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The Recreational Use of Provincetown Harbor and Attitudes Towards Shellfish Aquaculture

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THE RECREATIONAL USE OF PROVINCETOWN HARBOR AND ATTITUDES TOWARDS SHELLFISH AQUACULTURE

BY

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ABSTRACT

Aquaculture refers to the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean. In the United States shellfish aquaculture of mollusks experienced significant economic growth from 2005-2013. Similarly in Provincetown, Massachusetts, local fishermen and town officials are increasingly interested in expanding the development of shellfish aquaculture.

To study the potential for opposition to expanded aquaculture in Provincetown Harbor, face-to-face surveys were administered to residential and non-residential harbor users. The four sections aimed to identify harbor users activities, values, spatial use patterns and attitudes about shellfish aquaculture generally and specifically in Provincetown Harbor.

In this research study it was found that the local population group and the visitor population group value the Harbor differently. This research study also found that both population groups support the development of shellfish aquaculture in Provincetown Harbor. The final conclusion found by this research study was that if shellfish aquaculture development in Provincetown Harbor were to expand, certain considerations must be made such as potential spatial conflict and areas not used. Expanding shellfish aquaculture in the pre-existing requirement of water depths of 20-30 feet, there are areas in the Harbor where users are conflicting.

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CHAPTER ONE

INTRODUCTION

Aquaculture refers to the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean (NOAA, 2014). In the United States shellfish aquaculture of mollusks experienced significant economic growth from 2005-2013. In 2005 the mollusk shellfish aquaculture industry was worth approximately $203,183,000 and grew to $328,567,000 in 2013 (USDA, 2013;NASS, 2013). With the economic increase in the industry, shellfish aquaculture has recently been getting strong financial and regulatory support from the federal government and state governments (Woods Hole Oceanographic Institute, 2010; Massachusetts Executive Office of Energy and Environmental Affairs, 2015).

Conflict can occur between aquaculture and other users because aquaculture can permanently occupy space that other users either have used or would like to use in the future for other purposes (Walters, B. B., 2007; Birkland, 2001; Stephenson, 1990; Weeks, 1992; Anutha and Johnson, 1996; DeWalt *et al*. 1996; Aarset, 1998; Naylor *et al.* 1998; Walters, 2003). For example, spatial conflict has occurred between salmon aquaculture farms and traditional lobster fishing practices in the Bay of Fundy, Canada (Walters., 2007).

Moreover, recreational boating has been a growing industry around the world (Gray et al., 2010; Widmer et al., 2004). Similarly, Provincetown Harbor is experiencing growth in the amount of recreational boating. This increase in recreational boating activity in the Harbor has potential to conflict with the development of shellfish

aquaculture. In this study the Harbor was evaluated to better understand how the different population groups utilized the Harbor spatially. Information about what activities participants do in the Harbor was gathered to learn about the frequency and location of activities being done in the Harbor. Also, a survey was used to see how different participants value the Harbor to see if there were conflicts between the different population groups.

1.1 Attitudes of Recreational Marine Stakeholders

Attitudes towards the marine environment can differ amongst users, which can lead to conflict. In such a case, the conflict can be understood as "goal interference attributed to one another's behavior." (Gray et al., 2010; Jacob et al., 1980). The definition of a goal is, " any preferred social psychological, or physical outcome of a behavior that provides incentive for that behavior" (Gray et al., 2010; Gramman et al.,1981). For conflict to occur between users there must be, "direct or indirect contact between individuals or activities, and that one individual attributes his or her lack of goal attainment to anothers' behavior" (Gray et al., 2010). For example, sailboat owners and powerboat owners have been shown to value marine space differently (Gray et al., 2010). Conflicts among marine users for resources has also been seen between anglers and divers, (Lynch et al., 2004) recreational and commercial fishers (Lynch et al., 2004; Ruello et al.,1977; Murray-Jones et al., 2000), and management agencies and anglers (Lynch et al., 2004; Churchill et al., 2002).

Conflict amongst the different population groups found in Provincetown is possible because they might have different attitudes towards different uses in

Provincetown Harbor including shellfish aquaculture development in the Harbor. Thus for this study, it was vital to understand the setting preferences these users have towards the Harbor, their attitudes towards shellfish aquaculture, and what areas of the Harbor they use. This evaluation will allow for the identification of possible conflict amongst user groups and the measurement of the level of support for the development of shellfish aquaculture in the Harbor (Whitemarsh et al., 2006).

1.2 Marine Spatial Planning (MSP)

Marine spatial planning (MSP) that includes stakeholder engagement throughout the process potentially allows for an accurate evaluation of how different stakeholders are using an area (Gilliland et al., 2008). Evaluation of the social use of marine space, rather than just the biological and biophysical aspects of it, allows for a better understanding of how humans use a marine space (Dalton et al., 2010). The allocation of limited marine space historically has been based on a sector-by-sector basis focusing on individual activities and not how they interact with one another. However, coastal managers have started to utilize different aspects of MSP to focus more on ecosystem-based management (EBM) (Koehn et al., 2013; Kidd, 2012; Balaguer et al., 2011; Douvere 2008; Ehler 2008). The use of MSP in a spatially limited marine space allows for controversies and conflicts to be identified or forseen before new activities are introduced.

To understand how recreational users were using the Harbor, participatory mapping can be used to allow participants to draw on the map where they use particular parts of the Harbor (Yates et al., 2013). The use of a participatory mapping procedure produces strong data because the stakeholder feels like they have an impact on the study

(Yates et al., 2013). Involving stakeholders in a participatory mapping exercise was important because it generated spatial pattern information. This information allows managers to efficiently maximize benefits and minimize conflicts (Yates et al., 2013; Brody, 2003; Reed et al., 2008; Beierle, 2002; Koontz, 2006; Newig, 2007). Thus, participatory mapping was used to evaluate the usage patterns of users in Provincetown Harbor because it allowed for highly used areas to be identified.

1.3 Shellfish Aquaculture Activity in Provincetown

Within the current management and regulation structure, any resident from Provincetown can lease a 1-acre water space from the town for $25 (Provincetown, 2012). [1]

The State of Massachusetts has already designated areas within the inner part of Provincetown Harbor as acceptable shellfish aquaculture areas (Massachusetts Division of Marine Fisheries Shellfish Sanitation and Management, 2013). The Shellfish Constable in Provincetown is the local authority that oversees all the shellfish activities in the Town. The depths that are deemed allowable for shellfish aquaculture farms are approximately in 20-30 feet of water (Wisbauer, 2015). Aquaculture farms are restricted

[1] Application Process: "First-time Aquaculture License applications shall be approved for a two (2) year period. The Aquaculture License holder shall provide information concerning Aquaculture License activities. An effort toward production is required. First renewals shall be for an additional two (2) year period. Subsequent Aquaculture License renewals may be made for five (5) year periods. Renewal applications for established Aquaculture Licenses may be requested during the second year of operation. Renewal applications for established Aquaculture Licenses may be made at any time following the first three (3) years prior to the end of the five (5) year Aquaculture License period" (Provincetown, 2012).
Renewal Process: "… shall be subject to approval by the Board of Selectmen, with recommendations from the *Shellfish Committee* and Shellfish Department. Each Aquaculture License shall be reviewed annually by the Shellfish Committee and Shellfish Constable, involving a review of the Aquaculture License holder's yearly production report. Aquaculture License activity shall include the planting of hatchery-derived shellfish, or the capture and grow-out of wild-larvae of any indigenous shellfish species as provided by Massachusetts General Law" (Provincetown, 2012).

to these depths because it does not interfere with eelgrass beds or lobster fishing activity (Wisbauer, 2015). Recently, the Town and its Shellfish Constable are interested in expanding this practice in similar depths of 20-30 feet (Wisbauer, 2015). The expansion would encourage growers to spread their activities out in the designated 20-30 feet depths found in the Harbor.

The gear types that are seen throughout the Harbor today vary. The gear types that are dominant in the Harbor are floating cages and submerged benthic cages. Between the two different gear types, floating cages are the most abundant in Provincetown Harbor. The positives of having floating cages is that the food is abundant, and the cleaning and care for the shellfish is easy (Morse, 2015). The positives for using submerged benthic cages is that there is lower cost and higher efficiency yet there is also more possibility to lose shellfish due to predation or other causes (Morse, Dana L., 2015).

In Provincetown, Massachusetts, local fishermen and town officials are interested in increasing shellfish aquaculture (Wisbauer, 2015; McKinsey, 2015). The reason the Town is interested in the development of this industry is due to the increase restrictions on traditional fishing. (Woods Hole Institute, 2010).

1.4 Study Objectives

The main objective of this study was to identify if there would be any conflict between recreational users and the expansion of shellfish aquaculture within Provincetown Harbor. The study also aimed to identify if recreational users use and value the Harbor differently from each other. This was achieved by studying the values, activity frequency, and spatial use of the different recreational users of Provincetown Harbor.

CHAPTER TWO

METHODS

2.1 Study Area

The study area for this research is Provincetown Harbor, which is located in Cape Cod Bay, Massachusetts. Provincetown Harbor is the northernmost harbor found on Cape Cod and serves as a fishing port and a recreational destination. Provincetown Harbor is approximately 3.3 miles in length and 1.3 miles wide (measured using Arc GIS).

In the winter, 3,065 residents live in Provincetown. In the summer the population balloons to 60,000 people (Town of Provincetown, 2014). This massive population fluctuation has caused the Town to focus its economy on the tourism industry. According to the 2010 Census, over half of the housing (52.8%) in the Town consists of seasonal, recreational, or occasional use housing (U.S. Census, 2010). With such a large part of the population not living in the Town for the majority of the year, Provincetown's local management strategies and regulations must address the seasonal residents as well as the year round residents. This poses an interesting issue when trying to develop economic opportunities in the Town. Tourists, seasonal residents and year round residents have to be taken into account, and trying to balance everyone's potentially divergent interests might be difficult.

The collection of data was done in five key locations. The researcher chose the locations so he could encounter the most users of the Harbor. The six locations were: two town beaches, the town boat ramp, two marinas (Provincetown Marina and Flyers), and

the town pier (MacMillan Pier). These six locations were chosen based on their accessibility to the Harbor. All six locations are areas in which recreational users access the Harbor from land.

