

Evaluating the Effectiveness of Marina Signage Along Biscayne Bay Aquatic Preserves

An Internship Report

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Evaluating the Effectiveness of Marina Signage in Biscayne Bay Aquatic Preserves

Abstract of a masters degree internship report at the University of Miami, Rosenstiel School of Marine and Atmospheric Science. Supervised by: Maria Estevanez, Lisa Krimsky, Ph.D., and Pamela Sweeney. Number of pages in text: 72

Miami-Dade County is consistently a top-ranked county in Florida for boating accidents and fatalities. It is also home to Biscayne Bay, filled with unique, fragile marine resources that are both ecologically and economically significant. Biscayne Bay Aquatic Preserves is tasked with preserving the natural ecosystem and providing public access to the resources for the present and future generations. However, communication with boaters is difficult, yet important for disseminating information about protecting the natural resources and boat safety. One of the most common methods of communication is educational, non-regulatory signage in boat ramps and marinas. An intercept survey and mail surveys were conducted to determine the boaters' level of use of signage. , The results of the surveys suggest that boaters do not use signs to plan trips on the boat and signage is an inefficient use of an agency's resources. This study highly recommends that BBAP's Resources should instead be focused on other forms of communications such as internet campaigns and partnerships with other government agencies as well as news and weather stations.

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Introduction

1.0 Introduction

1.1 Background/Literature Review

The Biscayne Bay Aquatic Preserve Act was established in 1974 by the Florida Legislature to protect and preserve the unique habitat of Biscayne Bay. There are two preserves managed by Biscayne Bay Aquatic Preserves: Biscayne Bay Aquatic Preserve and Biscayne Bay-Cape Florida to Monroe County Line Aquatic Preserve. Comprised of 67,000 acres and regarded cumulatively as the Biscayne Bay Aquatic Preserves (BBAP), the boundaries of this managed area extend from the headwaters of Oleta River in the northern part of Miami-Dade County including the barrier islands of Miami Beach, Key Biscayne, Virginia Key, and Fisher Island south to Little Card Sound in Monroe County, not including Biscayne National Park. The northern portion of the Preserves is the primary focus of this study (See Figure 1) The preserves are managed by the Florida Department of Environmental Protection's Florida Coastal Office, the agency charged with overseeing the management of the state's aquatic preserve program. Per Florida Statute 253.397, Biscayne Bay is to be enhanced and preserved in "an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations".¹ Biscayne Bay Aquatic Preserves, or BBAP, includes and manages diverse ecosystems, habitats and wildlife, including habitats such as mangroves, coral reefs, sponge beds, macroalgae beds, and seagrass. Within these habitats are diverse fish, invertebrates, and marine mammals. In 2012, the *Biscayne Bay Aquatic Preserves Management Plan* was created to better continue this process of preservation for future generations.

