making some provisions for it as far we can because we don't own the property. Our river dock is already pretty low. Over the last few years we built some new ramp landings that are elevated a few feet higher than the old ones. The old ones were prone to going under water" (P7).*

The reaction of doubt was uncovered early in the interviewing process and further confirmed as more interviews were conducted.

4.2.3 Previous Damage

When asked about previous damage to their facilities, eight of the ten interviewees had sustained some sort of damage, whether from a storm or just winter ice. These responses were coded under the secondary node "Previous Damage". It was surprising to learn that although eight of ten interviewees experienced damage, many were still not concerned with the future.

Many who experienced damage never experienced anything major, which is perhaps why there is a lack of concern. One owner stated they have experienced a few thousand dollars of damages but they believed their facility is built to withstand future projections.

4.2.4 Storm Preparedness

The final secondary node that fell under "Resilience" is "Storm Preparedness". This category contains statements of how the interviewees typically prepare for a storm. Most interviewees had some sort of storm preparedness plan, however they were informal and based off experience. Many plans incorporate hauling vessels, notifying customers and moving equipment to higher ground. Two tertiary nodes were created to contain responses about hauling vessels and elevating equipment or structures.

Not all the marinas have the capability to haul vessels, however those that do try to haul as many vessels as possible. Those that do not have the equipment to haul the vessels would spend more time preparing the boats with the customers and outlining the customer's responsibilities. In addition, they encourage customers to get their boats off the docks to reduce the force on the pilings and dock systems.

> "*We strongly recommend that people haul their boats out. We have the ability to haul the vessels. They get it ready and we haul it and put it on land*" (P6).

All the interviewees agreed that getting as many boats off the docks as possible helps to minimize damage to the facility. During the interviews, it was learned that modern technology provides marina owners with advanced notice of incoming storms, which helps with preparation and resilience. Facilities that have strong written preparedness plans that are well executed were found, during the interviews, to have had less damage from past storms, indicating a higher level of resilience.

4.3 Do interviewees believe there are mechanisms by which policy makers and insurance companies could assist them in increasing resilience to future storms and a changing climate?

Responses geared towards answering this questions fell under the "Outside Assistance" node and was coded a total of 38 times. There is one secondary node called "Permitting Opinion" that falls under "Outside Assistance" to help organize the opinions marina owners and managers had towards permitting agencies. This secondary node was coded a total of 19 times. The "Permitting Opinion" node reflects responses about working with governing agencies. The overall reaction from interviewees indicated the solidarity of the business. Every interviewee indicated that storm preparedness and resilience is an internal problem within the business.

Table 4: Examples of text coded under "Outside Assistance" node

Outside Assistance (38)			"I think its internal because you know your facility best. You know what wind directions going to wipe you out. I think local knowledge is the most useful. The only outside help you may want to get is like getting boats out of the water." (P6)
	Permitting Opinion (19)		
		Negative	"No, it's complicated. It's expensive. It's not efficient. We don't need a CRMC and a DEM we just need one." (P8)
		Positive	"CRMC has been fairly easy to work with. They were very helpful with the dredging part of it. And a few of the other repairs we've done, CRMC has some people that are excellent to work with. Overall positive." (P6)

4.3.1 Outside Assistance

To identify whether marina owners believed additional third party help could enhance storm preparedness, nothing in the line of questioning was mentioned directly about incentives. Rather, interviewees were simply asked if they believed there is a need for outside assistance when preparing for storms and increasing storm resilience. Nine of the ten interviewees believed this to be strictly an internal problem. They believed their specialized knowledge of their facility is all they needed. Many of the marinas in Rhode Island are small facilities with small staff and they work within their bounds. When asked about outside help one manager stated,

They probably won't take it. Generally, were a stubborn group of people. (P2).

This statement further supports the idea that help is unwanted. The interviewees did not mention the idea of incentives or insurance reduced insurance premiums, even when prompted. They prefer to work internally as they always have.

When prompted with a question regarding outside factors that may limit a marina from increasing resilience all ten interviewees responded that it was upfront capital. One owner brought up the issue with return on investment when investing in adaptation measures.