2.2 Study Sample Population

Surveys were administered to recreational users of Provincetown Harbor. Recreational users were categorized into four categories of users, as defined by the Town's Public Pier Corporation: residents, non-residents, occupants, and visitors in Provincetown Harbor. Residency status was determined using the Town's legal definitions of the different resident statuses. The definitions are as follows:

(1) Residents- Defined as, " any registered voter in the Town of Provincetown."

(2) Non-Resident Taxpayer- Defined as, " any natural person owning real estate in the Town of Provincetown but who is not a Resident."

(3) Occupant- Defined as, " any natural person who lives in the Town of Provincetown six months of the calendar year or more but who is not a Resident or Non-Resident Taxpayer." (Provincetown Public Pier Corporation, 2014)

(4) Visitor- Anyone who does not fit within these categories.

These legal definitions were used to identify summer recreational harbor users. It was used because it symbiotically satisfied the need to identify different harbor users while following the legal definitions the Public Pier Corporation established.

2.3 Survey Design

Data for this study was collected through the use of a face-to-face survey. The surveys were given to the participants to fill out. If questions arose, the researcher was available to answer them. The survey had four sections. Each section is evaluated and explained separately below.

2.3.1 Section 1

Section one consists of questions that identify the participant's residency classification as well as activities they participate in within Provincetown Harbor.

The second part of section one asked respondents to rate how frequently they participate in certain activities within Provincetown Harbor. The participant was given a list of activities and asked to rate how frequently they partake in those activities using a four-point scale (1=Never, 2=Rarely, 3=Occasionally, 4=Frequently). The list included water-based recreation, fishing and shellfish activities. If respondents engaged in an activity that was not on the provided list, an "other" category was provided which allowed participants to openly write activities.

2.3.2 Section 2

The purpose of section two was to understand what participant's value when they use the Harbor. This section lists ten setting preferences that users may find important to their use of the Harbor. These ten setting preferences have also been used in another study (Gray et al., 2010). Following Gray et al. (2010) these ten setting preferences were

categorized by three main themes: extractive activity, nature/environment, and quiet/solitude. In order to test the reliability of grouping the ten setting preferences into the three main themes, Cronbach's Alpha testing was administered.

The responses on the importance of the ten setting preferences were developed using a Recreation Opportunity Spectrum (ROS) framework. The ROS is established on the basis that recreation experience is directly related to recreation settings, which can be defined by different combinations of environmental, social, and managerial factors (Gray et al., 2010;Driver et al., 1978; Clark et al., 1979). The responses to the ten setting preferences questions are based on a four-point scale (1=not at all important, 2=slightly important, 3= somewhat important, 4= very important) that measured the factors that respondents deemed important to their marine uses (Gray et al., 2010).

2.3.3 Section 3

Section three consisted of two open-ended questions and one closed-ended question. The two open-ended questions asked for the respondent's attitudes concerning shellfish aquaculture in general and whether they supported or opposed the development of shellfish aquaculture in Provincetown Harbor specifically. These questions allowed the participants to speak freely on their beliefs and ideas on shellfish aquaculture as a whole and in Provincetown Harbor.

The last question in this section in the survey asked participants to identify their level of support with shellfish aquaculture development in Provincetown Harbor using a four-point scale (1=Strongly Disagree, 2=Slightly Disagree, 3= Slightly Agree, 4=Strongly Agree).

2.3.4 Section 4

Section four contained a map that participants were asked to draw on to identify areas that they use most in the Harbor. The map consisted of the NOAA nautical map of Provincetown Harbor. In order to make the map user friendly and area specific, adjustments were made using the computer program ArcGIS. To allow for easy identification for participants, the researcher marked specific landmarks that were easily identifiable by users. The two identifiers used were Town Hall and Long Point Lighthouse. These landmarks are highly recognizable and are at different locations within the Harbor, which allows for different areas in the Harbor to be more easily identified. To increase the ability of the user to identify areas of use, the NOAA nautical map of the Harbor was used. This map depicts the bathymetry and depths of the Harbor. This is important because many of the participants' uses could be dependent on the bathymetry and depth of certain areas in the Harbor. The participants were allowed to mark the map as many times as they liked and each marking on the map was valued equally. This means that no matter where the participant marked the map, each marking was treated as being equally important.

2.4 Data Collection

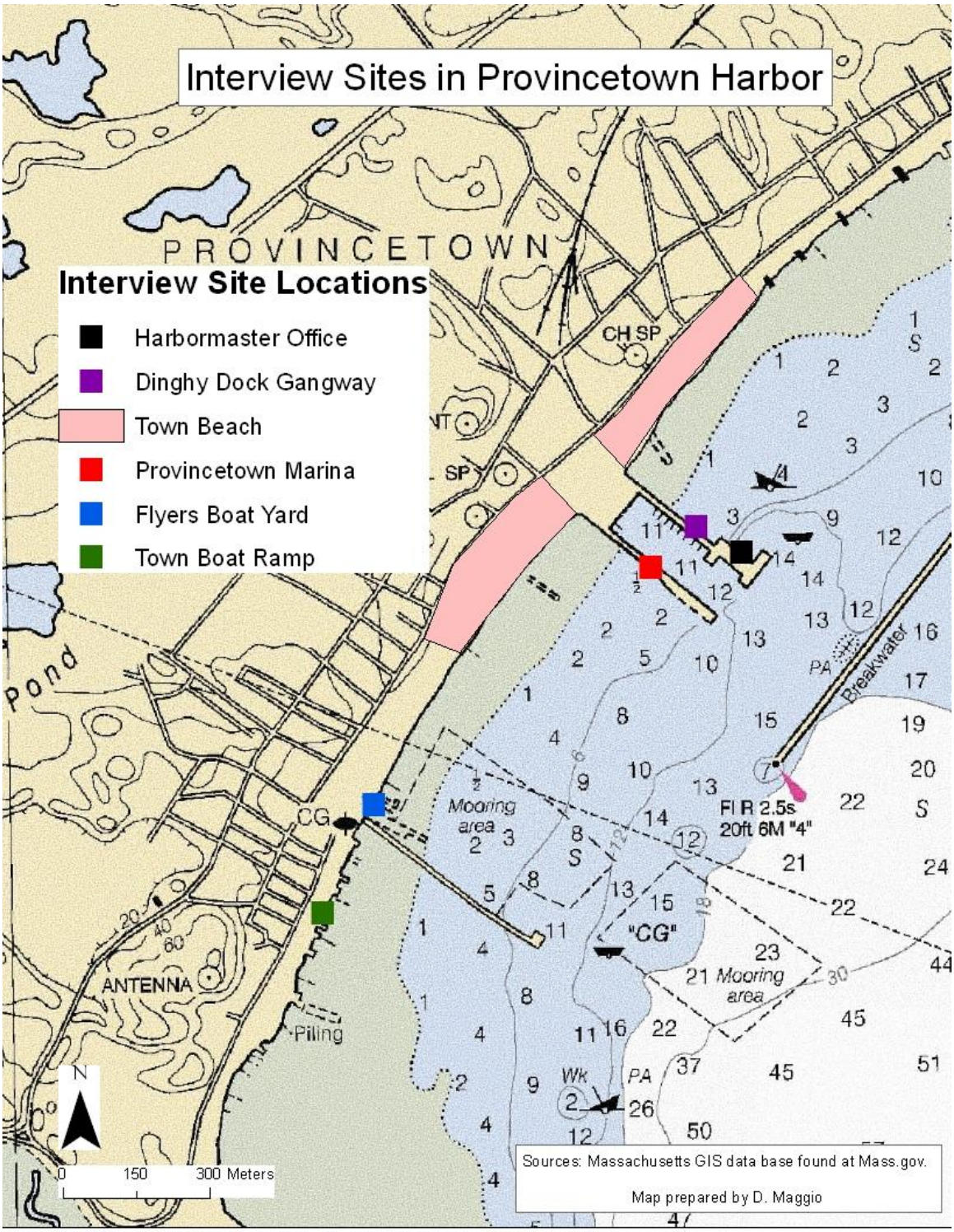
Data collection took place July 30, 2014 to August 23, 2014 and it followed a strict schedule. The data collection schedule included eight days at each of the four selected sites. Eight sampling days were chosen at each site because it followed a related study that sampled a total of six sites for eight days each (Gray et al., 2010). In order to avoid

selection bias the survey was only offered to every third person encountered. To be able to identify every third person, certain techniques at each of the four chosen study sites were developed and will be discussed below.

2.4.1 Location

For this study four interview sites were chosen. The four interview sites were MacMillan Pier (harbormaster office, dinghy dock gangway, town beaches), Provincetown Marina, Flyers Boat Yard and the Town boat ramp (Figure 1).

Figure 1: Interview Sites



2.4.2 Work Schedule

While conducting research, the researcher was employed full time as an Assistant Harbormaster in Provincetown. The work schedule consisted of a 40-50 hour workweek. The work schedule was as follows: Sunday-Monday 3pm- 11pm, Tuesday-Wednesday off and Thursday-Saturday 8am- 4pm. This was the scheduled workweek but if emergencies arose the schedule would change. Consequently, the schedule for my research had to be built around this work schedule.

2.4.3 Methods Used to Develop Research Schedule

The researcher attempted to survey on days that he was not working as a harbormaster; because the researcher was working up to 50 hours a week, he conducted most of his research at the interview site MacMillan Pier while working. The researcher made sure to survey at each location at least once on each day of the week. Since there were 8 sampling days per location, repetition of a day of the week occurred (e.g. MacMillan Pier was surveyed on two different Tuesdays). The repeated day was chosen randomly by writing the seven days of the week on separate pieces of paper and pulling one out of a hat. The researcher developed six time intervals between 8 am-8 pm; 8-10 am, 10 am-12 pm, 12-2 pm, 2-4 pm, 4-6 pm, 6-8 pm. For each sampling day a different time interval was chosen in order to capture the widest variety of uses of the Harbor. Choosing the order of which sites to do and what times to do them was chosen based on convenience and the researchers work schedule. After all of the six possible time intervals ranging

from 8 am-8 pm were scheduled, a new set of two-hour time intervals were chosen from 9 am- 9pm (e.g. original time intervals included 8-10 am and 10 am-12 pm; new time intervals included 9-11 am and 11 am- 1pm). This was done in order to differentiate the time periods and to not repeat similar two-hour time intervals.