¹ Online Sunshine

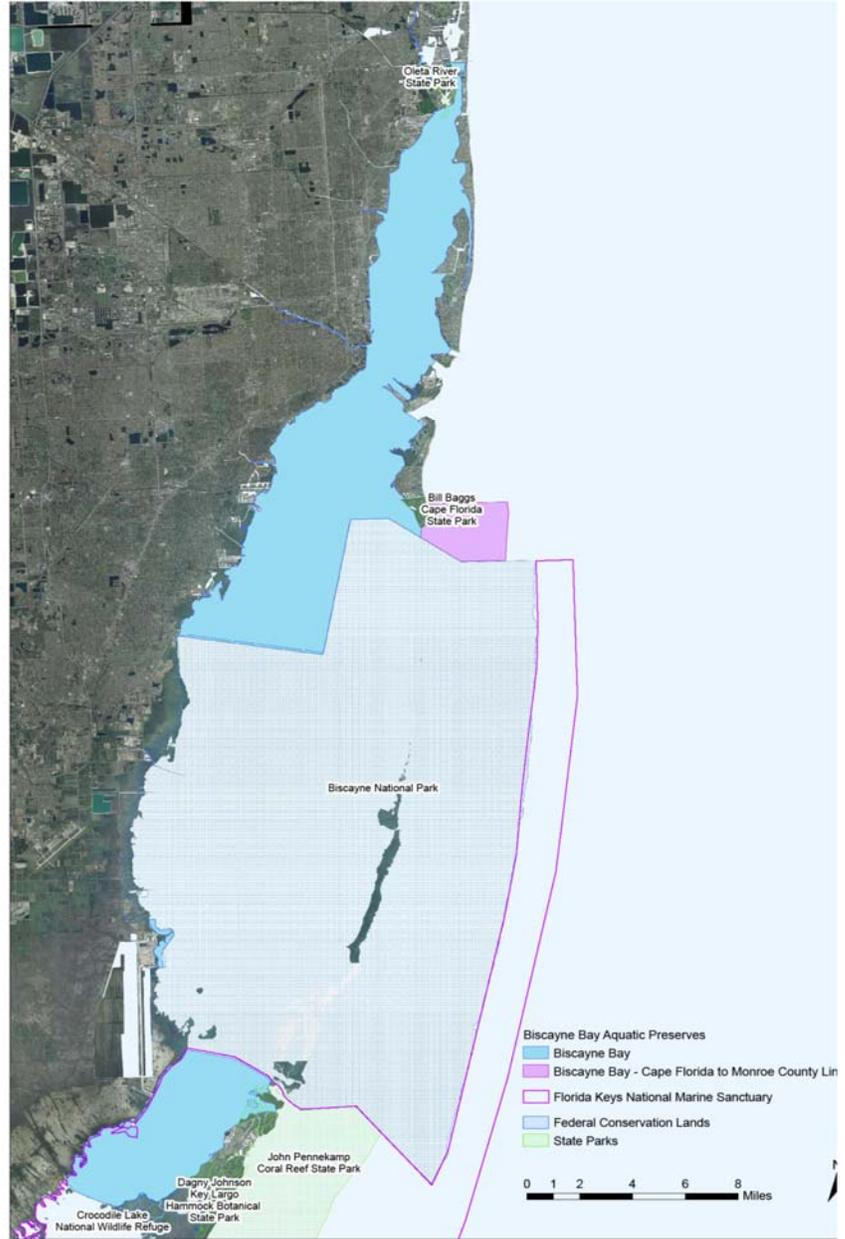


Figure 1
Map of Biscayne Bay and Biscayne Bay Aquatic Preserves Boundaries

Biscayne Bay is an ecological treasure trove, hosting many diverse habitats and supporting numerous natural resources within its shallow estuarine waters. One of the most essential habitats in Biscayne Bay is seagrass. Protected under Florida Statute

253.04(3)(a), seagrass forms “lush meadows”² that provide habitat, food sources, and sediment stabilization. All seven of the state’s seagrass species are found in BBAP. Seagrass serves as multiple types of habitat; for many juvenile fish, seagrass is a nursery until they mature and migrate to their adult habitat. Seagrass beds provide shelter for marine invertebrates and fish, including sport fish and reef fish. These fish are the basis for tourism (diving, snorkeling, recreational fishing) and commercial fisheries. Many other predators prey on these fish and invertebrates, as well as grazers that eat the seagrass itself. Additionally, the complex root system of seagrasses stabilize the sediment thereby reducing turbidity, while the leaf blades reduce wave-energy and help to protect Miami’s shorelines.³ Also contributing to shoreline stability are mangroves, whose complex root systems hold the shoreline in place during significant wave action caused by storms and hurricanes, and also filter out pollution and runoff.⁴ These trees provide shelter for wildlife, especially the young: the roots serve as nurseries for fish and invertebrates, while the branches serve as rookeries for birds.⁵ Hardbottom communities are abundant, which have little vegetation but support ecologically and economically important invertebrates including spiny lobsters, sponges, and soft corals.⁶