> *"It all comes down to upfront costs. Say you put $500,000 into your marina, how are you going to get that back? Can you charge more for a slip because you know it is stronger and better to withstand a storm? Or do your improvements have to be more towards the amenities situation where from a customer's perspective it is more desirable? I would rather spend our money*

to fortify the marina but the reality is you've got to spend the money where it improves in the customer's eyes" (P7).

When an owner feels there is no return on their investment they are going to spend their money elsewhere, as indicated by the previous response. Another owner suggested that beside upfront capital, if they do not believe there is a need to increase resilience they will not do so. If a marina is sheltered and has not suffered damage from previous storms they may not see a need to spend money fortifying their facility.

4.3.2 Permitting Opinion

When discussing permitting and the multifaceted process that marina owners and managers must go through to expand or build on their property, most interviewees had positive feelings. They noted the complexity of the process due to multiple governing agencies, however eight of the ten interviewees did not feel limited and stated that they could work with individual agencies. One manager stated,

"... working with CRMC is pretty painless. The guys are helpful. You just have to answer the questions and work within the parameters" (P2).

Not all felt that the process was painless, however they still understood how the process works and how to deal with it. This indifferent attitude does not inhibit an owner from beginning a project, but is rather just noting the inefficiency.

Of the ten interviewees, two were completely displeased with the permitting and building process. They did not understand the complexity and did not feel that individual agencies were easy to work with. These interviewees felt limited in expanding and building their facilities. One owner stated,

"…It's not efficient. You're dealing with government; government is not efficient" (P9).

This type of attitude can be detrimental when trying to implement resilience measures because there is already a distrust and negative feeling towards governing agencies. Therefore, if policy makers mandate taller piles or other resilience measures there may be backlash from marina owners thinking it is just another inconvenience.

4.4 What are the societal co-benefits of the mechanisms identified by interviewee?

The final research question investigated whether there are societal co-benefits of the mechanisms or incentives the interviewees identified. Since they did not identify any incentives or ways in which policy makers or insurance companies could assist in building resilience this portion of the interview shifted to investigate who else may benefit from a more resilient marina and in what ways.

Most interviewees agreed there is a larger benefit to having strong, robust marinas. They did not all agree for the same reasons. Some interviewees discussed how they add to the local economy by bringing in people from different areas, others identified that a more resilient marina creates less debris during a storm lowering cleanup costs for the public. Another interviewee stated they create jobs for the local economy and yet another discussed that a more resilient marina can eliminate environmental hazards, such as oil and fuel spills from the bay.

"… our main concern with dredging is to be able to haul all these boats. If a cat 5 storm comes up and the boats we can't haul end up breaking free and

sinking, leaking oil and diesel into the bay or marsh, so yeah I think it benefits everybody having facilities built to stand up to the environment" (P2).

Although no policy incentives were identified, the idea that a resilient marina can benefit more than those directly involved was expressed

CHAPTER 5

DISCUSSION

This study set out to gain information on the perceptions and priorities of marina owners in Rhode Island about resilience to rising sea level and future storms. To do so, four research questions where examined and analyzed through data obtained in ten interviews. The following sections discuss the results in the context of each research question.

5.1 What are interviewees' business growth and expansion priorities?

When investigating the future growth and expansion priorities of the ten Rhode Island marinas selected for this study, no interviewees mentioned plans to adapt or fortify their facility for sea level rise or future storm projections. All ten interviewees discussed maintenance projects, such as dredging or repairing damaged docks, and two noted the need to increase space for guests and landscaping needs. Although these repairs may not be intended specifically to help the marina during a storm, routine maintenance helps marinas to better survive storms. When discussing maintenance, this owner stated,

> *"We do it every year. We do annual maintenance; everything has a shelf life. I have 160 slips, once they hit around 15-20 years old I have to replace them or update them" (P9).*

Acknowledging the design life and constantly working to keep docks in good repair increases the overall resilience of the facility. Dock systems are constantly

being worn due to their environment. The salt water deteriorates metal connections, freezing water can crack piles and floats, and removing pieces of docks for winter storage can even wear them down because they bang around during the removal process. Proper upkeep and maintenance helps to improve the design life.