2.4.4 Research Schedule for Each Interview Site

The following figures show the different days, times, locations and if research was conducted while working. Each figure is for one of the four interview sites.

Figure 2: MacMillan Pier Interview Site

Date	Time	Day	Specific Location
July 30	8-10 am	Wednesday	Dinghy Dock Gangway
July 31	10 am-12 pm	Thursday	Town Beach
August 4	6-8 pm	Monday	Harbormaster Office
August 5	12-2 pm	Tuesday	Harbormaster Office
August 9	11 am- 1 pm	Saturday	Town Beach
August 10	4- 6 pm	Sunday	Harbormaster Office
August 12	2-4 pm	Tuesday	Dinghy Dock Gangway
August 15	9-11 am	Friday	Harbormaster Office

Figure 2 shows the research periods that were conducted at the interview site, MacMillan Pier. The different sub-locations within the interview location MacMillan Pier were identified in accordance to the dates the research was conducted. Each research period was identified by date, time, day and if research was conducted during time off from work or while working.

Figure 3: Provincetown Marina Interview Site

Date	Time	Day
July 30	10 am-12 pm	Wednesday
July 31	8-10 am	Thursday
August 4	12-2 pm	Monday
August 5	3-5 pm	Tuesday
August 8	2-4 pm	Friday
August 12	4-6 pm	Tuesday
August 16	6-8 pm	Saturday
August 17	1-3 pm	Sunday

Figure 3 shows the research periods that were conducted at the interview site, Provincetown Marina. Each research period was identified by date, time and day

Figure 4: Flyers Boat Yard Interview Site

Date	Time	Day
July 30	12-2 pm	Wednesday
August 1	11 am-1 pm	Friday
August 10	10 am- 12pm	Sunday
August 11	8-10 am	Monday
August 14	2-4 pm	Thursday
August 15	6-8 pm	Friday
August 19	4-6 pm	Tuesday
August 23	9-11 am	Saturday

Figure 4 shows the research periods that were conducted at the interview site, Flyers Boat Yard. Each research period was identified by date, time and day.

Figure 5: Town Boat Ramp Interview Site

Date	Time	Day
July 30	2-4 pm	Wednesday
August 1	4-6 pm	Friday
August 2	12-2 pm	Saturday
August 3	9-11 am	Sunday
August 17	10 am-12 pm	Sunday
August 18	8-10 am	Monday
August 19	6-8 pm	Tuesday
August 21	5-7 pm	Thursday

Figure 5 shows the research periods that were conducted at the interview site, Town Boat Ramp. Each research period was identified by date, time and day.

2.5 Data Collection Strategies

At MacMillan Pier (Town Pier) the Harbormaster office was used as a reference point. The researcher counted the number of people encountered and offered every third person the opportunity to participate in the survey. The Harbormaster office was not the only place on the Town Pier where research was conducted. The alternation of days between the Harbormaster office, the dinghy dock and the town beaches was done. Alternation between these three interview sites was chosen based on the researchers work schedule. The dinghy dock is a dock that is designated for mooring users dinghies and other small boats. In order to access these participants, the researcher sat next to the gangway and asked every third person that walked passed to participate in the survey. The researcher decided to interview at the Harbormaster office and the dinghy dock because it offered a greater opportunity to reach a wide variety of possible participants. Interviewing at the dinghy dock allowed access to recreational users who are going to or coming from their

boats and the Harbormaster offered the opportunity to be in contact with all different varieties of recreational harbor users.

It was much more difficult to count every third person on the town beaches. In order to address this issue the use of the tidal wrack line as a transect line was adopted. The wrack line is a natural occurrence of seaweed and other wrack that mark high tide lines on the beach. For this study, the last storm wrack line was used. This can be identified easily because it is the wrack line that is surrounded by dry sand on both sides and is usually found in the middle of the beach. This wrack line was used as a transect and this allowed the identification of every third person on either side of the transect to be quite easy.

The researcher had limited ability to access the customers at the two privately owned marinas because both companies were interested in keeping their moorings and slips private. In order to address their requests and satisfy the need to access the intended survey participants, the researcher was situated in front of the gangways leading to where their launches dock. A single launch boat could carry up to 15 passengers. In order to ensure every third person was being asked to participate in the study, the researcher only counted people getting off of the launches. The reason this was done was because participants were more eager to participate getting off their boats rather then waiting to go on to their boats. This allowed the researcher to engage the third, sixth and ninth potential participant in a single trip easily.

The final survey site was the town boat ramp. This was definitely the easiest of the study sites in terms of counting every third person. The boat ramp offered an area that bottlenecked users in order for them to use the beach and access the bottom of the boat

ramp. The boat ramp is situated right next to a public beach. To access the beach, a set of stairs was right next to the boat ramp. This allowed the researcher to engage participants at the beach as well as participants at the boat ramp. The ability to count people leaving and entering the boat ramp and the beach was not overwhelming like the privately owned marinas.

2.6 Data Analysis

For data analysis the respondents were reclassified into two categories, locals or visitors. Surveyees that were classified as Locals were based on the Public Pier Corporations definitions for residents, non-resident taxpayers and occupants. These three definitions are based on the criteria that an individual is a registered voter, property owner or lives in Provincetown at least a total of six months of the calendar year. These definitions all indicate that an individual has spent an extended amount of time in Provincetown. For the occupant classification, the researcher did not receive any participants that fell under this definition and therefore it was not in the data analysis. With the lack of occupant participants only residents and non-resident taxpayers were identified as Locals. The visitor classification was created and any participant that was not a registered voter, did not own property or live in Provincetown at least six months of the calendar year was considered a Visitor.

To compare these groups, the program SPSS was used to compute descriptive statistics. This allowed for the identification of which activities and values were ranked the highest amongst all respondents, Locals and Visitors. The researcher used a Mann-

Whitney U test to test for significant differences between Locals and Visitors. This was done for section one, section two, and section three of the survey questions.

For the open-ended questions found in the survey, the researcher coded participant's answers into hierarchical coding trees (Thompson, 2005). Microsoft Excel was used to create the codebook. The nine primary categories were created by reading the participants responses and identifying trends. For each primary category there were sub-categories that make up the primary categories (See Appendix B). The nine primary categories were: environment, culture, regulation, spatial use, economic value, taste, access, lack of knowledge, and no opinion. There were also two sections that identified if the participants supported or opposed shellfish aquaculture. For each response, a participant was able to mention more then one category found in the hierarchical trees that were created.

To develop the codebook for this study, the researcher read the individual responses and when the researcher was unable to code a response a new category was created or a pre-existing one was modified. After a few rounds of doing this independently, the researcher had a fellow graduate student code the responses using the codebook that the researcher created. If the fellow graduate student could not code a response using the pre-existing categories, new ones were made or pre-existing categories were modified. After this was done, the researcher and fellow graduate student compared and discussed their work and the coding scheme was modified until no further changes could be made.

To measure the accuracy and validity of the final codebook, simple agreement was calculated using the formula (# of agreements/#of coding decisions) (Geisler, 2004). The agreement ranged from 83-96%.

The respondents' markings on the paper map were digitized using ArcGIS 10.2 and entered into a geodatabase. Each digitized polygon was coded either as Local or Visitor in order to see if there were differences between the spatial distribution of Local users and Visitor users. In order to identify areas that were marked frequently amongst participants, a polygon co-occurrence tool was used (Honeycutt, 2013). This tool counted the amount of times that each area on the map was covered by a portion of a polygon. This is what allowed for the identification of density of use (See Figure 5, 6, 7). To show accurate use densities in Provincetown Harbor, the data that was produced after using the polygon co-occurrence tool was separated using a natural breaks classification. Natural breaks classification of the data was used because it separated the data into four classes based on similar overlapping polygon frequencies. Using a natural break classification maximized the differences between the data (ESRI, 2015). This allowed for an accurate measurement of the different densities of use in the Harbor.

CHAPTER THREE

RESULTS

3.1 Response rate

The total response rate for this study was a total of 73.53%. Out of 68 surveys that were offered to participants, a total of 18 people chose to not participate. The total number of survey participants was 50 (n=50). For the population group defined Locals, there were a total of 26 (n=26) participants. For the population group defined as Visitors, there were a total of 24 (n=24) participants.

3.2 Activity Frequencies

3.2.1 Activity Frequencies for All Participants

Participants were asked to rate how often they participated in a variety of activities within in Provincetown Harbor using a 1-4 Likert Scale (1= Never, 2= Rarely, 3=Occasionally, 4=Frequently). The activity that was done most frequently for all survey participants was swimming (17) (Table 1). The activities that were found to never be done for all survey participants were lobsterering with traps (42), diving for lobsters (44) and diving (39) (Table 1).

Table 1: Activity Frequencies for All Participants

Activity	n*	Never	Rarely	Occasionally	Frequently
Kayak	45	21 (46.7%)	17 (37.8%)	2 (4.4%)	5 (11.1%)
Powerboat	47	18 (38.3%)	8 (17%)	5 (10.6%)	16 (34%)
Sail	47	31 (66%)	3 (6.4%)	8 (17%)	5 (10.6%)
Fish From Shore	47	36 (76.6%)	5 (10.6%)	4 (8.5%)	2 (4.3%)
Lobster Dive	47	44 (93.6%)	0 (0%)	0 (0%)	3 (6.4%)
Stand-Up Paddleboard	48	38 (79.2%)	5 (10.4%)	3 (6.3%)	2 (4.2%)
Gather Shellfish	48	36 (75%)	4 (8.3%)	4 (8.3%)	4 (8.3%)
Lobster Trap	48	42 (87.5%)	1 (2.1%)	2 (4.2%)	3 (6.3%)
Fish From Boat	49	31 (63.3%)	5 (10.2%)	5 (10.2%)	8 (16.3%)
Dive	49	39 (79.6%)	6 (12.2%)	1 (2%)	3 (6.1%)
Swimming	50	9 (18%)	9 (18%)	15 (30%)	17 (34%)

*n varies due to the fact that not all respondents answered every question

3.2.2 Activity Frequencies for Locals

The activities that were found to be most popular amongst Locals were power boating (14) and swimming (21) (Table 2). The activities that were found to be the least popular amongst Locals were stand-up paddle boarding (25), lobster trapping (23) and diving for lobsters (23) (Table 2). Swimming was the only activity that the majority of Locals occasionally to frequently participate in (21) (Table 2). Locals suggested that they occasionally to frequently participate in power boating (14), while sailing was found to be an activity that Locals (20) never to rarely do in Provincetown Harbor (Table 2).