The habitats of Biscayne Bay are home to many diverse species of wildlife, including the Florida Manatee, which is an herbivorous marine mammal native to the warm shallow waters of Florida, and a direct consumer of Florida’s seagrasses.⁷ The Florida Manatee is protected both federally and by the State of Florida. Federally, it is listed under the

² Biscayne Bay Aquatic Preserves Management Plan p33

³ Biscayne Bay Aquatic Preserves Management Plan p34

⁴ NPS Mangroves

⁵ NPS Mangroves

⁶ NPS Biscayne Bay

⁷ Biscayne Bay Aquatic Preserves Management Plan p38

Endangered Species Act (16 U.S.C. §1531-1544) and the Marine Mammal Protection Act (16 U.S.C. §1361-1421). It is additionally listed under the Florida Endangered and Threatened Species Act and the Florida Manatee Sanctuary Act.⁸

In addition to its ecological benefits, Biscayne Bay supports Miami-Dade, Southeast Florida, and the state of Florida economically. The Biscayne Bay Economic Study released the “Final Economic Baseline and Trend Report” in 2005 that “describes the estimated uses and economic contribution of Biscayne Bay and the Miami River” from 1980 through 2004⁹. The study found that in 2004, total Biscayne Bay activities generated \$12.7 billion in output and \$6.3 billion in income to Miami-Dade County and contributed 157,000 jobs, \$14.7 billion output and \$7.5 billion in income to the state of Florida. One of the economic activities worth millions of dollars is commercial fishing; commercial fisheries, both within and outside of Biscayne Bay, depend on species of fish that depend on the Bay. Biscayne Bay and the Miami River are also crucial to the shipping industry, with the Port of Miami located in the Bay, and the Miami River feeding into it; the total estimated 2004 sales in shipping businesses amounted to \$4.15 billion. Biscayne Bay is also important for recreational opportunities, including activities such as snorkeling, fishing, swimming, paddling, scuba diving, boating for pleasure, picnicking on the Bay, sailing, and viewing the bay from the shore. Approximately 66% of all the recreational economic activity on Biscayne Bay is a result of boating, contributing \$3.8 billion in output to Miami-Dade County, and \$2.1 billion in income and 57,100 jobs.¹⁰ Boaters are key contributors to Biscayne Bay’s economy, and do so in part

⁸ FWC Manatee Management Plan p16

⁹ Biscayne Bay Economic Study Task 3 Report - Final Biscayne Bay Economic Baseline and Trend Report

¹⁰ Biscayne Bay Economic Study Task 3 Report - Final Biscayne Bay Economic Baseline and Trend ReportF

because of their high density.

Boaters are a major stakeholder in Biscayne Bay. The highest concentrations of recreational boating seen in Miami-Dade County are mostly within the boundaries of Biscayne Bay Aquatic Preserves, with the most popular boating destinations including Key Biscayne and Bakers Haulover Inlet. High speed boat traffic is concentrated all throughout the Preserve in northern Biscayne Bay; areas of especially high concentration include the Port of Miami, the Intracoastal Waterway, Miami Beach, and Government Cut.¹¹

Biscayne Bay is a hotspot for recreational boating, although this also means natural resource protection and human health and safety suffer from the high boating density. The goal of BBAP is to manage and preserve Biscayne Bay's natural resources for the enjoyment of future generations".¹² However, this is proving more and more difficult, as the density of boaters is incredibly high. Florida has the largest number of registered recreational vessels than any other state,¹³ and Miami-Dade is the county with the greatest number of total vessels registered in Florida, with over 61,000 registered vessels in 2013, and over 59,000 recreational vessels registered the same year.¹⁴ Miami-Dade County's economy depends significantly on these boating stakeholders. Miami-Dade County is consistently in the top 3 counties in Florida for most boating accidents, and has the number 1 spot in 2013.¹⁵ These accidents often result in fatalities and injuries. But in addition to endangering health and human safety, these accidents also endanger natural