In addition to routine maintenance, it was found that perimeter lines restrict expansion on the waterside of the facilities for nine of the interviewees. Perimeter lines give managers and owners permission from the CRMC and DEM to conduct their basic maintenance without needing to pull a permit, however they limit the future expansion of the facilities. When space is a limiting factor, an owner may choose to use their space in ways that increase revenue such as building slips, rather than building a structure to help fortify their facility for future rising sea levels and storms.

Overall, the ten marinas studied did not have plans for any large expansions or growth. However, three were adapting to the changing market of larger vessels by repurposing their docks or dredging to accommodate larger vessels. One manager acknowledges the changing market in this statement,

> *"Based on the fact that it's a 40-year-old facility, it was built to accommodate vessels when an 80 ft. yacht was a big boat and now a 200 ft. yacht is a big boat. This facility hasn't kept up with the technology, so that's definitely number one" (P3).*

When most marinas are not planning on improvement or expansion projects it makes it more difficult to implement adaptation measures to increase resilience. It can cut down costs and the need for various permitting when incorporating an adaptation project into another capital improvement project. An example of this was discussed when an

interviewee was rebuilding their facility after a storm loss. This project needed design permitting already, therefore by incorporating the adaptation method of elevation into the initial permit, it minimizes the number of permits needed.

5.2 To what level is increasing resilience a priority at their marina?

Most owners and managers interviewed are skeptical about the science behind sea level rise and future storm projections, therefore they are highly unlikely to address the issue. They indicated that their skepticism stems from uncertainty in future projections of climate change. Some interviewees felt their facility was adequately protected due to its location or design, whereas others believed they could not plan for what may (or may not) happen. This attitude acts as a barrier towards implementing adaptation measures and increasing resilience. When one believes there is no need to make changes or does not feel affected by sea level rise and large storms, no change will be initiated. These results related to Adger et al. (2008) because perceived risk, knowledge and experience can act as a limit to adaptation. Many owners did not perceive a risk or believed their experiences provided them with adequate knowledge so as not to have to address the science behind climate change.

Even though most of the interviewees expressed that they had experienced some damage in recent years, most were not concerned with an increasing level of damage, as seen in examples in the previous chapter. They consider it to be part of the risk assumed with owning a marina and believe that if they are affected then everyone else will be also. This was an unexpected result. This relates to the individual and social factors; however, it contradicts the idea developed by Barnett et al. (2014) that people may not implement change until something they value is affected. Even after

facilities were affected by storm damage, most owners were still unconcerned with future projections.

When discussing concern for the future this interviewee stated, *"I'm out of the floodplain. If it comes up this high everyone is screwed, not just us" (P4).*

The owner was referring to the office and restaurant on their property, not their docks when speaking about the flood zone. This group mentality may end up hurting the marina industry in Rhode Island in the future. Individual marinas need to step up to create new industry standards, instead of remaining complacent.

This research concluded that, now, resilience is not a major priority for marina owners and managers. Perhaps once the effects of sea level rise are more directly observed, action will be taken.

5.3 Do interviewees believe there are mechanisms by which policy makers and insurance companies could assist them in increasing resilience to future storms and a changing climate?

Most marina owners and managers interviewed agreed that working with the permitting agencies is a relatively painless task and that agencies tend to work with the owners, helping to improve the relationship and streamline the process. Although most believed the process to be unproblematic, some believed the exact opposite. This result is like the issue of government fragmentation discussed in Chapter 1. With multiple jurisdictions and governing agencies, inconsistencies arise complicating the building process. A town or city may have a different agenda for their waterfront land

than the CRMC or DEM and can result in issue for marina owners to obtain permits required for building. Some owners felt limited in building out due to the perimeter lines established by governing agencies, while others felt content with the current geographical extent of their business.

Owners and managers did not identify mechanisms by which policy makers and insurance companies could assist them. When speaking about the possibility of outside assistance most interviewees believed it is their responsibility to prepare their own facility. The participants believed they know their facilities and businesses best, therefore did not need or would not accept outside help. This finding is useful when discussing potential incentives to help implement adaptation and increase resilience because it shows the interviewees do not want outside help. Incentives will not work if the party they are designed for chooses not to utilize them.