Table 2: Activity Frequencies for Locals

Activity	n*	Never	Rarely	Occasionally	Frequently
Sail	25	19 (76%)	1 (4%)	3 (12%)	2 (8%)
Kayak	25	10 (40%)	10 (40%)	2 (8%)	3 (12%)
Lobster Dive	25	23 (92%)	0 (0%)	0 (0%)	2 (8%)
Powerboat	26	10 (38.5%)	2 (7.7%)	3 (11.5%)	11 (42.3%)
Swimming	26	2 (7.7%)	3 (11.5%)	9 (34.6%)	12 (46.2%)
Fish From Shore	26	19 (73.1%)	4 (15.4%)	2 (7.7%)	1 (3.8%)
Fish From Boat	26	17 (65.4%)	4 (15.4%)	0 (0%)	5 (19.2%)
Dive	26	20 (76.9%)	3 (11.5%)	1 (3.8%)	2 (7.7%)
Stand-Up Paddleboard	26	20 (76.9%)	5 (19.2%)	0 (0%)	1 (3.8%)
Gather Shellfish	26	17 (65.4%)	1 (3.8%)	4 (15.4%)	4 (15.4%)
Lobster Trap	26	22 (84.6%)	1 (3.8%)	2 (7.7%)	1 (3.8%)

*n varies due to the fact that not all respondents answered every question

3.2.3 Activity Frequencies for Visitors

The majority of Visitors suggested that they never to rarely participate in the listed 11 activities (Table 3). The two activities found to be done the least by Visitors was lobstering using traps (20) and diving for lobster (21) (Table 3). Swimming received the highest amount of Visitors that suggested they occasionally to frequently swim in Provincetown Harbor (11) (Table 3). The data suggests that Visitors occasionally to frequently sail more (8) than Locals do (5) (Table 2 and Table 3). When compared to Locals, the data suggests that Locals (14) tend to occasionally to frequently powerboat in the Harbor more than Visitors do (7) (Table 2 and Table 3).

Table 3: Activity Frequencies for Visitors

Activity	n*	Never	Rarely	Occasionally	Frequently
Kayak	20	11 (55%)	7 (35%)	0 (0%)	2 (10%)
Powerboat	21	8 (38.1%)	6 (28.6%)	2 (9.5%)	5 (23.8%)
Fish From Shore	21	17 (81%)	1 (4.8%)	2 (9.5%)	1 (4.8%)
Sail	22	12 (54.5%)	2 (9.1%)	5 (22.7%)	3 (13.6%)
Stand-Up Paddleboard	22	18 (81.8%)	0 (0%)	3 (13.6%)	1 (4.5%)
Gather Shellfish	22	19 (86.4%)	3 (13.6%)	0 (0%)	0 (0%)
Lobster Trap	22	20 (90.9%)	0 (0%)	0 (0%)	2 (9.1%)
Lobster Dive	22	21 (95.5%)	0 (0%)	0 (0%)	1 (4.5%)
Fish From Boat	23	14 (60.9%)	5 (21.7%)	1 (4.3%)	3 (13%)
Dive	23	19 (82.6%)	3 (13%)	0 (0%)	1 (4.3%)
Swimming	24	7 (29.2%)	6 (25%)	6 (25%)	5 (20.8%)

*n varies due to the fact that not all respondents answered every question

3.2.4 Comparison of Activities for Locals and Visitors

Table 4 compares Locals and Visitors in the activities they do in Provincetown Harbor. The majority of activities did not have any significant statistical differences between Locals and Visitors. However, the two activities that did show a significant difference between Local and Visitor participants was swimming and gathering shellfish (Table 4). The significant difference between Local and Visitor survey participants was Locals swim more than Visitors do in the Harbor ($U=185$, $n_1=26$, $n_2=24$, $p= .01$) (Table 4). Gathering shellfish did show a significant difference but it is not a large enough difference to claim that either population group differs in this activity ($U= 214$, $n_1=26$, $n_2=22$, $p=.05$) (Table 4).

Table 4: Comparison of Activities for Locals and Visitors

Activity	Locals		Visitors		*p value*	U statistic
	n_1*	Median	n_2*	Median		
Swimming	26	3[a]	24	2[a]	.010	185
Gather Shellfish	26	1[a]	22	1[a]	.050	214
Sail	25	1	22	1	.145	217.5
Kayak	25	2	20	1	.285	207
Powerboat	26	3	21	2	.397	235.5
Dive	26	1	23	1	.578	279.5
Lobster Trap	26	1	22	1	.589	271
Fish From Shore	26	1	21	1	.623	256
Lobster Dive	25	1	22	1	.632	265.5
Stand-Up Paddleboard	26	1	22	1	.872	280.5
Fish From Boat	26	1	23	1	.898	293.5

*n_1 and n_2 vary due to the fact that not all respondents answered every question
[a] denotes significant difference between locals and visitors

3.3 Setting Preferences

3.3.1 Comparison Between Locals and Visitors for Setting Preferences

Local respondents showed that they value extractive activities within the Harbor (U=186, n_1=26, n_2=24, p=.013) (Table 5). Visitor respondents showed that they do not value extractive activities within the Harbor (U=186, n_1=26, n_2=24, p=.013) (Table 5). Comparing the importance of extractive activities between Local and Visitor participants, the data shows that Locals find it to be more important than Visitors do. This may explain why a significant difference was found between Locals and Visitors in the frequency in which they gather shellfish in the Harbor (U=214, n_1=26, n_2=22, p=.050) (Table 4). This could also influence the support level for Locals and Visitors on the expansion of shellfish aquaculture in Provincetown Harbor. Since Locals value having extractive

activities in the Harbor more than Visitors do, this could support why Locals more strongly support the development of shellfish aquaculture ($U=168$, $n_1=25$, $n_2=22$, $p=.011$) (Table 7).

Both Local and Visitor respondents showed that they value nature/environment qualities found in Provincetown Harbor ($U=184$, $n_1=26$, $n_2=24$, $p=.006$) (Table 5). Although both Locals and Visitors found this to be an important preference setting, Locals found it to be more important than Visitors did ($U=184$, $n_1=26$, $n_2=24$, $p=.006$) (Table 5). Since the nature/environment setting preference holds importance for Locals and Visitors, shellfish aquaculture activities may interfere. The expansion of shellfish aquaculture in the Harbor may affect the natural scenery, and it will introduce development. Both of these values are found in the nature/environment setting preference was valued by both Locals and Visitors. Thus, the development of shellfish aquaculture could possibly conflict with Locals and Visitors value of nature/environmental setting preferences.

The final significant difference between Locals and Visitors is the setting preference of being away from other boaters. Local survey respondents found this setting preference to be very important, while the Visitor survey respondents found this not to be important ($U=82$, $n_1=26$, $n_2=24$, $p=.000$) (Table 8). If the development and expansion of shellfish aquaculture does occur in Provincetown Harbor, Locals might find it harder to be away from other boaters due to increased fishing activity.

Table 5: Comparison Between Locals and Visitors for Setting Preferences

Variable	Locals		Visitors		*P*	U
	n*	Median	n*	Median	*value*	statistic
Extractive Activities: (α=.905) Catching Fish Gather Shellfish Lobstering	26	3[a]	24	1.67[a]	.013	186
Nature/Environment: (α=.765) Viewing Natural Scenery Clean/Unpolluted Water Viewing Marine Wildlife Seeing Undeveloped Shoreline	26	4[a]	24	3.75	.006	184
Quiet/Solitude: (α=.313)*						
Being Away From Other Boaters	26	4[a]	24	2[a]	.000	82
Being in a Peaceful, Quiet Place	26	4	24	4	.116	247
Being Around Other Boaters	25	2	24	2	.225	242

*n varies due to the fact that not all respondents answered every question

*α The reliability for the quiet/solitude setting preference group was extremely low. For this reason, the individual setting preferences was individually compared using a Mann-Whitney U test. From a previous study, the quiet/solitude category received an α=0.57 (Gray et al., 2010).

[a] denotes significant difference between locals and visitors

3.4 Quantitative Data: Shellfish Aquaculture

3.4.1 Support/Opposition to Shellfish Aquaculture Development in Provincetown Harbor for All Participants

The majority (26) of participants strongly agreed that shellfish aquaculture should be further developed in Provincetown Harbor and very few (2) strongly disagreed (Table 6). The majority (22) of Locals slightly to strongly agreed with shellfish aquaculture development in Provincetown Harbor (Table 6). The majority of Visitors (18) slightly agreed to strongly agreed with shellfish aquaculture development in the Harbor (Table 6). Overall, both Locals and Visitors support the expansion of shellfish aquaculture in Provincetown Harbor.

Table 6: Support/Opposition to Shellfish Aquaculture Development in Provincetown Harbor for All Participants

n*	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
All respondents (n=47)	2 (4.3%)	5 (10.6%)	14 (29.8%)	26 (55.3%)
Locals (n=25)	2 (8%)	1 (4%)	3 (12%)	19 (76%)
Visitors (n=22)	0 (0%)	4 (18.2%)	11 (50%)	7 (31.8%)

*n varies due to the fact that not all respondents answered every question

3.4.2 Comparison of Level of Support for Shellfish Aquaculture in Provincetown Harbor of Locals and Visitors

The results show that there was a significant difference between Locals and Visitors with their support of shellfish aquaculture development in Provincetown Harbor (Table 7). Local survey respondents (25) more strongly support the expansion of shellfish aquaculture in Provincetown Harbor more than Visitors ($U=168$, $n_1=25$, $n_2=22$, $p=.011$) (Table 7). Visitor survey respondents (22) slightly agreed with the expansion of shellfish aquaculture in Provincetown Harbor ($U=168$, $n_1=25$, $n_2=22$, $p=.011$) (Table 7). Although

there was a significant difference found between Local and Visitor respondents, the data supports that the majority (40) (Table 6) of recreational users support the expansion of shellfish aquaculture in Provincetown Harbor ($U=168$, $n_1=25$, $n_2=22$, $p=.011$) (Table 7).