¹¹ Gorzelany ii

¹² Online Sunshine

¹³ FWC 2013 Boating Accidents Statistical Report, Boating Accident Review p3

¹⁴ FWC 2013 Boating Accidents Statistical Report, 2013 Reportable Boating Accidents

¹⁵ FWC boat stats

resources. However it is not the accidents alone that endanger the resources, the irresponsible boating that leads to accidents also causes vessel groundings, which occurs when a vessel ends up in shallow water, such as shoals, coral reefs, and seagrass beds, and becomes stuck, or grounded, in the sediment, disturbing natural resources. Vessel groundings destroy fragile seagrass beds and coral reefs, which are both slow to recover. Scarred seagrass beds are also more susceptible to many environmental factors which further slow down recovery; one example is erosion, caused by storms and wave action, which causes sediment to become suspended, blocking sunlight from the plants. Complete recovery of seagrass scarring can take up to ten years.¹⁶ Sargent notes that as boat registration and ownership increases in Florida, along with an increasing population, seagrass scarring concurrently increases. Many of these boaters are inexperienced and do not know about the many factors that go into the recovery of these natural resources, and thus they cause long term damage to seagrass.¹⁷ Biscayne Bay serves a large economic purpose; without these natural resources, the dependent stakeholders will suffer great economic and social losses in addition to the negative ecological impacts. These impacts are so great, that large boat-rafting parties that have recently become popular in Biscayne Bay are now at risk of being shut down in areas like Mashta Flats; motorized vessels may lose or experience reduced public access because of concerns including fatalities and the complete loss of seagrass in areas with high motorized vessel activity.¹⁸

Uneducated and/or irresponsible boaters also injure precious wildlife such as the endangered Florida manatee. In the decade between 1995 and 2005, 32.3% of known

¹⁶ Sargent p16

¹⁷ *ibid*

¹⁸ Granfield

causes of manatee fatalities were from watercraft; 35% of all documented deaths of known cause are due to boats and watercraft.¹⁹ Boaters have a perception that degradation of natural resources is caused by everyone but themselves, that they are not the worst offenders; this mentality is dangerous.²⁰ The cause for degradation of natural resources in and around Biscayne Bay is human activity, both direct and indirect. Thus, the only ways to prevent more damage, and repair and perhaps reverse extant damage are for humans to fix and prevent their own mistakes, but this requires knowledge of the natural resources and humans' effect on them. The way to improve boaters' perception of natural resources and thus their behavior is through education and communication.

Educational information targeted for the boating community exists, but is only valuable if boaters have both the motivation and access to find it. The Florida Fish and Wildlife Conservation Commission, or FWC, in particular has a rich, substantive website filled with boating and natural resource information, especially about seagrass communities, reefs (both artificial and coral), and manatee protection. The website includes descriptions of wildlife and ecosystems, and explains why these resources are important, and why they must be protected, especially by boaters. The Internet is rife with information on natural resources of Florida's coastlines; however, it is a matter of having the personal motivation and incentive to find the relevant information. Even though the FWC website is seemingly simple to navigate, information about natural resources can often be difficult to find and, as a boater, one would have to know what keywords to search for and what websites or entities to look to for trustworthy

¹⁹ FWC Manatee Management Plan p8

²⁰ Shivlani and Villanueva

information. If the boater is in the know and knows what sources to use, they can easily find the right information. But if the boater is outside of environmental inner circles, knowing what to search for online, or even if they need to be searching for information, is elusive. The information is also often hidden behind many embedded links or tabs on website pages, forcing the user to patiently click-through multiple pages to find the desired information. Finally, in order to even access this information, the boater must have access to both a computer and internet, which may not necessarily be possible for many boaters in Miami-Dade County. According to the Pew Research Center, 2013 data from the U.S. Census Bureau shows just over 15% of households in Miami do not own a computer.²¹