Understanding the perceptions of the marina owners is the first step towards creating incentives to increase adaptation. Learning the shortcomings of the permitting process can provide insight as to what areas need improvement and what types of improvement would be most beneficial to the industry.

5.4 What are the potential societal co-benefits of the mechanisms identified by interviewees?

Although the interviewees did not state potential mechanisms by which policy makers and insurance companies could assist them in building resilience, they did discuss ways that their facility contributes to the community. The interviewees made clear that there are a series of benefits that can be observed from a marina that can withstand the forces of nature. Understanding these benefits can help to create policy

incentives for marinas potentially saving them money, while increasing their resilience.

The goal of this question was to lay the groundwork to identify potential benefits of implementing policy incentives for climate change adaptation. Many interviewees did not believe there was a need for outside assistance, therefore did not understand this question because it builds off the previous. I provided explanations to those that did not understand and shifted the interview questions to ask if anyone else can benefit from a more resilient marina. After doing so, participants could answer and identified specific benefits of a resilient marina and addressed consequences of a less resilient marina.

5.5 Limitations to the Study

Due to the response rate and time constraints the sample interviewed here was not representative of all Rhode Island marinas. There were regions of the state that were not incorporated due to lack of response to the initial interview invitations. In addition, the sizes of the marinas interviewed were not necessarily telling of the average or median size marina in Rhode Island. Due to these limitations, the results of this study cannot be generalized and analyzed for every marina in the state. Although the results are specific to the marinas interviewed, this study does serve its purpose as a preliminary study to understand priorities. Many responses were similar between marinas; however further research is necessary to determine the overall perceptions of Rhode Island marina owners.

5.6 Recommendations for Future Studies

Future studies can build off the perceptions and attitudes examined during this study. I have three recommendations for future studies. The first would be another study replicating what was done here, however on a larger scale. This would allow for the results to be more generalizable. In addition, with a larger sample size conclusions could be drawn by comparing responses to similar sized facilities. This may provide different results than seen here because the participants were all relatively small facilities with similar attitudes and perceptions. Perhaps incorporating large facilities, a contrast in opinions would be seen. Understanding the perceptions and priorities of marina owners helps to inform decision makers when generating policies and other mandates. This work can act as an initial starting point for a further investigation into potential policy incentives to increase sea level rise and storm adaptation amongst marinas in Rhode Island.

The second study is to interview policy makers and insurance companies to identify where they would benefit from a more resilient marina industry. Once potential incentives are identified they could be used as in a third study by bringing back to the marina industry to determine the feasibility from the marina owner perspective. Perhaps this would yield different results than this study because the marina owners would see what types of incentives are possible, instead of taking all the responsibility to protect their own business. Aligning the goals of the marina industry with those of the policy makers and insurance companies could result in a collaborative partnership to increase resilience.

CHAPTER 6

CONCLUSION

Determining the priorities and perceptions of marina owners in Rhode Island about increasing resilience towards sea level rise and future storms provided insight where scientific literature was lacking. The ten marina representatives interviewed are skeptical about the science behind sea level rise and questions its existence. In addition, the governance structure is perceived to be too complicated, resulting in dissatisfaction from the industry.

Results suggest that the 10 marinas interviewed do not plan on expanding, and due to space constraints do not prioritize building adaptation structures such as breakwaters or wave attenuators. In addition, I learned that overall there is not a feeling of concern for future climate projections stemming from disbelief in the science and personal biases. These barriers may continue to hinder climate change adaptation until impacts are devastating. Even after experiencing past damages, owners were unconcerned for the future as evidenced by responses in the interviews. Many simply did not believe sea level rise was occurring and even some who believed it was did not feel threatened. The creation of feasible policy to incentivize future planning and climate change resilience is possible, however a further understanding of the attitudes of marina owners towards governing agencies is needed. Findings suggest the public could benefit as well as the marina industry from increased resilience that minimizes damages after storm events.