Table 7: Comparison of Level of Support for Shellfish Aquaculture in Provincetown Harbor of Locals and Visitors

Variable	Locals		Visitors		*P value*	U statistic
	n*	Median	n*	Median		
Support/Opposition	25	4[a]	22	3[a]	.011	168

*n In this table n varies because they are different n's
*p values refers to the statistical significance of a Mann-Whitney U test
[a] denotes significant difference between locals and visitors

3.5 Qualitative Data: Shellfish Aquaculture

3.5.1 Open Ended Responses for General Shellfish Aquaculture Practices

These responses are for the first open-ended question, which asked participants to express their thoughts on the practice of shellfish aquaculture. The majority of Locals (17) indicated general support towards shellfish aquaculture (Table 8). The majority of Visitors (14) indicated general support towards shellfish aquaculture (Table 8). Both Locals (6) and Visitors (7) mentioned that there was economic value in shellfish aquaculture (Table 8). Survey participants clearly emphasized the positive economic value that general shellfish aquaculture activities offer. It was also found that Locals (6) and Visitors (7) mentioned that shellfish aquaculture could have positive environmental implications (Table 8).

Table 8: Hierarchical Coding Tree for All Participants Regarding the Opinions of General Shellfish Aquaculture

Locals	Visitors
Environment *Positive* (6) *Negative* (3)	Environment *Positive* (3) *Negative* (1)
Culture (1)	Culture (1)
Regulation (3)	Regulation (1)
Spatial Use *Positive (1)* *Negative (1)*	Spatial Use *Positive* (0) *Negative* (2)
Economic Value *Positive* (6) *Negative* (1)	Economic Value *Positive (7)* *Negative (0)*
Taste (1)	Taste (0)
Access (1)	Access (0)
Lack of Knowledge (1)	Lack of Knowledge (3)
No Opinion (4)	No Opinion (4)
Support (17)	Support (14)
Opposition (1)	Opposition (1)

*Within each coding subject there were sub-categories to make coding easier. See Appendix.

3.5.2 Open Ended Responses for Shellfish Aquaculture Development in Provincetown Harbor

These responses are for the second open-ended question, which asked participants to express their thoughts on the practice of shellfish aquaculture in Provincetown Harbor (Table 9). The majority of Locals (16) indicated general support towards the practice of shellfish aquaculture in Provincetown Harbor (Table 9). The majority of Visitors (12) indicate general support towards the practice of shellfish aquaculture in Provincetown Harbor (Table 9). Both Locals (6) and Visitors (5) expressed the possibility of spatial conflict (Table 9). Locals (8) and Visitors (3) also indicated that there could be positive environmental impacts caused by the further development of shellfish aquaculture (Table 9). Proper regulation on the further development of shellfish aquaculture in Provincetown

was equally mentioned by Locals (3) and Visitors (3) (Table 9). The data suggests that both Locals and Visitors support shellfish aquaculture activities in Provincetown Harbor. The one concern that is shared by both recreational user groups was the possibility of conflict between pre-existing uses and shellfish aquaculture in the Harbor.

Table 9: Hierarchical Coding Tree for All Participants Regarding to Participants Thoughts Towards Shellfish Aquaculture in Provincetown Harbor

Locals	Visitors
Environment *Positive* (8) *Negative* (3)	Environment *Positive* (3) Negative (1)
Culture (1)	Culture (0)
Regulation (3)	Regulation (3)
Spatial Use *Positive* (1) *Negative* (6)	Spatial Use *Positive* (1) *Negative* (5)
Economic Value *Positive (3)* *Negative (0)*	Economic Value *Positive (0)* *Negative (0)*
Taste (0)	Taste (1)
Access (1)	Access (0)
Lack of Knowledge (1)	Lack of Knowledge (1)
No Opinion (3)	No Opinion (6)
Support (16)	Support (12)
Opposition (5)	Opposition (3)

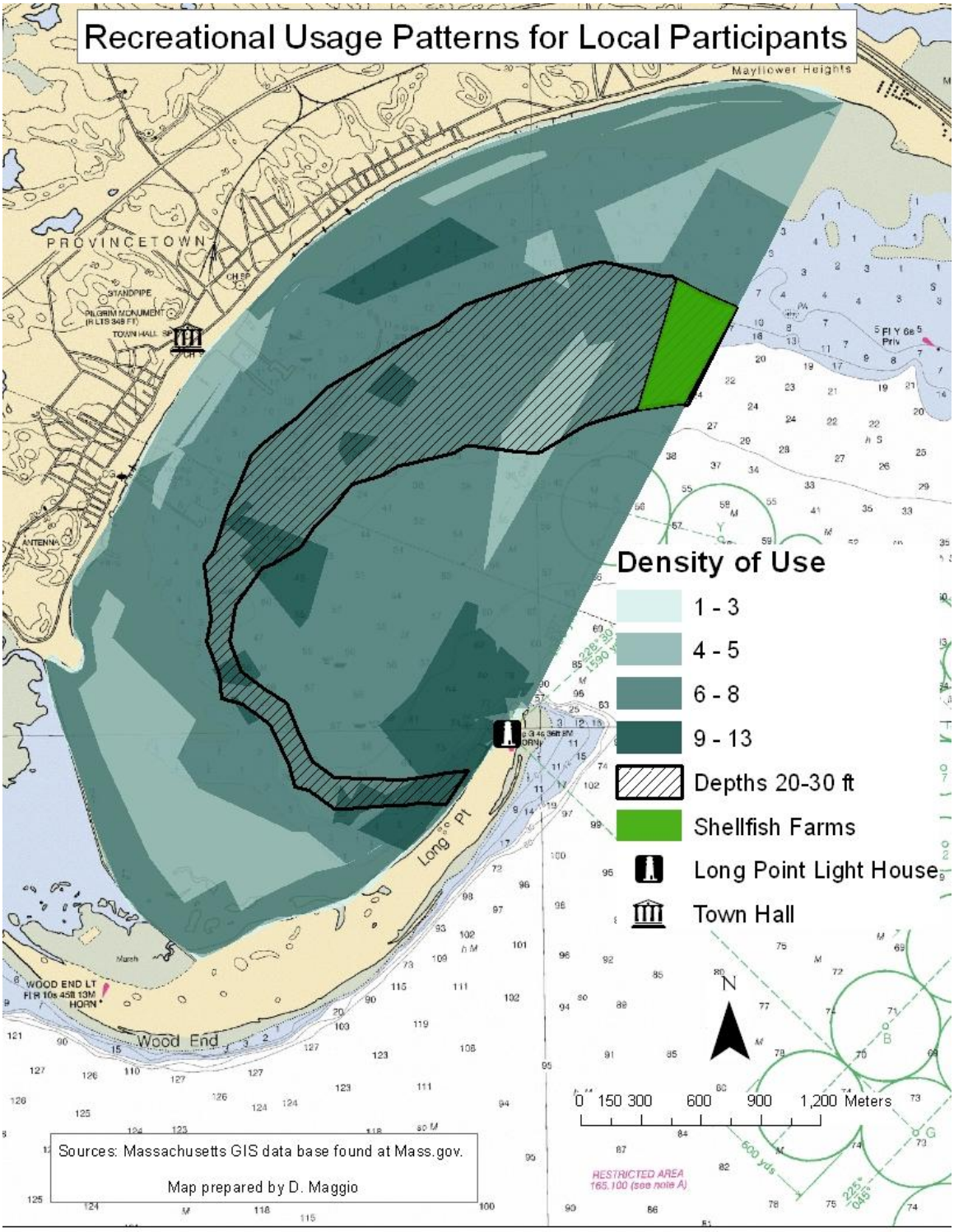
*Within each coding subject there were sub-categories to make coding easier. See Appendix.

3.6 Participatory Mapping

3.6.1 Recreational Usage Patterns for Locals

In Figure 6 the map illustrates all the areas of use that Locals marked within the Harbor. The green shaded area that was designated as shellfish farms illustrates the general location that current shellfish aquaculture activities are presently being done. Locals tended to use the majority of the Harbor (Figure 6). Spatial conflict with pre-existing shellfish aquaculture activities was found. If the expansion of shellfish aquaculture farms occurs Local usage patterns will continue to be conflicting.

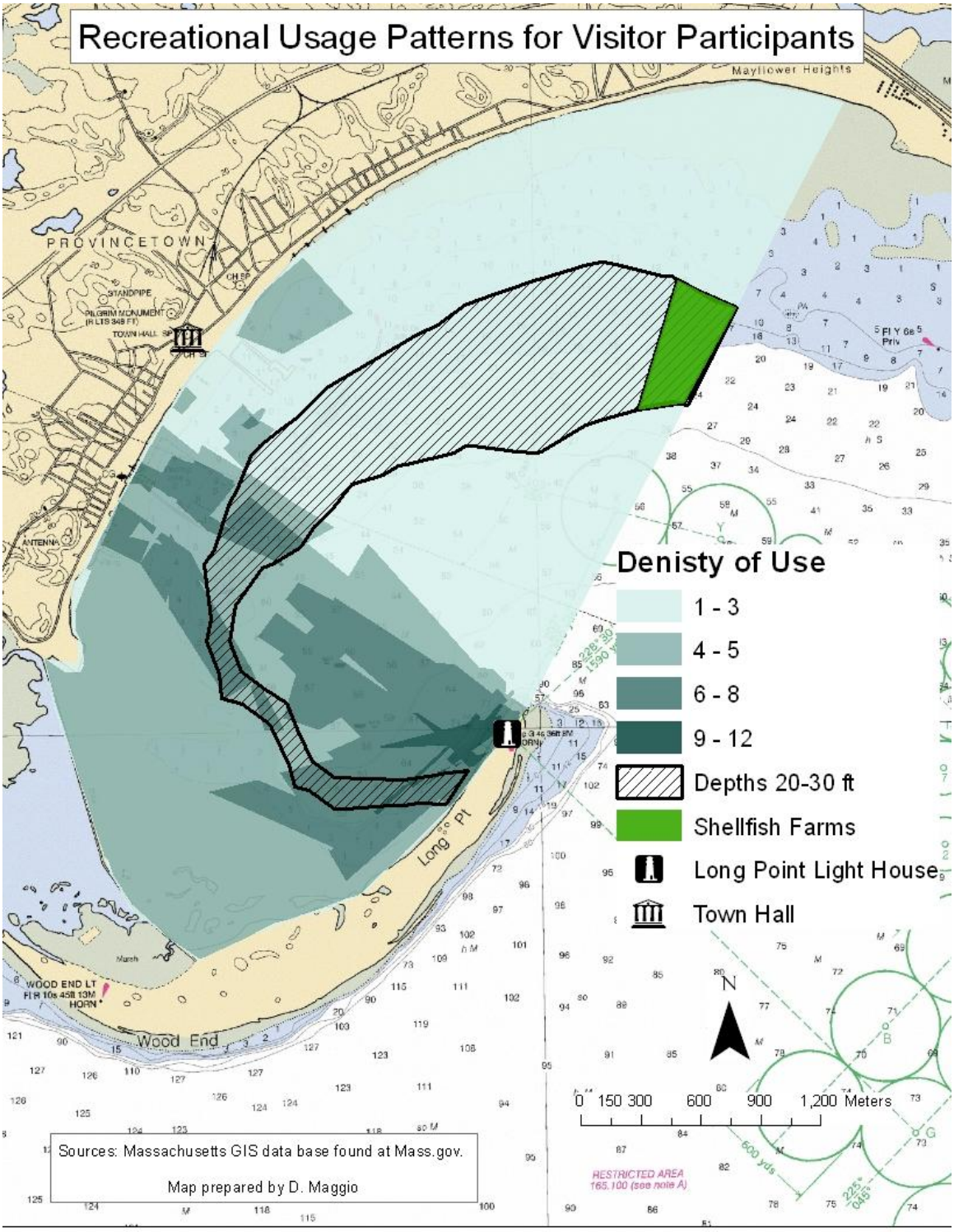
Figure 6: Recreational Usage Patterns for Locals