This study suggests future research to be conducted in this field to expand upon knowledge of perceptions and attitudes of marina owners and managers. Further interviews and surveys with a larger sample of participants can help generate more generalizable results. These results can be discussed with policy makers and insurance companies to align the interests of the industry with the governing bodies. The recreational boating industry is of utmost importance to tourism and local economies and provides an essential role in creating the identity of Rhode Island, however this industry plays a large role in most coastal states Building upon this research, policy incentives that meet the needs of marinas, governing agencies, and the public can be created, helping to ensure a resilient future for the recreational boating industry. Doing so can help save tax payer money and limit the need for federal funding for post disaster clean-up, as seen after Superstorm Sandy. Understanding the policy maker's goals and priorities is a next step towards improving the resilience of the recreational marina industry.

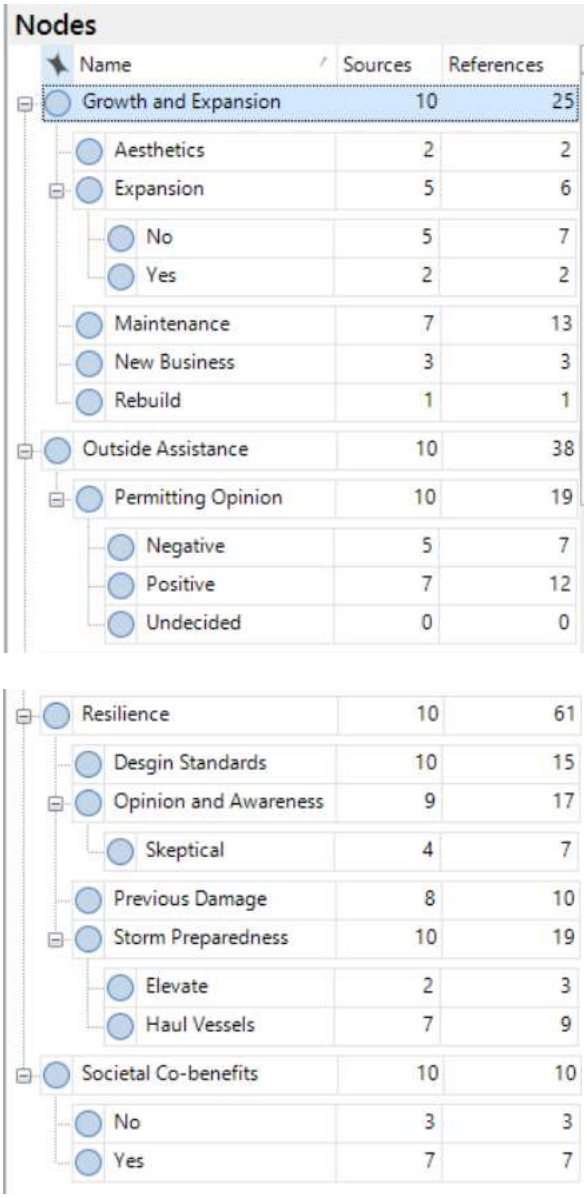
APPENDIX A: Marina Categorization

Marina Categorization															
Marina	Email	Phone	Address	Town	# of slips	size of vessel	Launch Ramp	Fuel Dock? (Yes/No)	Pumpout? (Yes/No)	RIMTA? (Yes/No)	Deepwater channel (Yes/No)	Seasonal or transient	Travel Lift/crane/haul?	Moorings	Service dept.?
Smuggler's Cove Marina	office@biresorts.com	401-466-7961	41 Water St	Block Island	12	55'	no	yes	yes	no	yes	transient	no	no	yes
West Wind Marina	n/a	401-849-4300	1 Waites Wharf	Newport	15	250'	no	no	no	no	yes	transient	no	no	no
Forty 1 North	info@41north.com	401-846-8018	351 Thames st	Newport	20	max. 250'	no	no	yes	Yes	yes	both	no	no	no
Skip's Dock	n/a	401-648-6728	1161 Succotash Rd	South Kingstown	20	n/a	no	no	no	no	n/a	n/a	no	no	no
Snug Harbor Marina	fishsnugharbor@hotmail.com	401-783-7766	410 Gooseberry Rd	Wakefield	20	n/a	no	yes	no	Yes	n/a	n/a	no	no	no
Pier 65 Marina	n/a	401-596-6350	65 Margin st	Westerly	22	60'	no	yes	no	Yes	n/a	both	yes	no	yes
Newport Yachting Center	marina@newportyachtingcenter.com	1800-653-DOCK	20 Commercial Wharf	Newport	25	accommodate mega yachts	no	yes	yes	no	yes	both	no	no	yes
Newport Shipyard Co LLC	info@newportshipyard.com	401-846-6000	1 Washington st	Newport	30	n/a	no	no	no	Yes	n/a	both	n/a	no	yes
Sakonnet Point Marina	msimon@sakonnetpointmarina.com	401-635-4753	11 Bluff head Ave, PO Box 475	Little Compton	32	40'	no	yes	yes	no	n/a	both	n/a	n/a	no
Casey's Marina	wrcasey@cox.net	401-849-0281	10 Spring Wharf	Newport	35	max. 250', 14' draft	no	yes	yes	no	14' draft	both	yes	no	yes
Greenwich Cove Marina	n/a	401-885-6611	45 Water St	East Greenwich	48	n/a	n/a	n/a	n/a	no	yes	both	n/a	yes	n/a
Viking Marina	info@vikingmarina.com	401-348-8148	19 Margin St	Westerly	48	n/a	yes	no	no	no	n/a	n/a	yes	no	no
Bullock Cove Marine, Inc.	jim@bullockcovemarine.com	401-433-3010	254 Riverside Dr	Riverside	50	max. 45'	no	no	no	no	n/a	n/a	yes	no	yes
Lavins Landing Marina	n/a	401-322-7277	60 Sportsmand Rd	Charlestown	50	n/a	yes	no	no	Yes	n/a	both	no	no	no
Wickford Marina	wickford.marina@verizon.net	410-294-8160	67 Esmond Ave	North Kingstown	60	100'	no	n/a	n/a	no	n/a	both	no	no	no
Marina Bay Docking	mafisky@aol.com	401-789-4050	214 Salt Pond Rd	Wakefield	65	max. 50'	no	n/a	n/a	no	no	both	n/a	yes	n/a
Newport Onshore Marina	donnell.murphy@nosmarina.com	401-849-0480	thames st	Newport	65	n/a	n/a	n/a	n/a	no	n/a	both	n/a	no	n/a
Allen Harbor Marina	n/a			North Kingstown	66	LOA 33, Beam 12	Yes	No	Yes	No	N/A	Seasonal			
RI Mooring Services, Inc.	moorings@rimoorings.com	401-295-2502	15 Patrol Road	North Kingstown	69	60'	no	no	no	Yes	n/a	both	yes	no	yes
Warwick Cove Marina	n/a	401-737-2446	2 Seminole St	Warwick	74	n/a	no	no	no	Yes	no	n/a	no	no	no
Lotteryville Marina	n/a	401-207-6643	25 Avondale Rd	Westerly	75	n/a	yes	no	no	no	n/a	both	yes	yes (20)	yes (on call)
Wharf Marina, Inc.	n/a	401-338-1717	138 Wharf Rd	Warwick	80	40'	no	n/a	n/a	Yes	n/a	n/a	no	no	no
Block Island Boat Basin	n/a	401-466-2631		Block Island	85	max. 100'	n/a	n/a	n/a	no	entrance - 14'	85% transient	N/a	yes	yes
Conanicut Marine Services, Inc.	link on web	401-862-2000	20 Narragansett Ave	Jamestown	100	n/a	no	yes	n/a	no	55' draft to mooring	both	yes	yes	yes
Paynes Dock	n/a	401-466-5572	Ocean Ave, PO Box 646	Block Island	100	300'	no	yes	no	no	yes	transient	n/a	no	no
Ram Point Marina	rampoint@aol.com	401-783-4535	2 William Schmid Drive	Wakefield	100	n/a	no	yes	yes	Yes	no	both	yes	no	yes
East Greenwich Marina	eastgreenwichmarina@gmail.com	401-575-7665	28 Water Street	East Greenwich	125	n/a	no	n/a	n/a	no	n/a	both	no	no	no
Striper Marina	n/a	401-245-6121	26 Tyler Point rd	Barrington	125	n/a	yes	yes	no	Yes	no	both	n/a	no	yes
Belle Vue Yachting Center/ PJ Marina	anne@pjmarina.com	401-789-7189	360 Gooseberry Rd	Wakefield	144	max. 110'	no	yes	yes	no	no	seasonal	yes	no	yes
Ponaug Marina, Inc.	ponaug@cox.net	401-884-1976	285 Arnolds Neck Drive	Warwick	150	40'	yes	yes	yes	no	n/a	both	n/a	no	yes
Stone Cove Marina	info@StoneCoveMarinaRI.com	401-783-8990	Salt Pond Rrd	Wakefield	150	32'	no	yes	yes	Yes	no	both	yes	no	no
Brewer Wickford Cove Marina	wcm@byy.com	401-884-7014	65 Reynolds Street	Wickford	155	n/a	n/a	yes	yes	Yes	N/A	both	n/a	44	yes