3.6.2 Recreational Usage Patterns for Visitors

In Figure 7 the map illustrates that Visitors tend to primarily use the west end of the Harbor (Figure 7). Both Visitors and Locals usage densities were highest in the west end of the Harbor (Figure 6 and Figure 7). Visitors usage densities differ in the Northeast section of the Harbor. Visitors indicated that they use this section of the Harbor significantly less than Locals do (Figure 6 and Figure 7). Spatial conflict with existing shellfish aquaculture farms was not found and the expansion of the practice would not interfere with Visitor usage patterns (Figure 7).

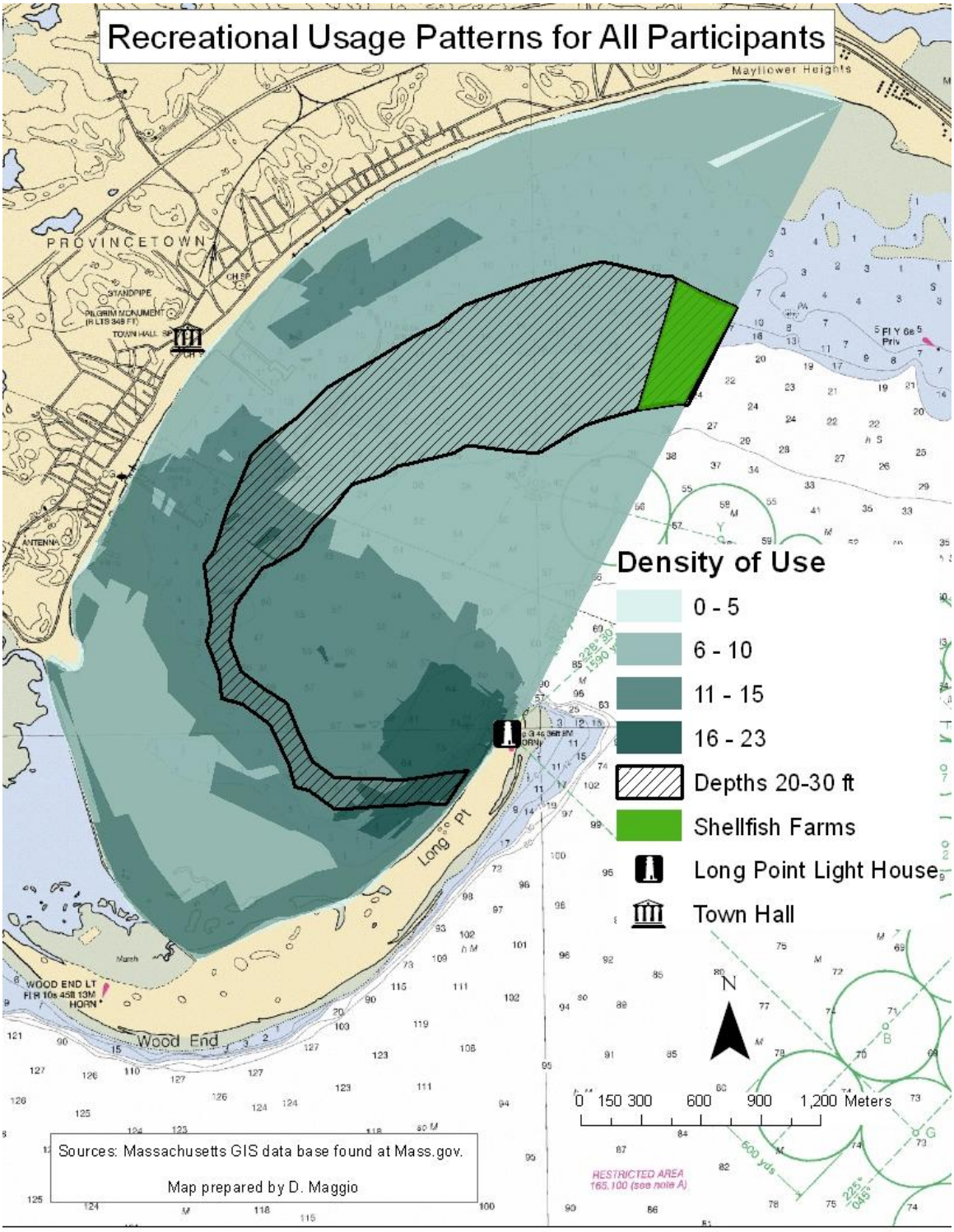
Figure 7: Recreational Usage Patterns for Visitors



3.6.3 Recreational Usage Patterns for All Participants

In Figure 8 all of the survey participants markings on the participatory map are shown. The area that is most heavily used by all participants was the west end of the Harbor (Figure 8). The area that is least used by all participants was the east end of the Harbor. A high amount of spatial conflict was not found with existing shellfish aquaculture activity.

Figure 8: Recreational Usage Patterns for All Participants



CHAPTER FOUR

DISCUSSION

4.1 Setting Preferences and Participants Values

It was found that Locals put more emphasis on having the ability to extract resources from the Harbor. With the introduction of shellfish aquaculture, and the plan to expand the practice, Locals seem inclined to support it.

Visitor responses indicated that they do not value extractive activities as much as Locals did. With the proposed increase in development of shellfish aquaculture in the Harbor, Visitors may not value this activity as highly as Locals may and hence they seem to be less inclined to support it.

Locals found it very important to be away from other boaters in comparison to Visitors who found that being away from other boaters was slightly important. This could explain why the Locals were much more widely distributed in their usage patterns in the Harbor. With the introduction of more shellfish aquaculture activity, an increase of shellfish aquaculture commercial fishing activities will occur. An increase of shellfish aquaculture commercial fishing activities will increase the amount of boat traffic in the Harbor. The ability for Locals to be away from other boaters in the Harbor will become more difficult. Even though there is current support, this might be where conflict can arise.

As previously found in Gray et al., (2010), both Locals and Visitors found the nature/environment setting preferences very important. This finding could lead to

potential issues for the expansion of shellfish aquaculture. Recreational users clearly indicated they value nature/environment setting preferences which include: viewing natural scenery, clean/unpolluted water, viewing marine wildlife and seeing undeveloped shoreline. Development of shellfish aquaculture in Provincetown Harbor may conflict with this highly valued setting preference. Ways to address this would be further research on the available gear types and how they will affect the natural aesthetics of the Harbor. The data suggests that if submerged benthic cages were used, most potential conflicts could be avoided. The issue of spatial conflict with pre-existing uses would be reduced if the aquaculture cages were not on the surface of the water. The highly valued nature/environment setting preferences would also be maintained if the aquaculture activities were on the sea bottom.

4.2 Support and Other Concerns

The data supports that both Locals and Visitors support the general practice of shellfish aquaculture and the development of shellfish aquaculture. This suggests that increasing the development of shellfish aquaculture could be possible.[2] All recreational users of the Harbor mentioned the economic value that shellfish aquaculture generates. All recreational users also mentioned the positive environmental impacts that shellfish aquaculture development can have in Provincetown Harbor. This can be related to the high value recreational users placed on the nature/environment setting preference, specifically clean/unpolluted water.

[2] This is based on my survey that only received 50 respondents. Although this is a small sample size, the overwhelming amount of support received still should be considered.

In order for shellfish aquaculture development in Provincetown Harbor to be successful, certain concerns of recreational users must be addressed. The first is that nature/environmental setting preferences must be taken into account. All recreational users indicated the importance of this setting preference while they use Provincetown Harbor. Another concern would be the possibility of spatial conflict with pre-existing uses found in the Harbor. This could be addressed by using the spatial maps that were created in this study as well regulating the type of shellfish aquaculture gear used. It is recommended that submerged benthic cages be used in Provincetown Harbor. This would address the concern all recreational users have for preserving the nature/environmental setting preference in Provincetown Harbor as well as minimize spatial conflict with pre-existing uses.

4.3 Spatial Use

Locals and visitors spatially use the Harbor differently from each other. From the results, the participatory maps show that visitors primarily use the western part of the Harbor and locals tend to use the majority of the Harbor. This could be attributed to the fact that locals found it very important to be able to be away from other boaters while in Provincetown Harbor. [3] Long Point tended to be used heavily by both locals and visitors.

This spatial use data allows policy-makers in Provincetown to identify areas of heavy use, and develop shellfish farms in areas that will cause the least amount of conflict. With the Provincetown's interest to grow its current deepwater shellfish aquaculture activities that require depths of 20-30 feet (Wisbauer, 2015) the maps can be

[3] With low survey numbers, the use patterns explained are not exact but they do offer useful spatial information that can be useful for Harbor development projects.

used to identify specific conflict areas. The results suggest that the west end of the Harbor will have more potential for conflict with the introduction of any new shellfish aquaculture activity. This is because most of the heaviest use patterns are found in the west end of the Harbor. Not only is the heaviest use found in the west end of the Harbor but also most of the heaviest use patterns are found in the necessary depths of 20-30 feet. The research results suggest that if any new shellfish farms were developed, the area that will cause the least amount of impact would be found in the east end of the Harbor where existing shellfish aquaculture activities are. However, if growth was to happen in the east end of the Harbor, Locals would have to be targeted for public outreach because they use the east end of the Harbor more heavily then Visitors and the Locals have expressed a greater interest in solitude. However, Locals are much easier to reach.

4.4 Limitations of the Study

One limitation of this study was the total number of participants that were surveyed. In the future, the study period should be longer and should not be limited to eight sampling days in order to get more participants and stronger data. Another limitation was not asking participants where they do certain activities in the Harbor. Understanding what activities were done where was not possible because participants were not required to identify what activities they were doing in the Harbor. The identification of populations was also limiting. It is difficult to identify different population groups on Cape Cod because a lot of people vacation there for many years and in that sense they are not visitors but they are also not locals. This was somewhat confusing and developing a different definition of participants is recommended.

4.5 Recommendation for Future Studies

Future studies involving shellfish aquaculture in Provincetown should focus on waters outside of the Harbor. Specifically, the marine areas from Long Point Lighthouse to Race Point. To understand the impact of the introduction of shellfish aquaculture, the methods from this study can be replicated as well as in other coastal areas. Future studies of human uses in Provincetown Harbor should try to connect types of activities with areas of use.

CONCLUSION

If the Town of Provincetown expands shellfish aquaculture in the Harbor, there are many things that have to be addressed. First, identifying the frequency of activities are being done in the Harbor is vital because it can help identify which activities are being done most. Secondly, the values that harbor users have towards the Harbor must be evaluated to better understand users. Understanding what users find to be important to their use of the Harbor can identify the possibility for future conflict with the development of shellfish aquaculture. Thirdly, the evaluation of how the Harbor is spatially being used and areas of heavy use must be identified because certain areas in the Harbor may be areas where development is not possible due to pre-existing use patterns.

In this research study it was found that the Local population group and the Visitor population group value the Harbor somewhat differently. Locals valued extractive activities more than Visitors. Locals also felt that it is was very important to be away from other boaters while Visitors found this to only be slightly important. Both population groups also differed in their values concerning the nature/environment setting preferences. Locals felt that nature/environment setting preferences were very important and Visitors found this to be somewhat important. However, both agreed that nature/environment setting preferences are important to their use of Provincetown Harbor, only the level of importance differed.

In order to address these value preferences for both groups, policy-makers should reach out to recreational users and get their opinions on how they could best address their concerns. Regulation on the type of gear used for shellfish aquaculture should also be

created because a lot of values and concerns that recreational users expressed could be addressed. If regulation was put into place to only allow submerged benthic aquaculture cages potential conflict can possibly be avoided. This will allow for a streamline development plan that will likely receive less opposition from users when proposed.

This study also found that both population groups support the development of shellfish aquaculture in Provincetown Harbor. This is important because it supports the possibility of expansion of shellfish aquaculture in the Harbor. With a strong support system, Provincetown has a great opportunity to develop a successful shellfish aquaculture program. That said, the research also found that there are concerns amongst participants that have to be addressed. The most prominent concern found was the possibility of spatial conflict with pre-existing uses found in the Harbor. This needs to be addressed before the introduction of more shellfish farms in the Harbor.

Finally, this study suggests that expanding shellfish aquaculture in the water depth of 20-30 feet in the west end of the Harbor will potentially create conflicts. The west end of the Harbor is highly used and the development of shellfish aquaculture in this area is not recommended due to the density of activity found here among all population groups. This study suggests that the best area for growing shellfish aquaculture in Provincetown Harbor is in the east end of the Harbor. This area is a proven area for successfully growing shellfish because existing farms are found in this location and are doing well. The east end also has the largest area for the required depths of 20-30 feet. However, if more shellfish farms are introduced in this area, policy-makers must address the Local population because they do use this area much more then the Visitor population. Locals also expressed a preference for a less busy environment. If the introduction of more

shellfish aquaculture activity was introduced in the east end, it may conflict with Locals value of a less busy environment.

APPENDIX A:

UNIVERSITY OF RHODE ISLAND

Thank you for agreeing to participate in this survey. What this survey is for is to see how recreational users use Provincetown Harbor as well as the attitudes they have towards shellfish aquaculture.

Section 1:

Circle which Residency classification you are considered.

A) Resident- Any registered voter in the Town of Provincetown
B) Non-Resident Taxpayer- Any natural person owning real estate in the Town of Resident but who is not a Resident
C) Occupant- Any natural person who lives in the Town of Provincetown six months of the calendar year or more but is not a Resident or Non-Resident
D) Visitor- If you do not fit in any of the other categories you are considered a visitor

For these listed activities mark how much you participate in each activity in Provincetown Harbor within the last three months. These questions are based on a 1-4 scale, (1= never, 2= Rarely, 3= Occasionally, 4=Frequently)

Power Boat

1 2 3 4

Sail Boat

1 2 3 4

Kayak

1 2 3 4

Swim

1 2 3 4

Fish (From Shore)

1 2 3 4

Fish (From Boat)

1 2 3 4

Dive

1 2 3 4

Stand Up Paddle Board Surfing

1 2 3 4

Gather Shellfish

1 2 3 4

Lobster (Traps)

1 2 3 4

Lobster (SCUBA Dive)

1 2 3 4

Other:

_____
_____
_____
_____
_____
_____

Section 2:
In this section, these questions rank from 1-4 asking how important certain things within the Harbor are important to you. There will be a list of items that will allow you to rank the importance to them to you. (1= not important, 2=slightly important, 3= somewhat important, 4=very important)

Items				
Catching Fish	1	2	3	4
Gathering Shellfish (clams, mussels, oysters)	1	2	3	4
Lobster (diving or using boat with lobster pot)	1	2	3	4
Viewing natural scenery	1	2	3	4
Clean/unpolluted water	1	2	3	4
Viewing marine wildlife	1	2	3	4
Seeing undeveloped shoreline	1	2	3	4
Being away from other boaters	1	2	3	4
Being in a peaceful, quiet place	1	2	3	4
Being around other boaters	1	2	3	4

Section 3:
This section entails open-ended questions asking for your opinion on aquaculture.

What are your personal thoughts and feelings towards the practice of shellfish aquaculture?

_____

_____

_____

_____

_____

_____

_____

_____

Do you think that Provincetown Harbor would be a good place for shellfish aquaculture to be done in? Why or Why not?

_____

_____

_____

_____

_____

_____

_____

_____

_____

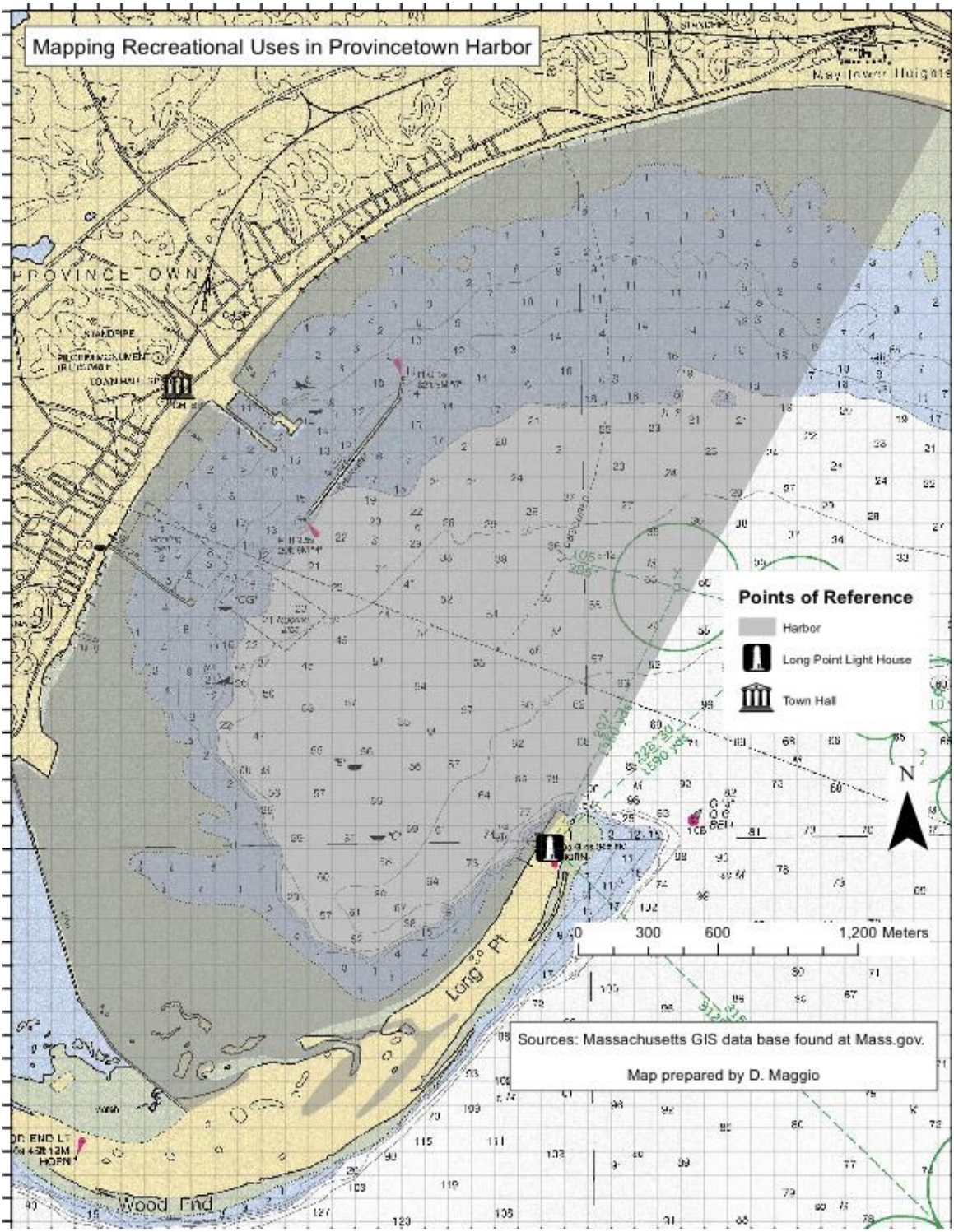
_____

_____

How strongly do you support or oppose shellfish aquaculture in Provincetown Harbor? (1= Strongly Disagree, 2= Slightly Disagree, 3= Slightly Agree, 4= Strongly Agree)

1 2 3 4

Thank you for participating in this research study.