Winstead's Marina	winsteads@aol.com	401-737-8723	471-478 Tiffany Ave	Warwick	160	n/a	yes	no	no	no	n/a	n/a	n/a	n/a	n/a
Goat Island Marina (IDC Marina)	boat@newportexperience.com	401-849-5655	5 Marina Plaza	Newport	175	15'-250'	no	yes	Yes	Yes	yes	both	no	no	no
Norton's Shipyard & Marina	info@nortonsmarina.com	401-884-8828	Division St.	East Greenwich	185	300'	no	no	yes	Yes	n/a	both	yes	yes (100)	no
Bay Marina, Inc.	n/a	401-739-6435	1800 West Shore Road	Warwick	200	max. 55'	no	no	no	Yes	N/A	seasonal	N/a	4	
Harbor Light Marina, Inc.	marina@harborlightsri.com	401-737-6353	200 Gray St	Warwick	225	20'-50'	n/a	yes	yes	Yes	n/a	both	yes	no	yes
Brewer Sakonnet Marina	bsm@byy.com	401-683-3551	222 Narragansett Blvd	Portsmouth	314		n/a	yes	yes	Yes	n/a	both	n/a	n/a	yes
Apponaug Harbor Marina	n/a		17 Arnolds Neck Dr	Warwick	348	22' - 44'	yes	no	yes	no	N/A		Yes	30	
East Passage Yachting Center	n/a	401-683-4000	1 lagoon rd	Portsmouth	360	max.150'	n/a	n/a	n/a	no	yes	both	yes	no	yes
Brewer Greenwich Bay Marina	bgb@byy.com	401-884-1810	252 Second Point Road	Warwick	380	20'-60'	n/a	yes	n/a	Yes	n/a	seasonal	yes	no	yes
Brewer Yacht Yard Cowesett	cow@byy.com	401-884-0544	1 Masthead dr	Warwick	765	n/a	n/a	no	no	Yes	n/a	both	n/a	no	yes
Bowen's Wharf Co., Inc.	marinaoffice@bowenswharf.com	401-640-4104		Newport	250' of transient dockage	max. 200'	no	n/a	yes	Yes	yes	transient	N/a	n/a	n/a
Breezy Point Marina	n/a	401-738-0357	33 Sayles Ave	Warwick	n/a		yes	n/a	n/a	no	n/a	n/a	N/a	n/a	n/a
Brewer Cove Haven Marina	chc@byy.com	401-246-1600	101 Narragansett Ave	Barrington	n/a	up to 13' draft	no	yes	n/a	Yes	13' draft	both	yes	n/a	yes
Clark Boat Yard & Marine Works, LLC	clarkboatyard@gmail.com	401-423-3625	110 Racquet Rd	Jamestown	n/a	n/a	no	no	no	yes	N/A	both	yes	yes	yes
Gooseberry Marina	n/a	401-789-5431	392F Gooseberry Rd	Wakefield	n/a										
Jim's Dock	n/a	401-783-2050	1175 succotash rd	Jerusalem	n/a										
Lockwoods Marina	info@lockwoodsmarina.com	401-783-2868	650 Succotash Rd	East Matunuck	n/a	35'	yes	yes	no	no	no	transient	no	no	yes
Ocean House Marina	n/a	401-364-6040	60 Town Dock Rd	Charlestown	n/a	n/a	yes	no	yes	Yes	n/a	both	yes	no	yes
Pawtuxet Cove Marina	pawtuxetCoveMarina@aol.com	401-941-2000	69 Fort Ave	Cranston	n/a	n/a	no	no	no	Yes	n/a	seasonal	N/a	no	no
Pirate Cove Marina	info@piratecovemarina.net	401-683-3030	109 Point Rd	Portsmouth	n/a	70'	no	yes	yes	Yes	n/a	both	yes	yes	yes
Pleasant Street Wharf	pswinc@verizon.net	401-294-2791	160 Pleasant St	Wickford	n/a					Yes					
Silver Spring Marine	n/a	401-783-0783	362 Pond St	Wakefield	n/a	50'	no	no	no	Yes	no	both	yes	no	yes
Angel's Marina	n/a		36 Bay Avenue	Warwick	n/a		yes			no					