Mapping Recreational Uses in Provincetown Harbor
PROVINCETOWN
Points of Reference
Harbor
Long Point Light House
Town Hall
N
0
300
600
1,200 Meters
Long Pt
Wood End
Sources: Massachusetts GIS data base found at Mass.gov.
Map prepared by D. Maggio

APPENDIX B:

Environment *Positive:* Clean Water Conserve/Preserve Restore Natural Harbor Processes Connection to Nature *Negative:* Pollution/Decrease Water Quality Damage Natural Processes (i.e. disease)	**Culture** Fishing Culture Be a Leader
Regulation Need to "Fix" Problem Need Proper Regulation Need for Specific Areas	**Spatial Conflict** *Positive:* Plenty of Space *Negative:* Lack of Space Navigation Existing Uses
Economic Value *Positive:* Sustainable Food Supply Local Food Production Not Being Exploited *Negative:* Business Constraints	**Taste**
Access	**Lack of Knowledge**
No Opinion	**Support**
Opposition	

BIBLIOGRAPHY

Aarset, B. 1998 ‘Norwegian salmon-farming industry in transition: dislocation of decision control’ *Ocean and Coastal Management* **38**, 187–206

Anutha, K., and Johnson, D. 1996 ‘Aquaculture planning and coastal management in Tasmania’ *Ocean and Coastal Management* **33**, 167–192

"Aquaculture." *Massachusetts Executive Office of Energy and Environmental Affairs*. N.p., n.d. Web. 15 Mar. 2015. <http://www.mass.gov/eea/agencies/agr/about/divisions/aquaculture-program-generic.html>.

Balaguer, Pablo, et al. "Spatial analysis of recreational boating as a first key step for marine spatial planning in Mallorca (Balearic Islands, Spain)." *Ocean & Coastal Management* 54.3 (2011): 241-249.

Beierle TC (2002) The quality of stakeholder-based decisions. Risk analysis: an official publication of the Society for Risk Analysis 22: 739–749. Available: http://www.ncbi.nlm.nih.gov/pubmed/12224747.

Birkland, T, 2001. An Introduction to the Policy Process. Theories, concepts and models of public policy making. M.E. Sharp, Armonk, NY.

Brody SD (2003) Measuring the Effects of Stakeholder Participation on the Quality of Local Plans Based on the Principles of Collaborative Ecosystem Management. Journal of Planning Education and Research 22: 407–419. doi:10.1177/0739456X03253022

Churchill, T. N., P. W. Bettoli, D. C. Petreson, W. C. Reeves, and B. Hodge. 2002. Angler conflicts in fisheries manage- ment: a case study of the striped bass controversy at Norris Reservoir, Tennessee. Fisheries 27(2):10–19.

Clark RN, Stankey GN (1979) The recreation opportunity spectrum: a framework for planning, management, and research. USDA Forest Service Res. Paper PNW-98

Dalton, Tracey, Robert Thompson, and Di Jin. "Mapping Human Dimensions in Marine Spatial Planning and Management: An Example from Narragansett Bay, Rhode Island." *Marine Policy* 34.2 (2010): 309-19. Print.

Dewalt, B. R., Vergene, P., and Hardin, M. 1996 ‘Shrimp aquaculture development and the environment: people, mangroves and fisheries on the Gulf of Fonseca, Honduras’ *World Development* **24**, 1193–1208

Driver BL, Brown PJ (1978) The opportunity spectrum concept in outdoor recreation supply inventories: a rationale. In Proceedings of the Integrated Renewable Resources Inventories Workshop. USDA Forest Service General Technical Report INT-220:24-31

Geisler, C. 2004. *Analyzing Streams of Language:Twelve Steps to the Systemic Coding of Text, Talk, and Other Verbal Data.* New York: Pearson Longman.

Gilliland, Paul M., and Dan Laffoley. "Key elements and steps in the process of developing ecosystem-based marine spatial planning." *Marine Policy* 32.5 (2008): 787-796.

Gramann, James H., and Rabel J. Burdge. "The effect of recreation goals on conflict perception: the case of water skiers and fishermen." (1979).

Gray, Darcy L., et al. "Incorporating recreational users into marine protected area planning: a study of recreational boating in British Columbia, Canada." *Environmental management* 46.2 (2010): 167-180.

Honeycutt, Dale. "ArcGIS." *Count Overlapping Polygons*. ESRI, 25 Oct. 2013. Web. 06 Apr. 2015. <http://www.arcgis.com/home/item.html?id=1dd4a6832b3d40b494dbf8521cc5134c>.

Jacob, Gerald R., and Richard Schreyer. "Conflict in outdoor recreation: A theoretical perspective." *Journal of leisure research* 12.4 (1980): 368-380.

Koontz TM, Thomas CW (2006) What Do We Know and Need to Know about the Environmental Outcomes of Collaborative Management? Public Administration Review 66: 111–121. Available: http://doi.wiley.com/10.1111/j.1540-6210.2006.00671.x

Live Edit." *Town of Provincetown, MA*. Town of Provincetown, n.d. Web. 12 June 2014

Lynch, Tim P., et al. "Conflict and impacts of divers and anglers in a marine park." *Environmental Management* 33.2 (2004): 196-211.

"Massachusetts Division of Marine Fisheries Shellfish Sanitation and Management." *Designated Shellfish Growing Areas*. Massachusetts Executive Office of Energy and Environmental Affairs, 28 June 2013. Web. 15 Mar. 2015. <http://www.massmarinefisheries.net/shellfish/dsga/CCB4.pdf>.

McKinsey, Rex (March 6, 2015). Personal Interview

MILLAR, C., and Aiken, D. E. 1995 ‘Conflict resolution in aquaculture: a matter of trust’ in *Cold-Water Aquaculture in Atlantic Canada*, ed A. D. Boghen, 2nd ed. (

Moncton, NB : Canadian Institute for Research on Regional Development) 617–645

Morse, Dana L. "Eastern Oyster Production in Maine: A Basic Review." *Eastern Oyster Production in Maine: A Basic Review* (n.d.): n. pag. Maine Seagrant. Web. 09 Feb. 2015. <http://www.seagrant.umaine.edu/files/Dana%20Morse/Oyster%20Prod%20Overview%20FINAL.pdf>.

Murray-Jones, S., and A. S. Steffe. 2000. A comparison between the commercial and recreational fisheries of the surf clam, Donax deltoides.. Fisheries Research 44:219–233.

Naylor, R. L., Goldburg, R. J., Mooney, H., Beveridge, M., Clay, J., Folke, C., Kautusky, N., Lubchenko, J., Primavera, J. H., and Williams, M. 1998 'Nature's subsidies to shrimp and salmon farming' *Science* **282**, 883–884

Newig J (2007) Does public participation in environmental decisions lead to improved environmental qulaity? Towards an analytical framework. Research and Practice for a Sustainable Future 1: 51–71.

Provincetown Public Pier Corporation. *Public Hearing Notice*. Town of Provincetown, n.d. Web. 27 Mar. 2014.

Reed MS, Dougill AJ, Baker TR (2008) Participatory indicator development: what can ecologists and local communities learn from each other? Ecological applications: a publication of the Ecological Society of America 18: 1253–1269. Available: http://www.ncbi.nlm.nih.gov/pubmed/18686585.

Ruello, N. V., and G. W. Henry. 1977. Conflict between com- mercial and amateur fishermen. Australian Fisheries 36(3):4 –10.

"Shellfish Aquaculture in Massachusetts." *: Woods Hole Sea Grant*. Woods Hole Oceanographic Institute, Sept. 2010. Web. 12 June 2014.

Stephenson, R. L. 1990 'Aquaculture collides with traditional fisheries in Canada's Bay of Fundy' *World Aquaculture* **21**(2), 34–45

"Support." *Quantile Classification*. ESRI, n.d. Web. 06 Apr. 2015. <http://support.esri.com/en/knowledgebase/GISDictionary/term/quantile%20classification>.

Thompson, Robert. "Reporting offshore wind power: are newspapers facilitating informed debate?." *Coastal Management* 33.3 (2005): 247-262.

United States. Board of Selectmen. *TOWN OF PROVINCETOWN REGULATIONS FOR AQUACULTURE LICENSES*. Board of Selectmen, 14 May 2012. Web. 9 Feb. 2015. <http://www.provincetown-ma.gov/DocumentCenter/View/2457>.

United States Department of Agriculture (USDA) and National Agricultural Statistics Service (NASS). "Census of Aquaculture 2013. "*2012 Census of Agriculture* &, special studies part 2, 2013

U.S. Census Bureau, 2010; "Amercian FactFinder"; "Using American FactFinder";http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk; (16 March, 2015)

Walters, B. B. 2003 'People and mangroves in the Philippines: Fifty years of coastal environmental change' *Environmental Conservation* **30**, 293–303

Walters, B. B. 2007, Competing use of marine space in a modernizing fishery: salmon farming meets lobster fishing on the Bay of Fundy. The Canadian Geographer / Le Géographe canadien, 51: 139–159. doi: 10.1111/j.1541-0064.2007.00171.x

Weeks, P. 1992 'Fish and people: aquaculture and the social sciences' *Society and Natural Resources* **5**, 345–357

Whitmarsh, David, and Premachandra Wattage. "Public attitudes towards the environmental impact of salmon aquaculture in Scotland." *European Environment* 16.2 (2006): 108-121.

Widmer WM, Underwood AJ (2004) Factors affecting traffic and anchoring patterns of recreational boaters in Sydney Habour, Australia. Landscape and Urban Planning 66:173-183

Wisbauer, Stephen (March 6, 2015). Personal Interview.

Yates, Katherine L., and David S. Schoeman. "Spatial access priority mapping (SAPM) with fishers: a quantitative GIS method for participatory planning." *PloS one* 8.7 (2013): e68424.