APPENDIX B: Interview Instrument

1) **What are the business growth and expansion priorities of ten RI marina owners for the next 10-15 years?**
    - When was your most recent renovation or construction to your facility? What was the reason for it?
    - Do you have plans to expand? Either to increase the number of slips, accommodate larger vessels, or incorporate more services such as fuel tanks, pump out stations, engine servicing, boat hauling, etc.
    - If you could change or add one thing about your facility what would it be and why?
2) **To what level is resilience a priority to ten RI marina owners?**
    - Are you aware of projections for future storms and sea level rise? If so, please explain the extent.
    - Are you concerned with projections for an increase in storm intensity and rising sea levels? Why or why not? Do you believe the projections?
        i. On a scale from 1 – 5 (1 being not concerned at all, 5 being very concerned) where does resilience fall?
    - What practices do you have in place that have helped to prevent damage from storms in the past?
    - How do you typically prepare for a storm when you have advanced warning?
    - What design standards did you construct your dock system to? How did you decide? (Are your docks fixed piers, floating, or combination of the two? What materials are they made out of?)
    - Has your property suffered damage from hurricanes or nor'easters in the past? If so, which storm and to what extent? If so, how did you recover and prepare for the next?
3) **Do ten RI marina owners believe there are mechanisms by which policy makers and insurance companies could assist them in building resilience to future storms and a changing climate?**
    - Do you feel that the permitting process to build on your property is efficient? Why or why not?
    - Do you feel limited in terms of building? If yes, how?
    - From your perspective, is help needed for marina owners to better prepare for storms and rising sea levels? If yes, who do you believe could provide the most assistance?
    - Besides upfront costs of projects, what may prevent you from building a marina that is more robust to increased storms and rising sea levels?
4) **What are the potential societal co-benefits of the mechanisms identified by ten RI marina owners?**
    - In your opinion, does anyone else (meaning anyone who is not directly related to the marina) benefit from having marinas that are more resilient?
    - Previous questions asked who can help marina owners better prepare for storms and rising sea levels, is it in their interest to do this? Why? Can it help them accomplish their goals as an agency or business?

APPENDIX C: Hierarchy of Nodes



Nodes

Name	Sources	References
Growth and Expansion	10	25
Aesthetics	2	2
Expansion	5	6
No	5	7
Yes	2	2
Maintenance	7	13
New Business	3	3
Rebuild	1	1
Outside Assistance	10	38
Permitting Opinion	10	19
Negative	5	7
Positive	7	12
Undecided	0	0
Resilience	10	61
Desgin Standards	10	15
Opinion and Awareness	9	17
Skeptical	4	7
Previous Damage	8	10
Storm Preparedness	10	19
Elevate	2	3
Haul Vessels	7	9
Societal Co-benefits	10	10
No	3	3
Yes	7	7

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