Beyond the Internet, entities such as the Department of Environmental Protection, FWC, Florida Sea Grant, and the National Park Service publish pamphlets, brochures, booklets, and maps with information pertaining to natural resources in Biscayne Bay, and are made available for free to the public. These are available in various locations and boating events, such as boat shows. However, having merely been given a packet of information does not automatically transfer the knowledge to the boater. Again, the boater must be self-motivated enough to read through the pamphlets carefully and process the information presented, as well as remember to apply the knowledge while boating. Boaters can also take a boating safety course, which is required of anyone born after January 1st, 1988 per Florida law. The course must be approved by FWC, and can be taken online or as a class; however, this law may not be known by uneducated boaters,

²¹ Pew Research Center

thus causing a paradox- educating the uneducated boater about needing to be educated.²²

Being experienced is not equivalent to being educated about natural resources. Boaters need the personal motivation to become educated about the issues surrounding safe boating and preserving natural resources while operating a boat. Presently, the most direct form of communication with boaters is through signage at boat ramps and marinas.

Educational signage is historically a popular method for organizations and agencies to communicate with boaters. It is commonly used because it is directly in the line of sight of boaters, and boaters are used to reading the navigational and regulatory signs in marinas and boat ramps; the assumption seems to be that boaters will inherently read these educational signs about natural resources as well. Within their Manatee Protection Educational Program, FWC recommends the use of educational signs “to reduce the likelihood of boat and manatee collisions,” and to place the signs in “prominent locations” with high pedestrian traffic, and with multiple signs at larger boat ramps.²³ However, too many signs cause signage congestion, and decreases the chances of boaters reading the signs. Oftentimes the signs are faded and out of date, seemingly causing more of an eyesore than an educational experience. Little research has been done on marine and aquatic signage and the effect on its intended audience. No research that I could find has been done on signage in marinas and boat ramps, but some research on aquatic signage has been conducted along beaches. Matthews et. al. suggests that while a wide range of tactics to disseminate marine information has been used, signs are the most universal. Signage appears to have been widely accepted in the past as the best route to

²² Hitchins slide 2

²³ FWC Manatee Educational Signs; Requirements for Manatee Protection Educational Program

disseminate knowledge along coastal areas, due to the frequency of posted signs. Medeiros et. al. suggests that warning signs on beaches are not enough for protection, that further protection measures and wardening are necessary, through their study on the effects of signage on human disturbance on tern nesting.²⁴ Marina and boat ramp signage effectiveness has recently been called into question. Florida Sea Grant and Biscayne National Park jointly formed a Miami-Dade County working group to re-evaluate boat ramp signage, and through assessment of current signage and preliminary intercept surveys, found that existing marina signage may not be effective at educating boaters.²⁵

1.2 Statement of Problem

A large task in managing Biscayne Bay Aquatic Preserves is facilitating public use of the Preserves, and one of the steps in this management is coordinating interpretation and signage to educate the public on natural resources and boating safety.²⁶ As previously stated, Biscayne Bay Aquatic Preserves is teeming with diverse but fragile ecosystems. The State of Florida has statutes protecting habitats that comprise these ecosystems and often specific laws protecting species that inhabit them, but these laws can be technical and difficult for the general public to access and understand. Thus, the Preserves interprets and uses signage in marinas and boat ramps to explain the importance of the ecosystems and abiding by their related statutes. Preserves managers incorporated the interpretation and signage aspect of the Public Use Management Plan in the 1990's by partnering with the four Miami-Dade County boat ramps and marinas

²⁴ Medeiros et. al.

²⁵ MPS Internship Project Meeting

²⁶ Biscayne Bay Aquatic Preserves Management Plan p85

immediately adjacent to the preserve-Pelican Harbor, Crandon Park, Matheson, and Haulover. The signs in these marinas and boat ramps focus on 3 main subjects: boating regulations, safety, and how to “Be a Better Boater”, manatee laws and facts, and seagrass laws and facts.²⁷ These signs are meant to be read as the marina and boat ramp patrons enter the facility, and are taught (and for returning patrons, reminded) about the importance of protecting Biscayne Bay’s natural resources and practicing safe boating habits.

Boaters that are unfamiliar with seagrass beds drive through these shallow resources, tearing apart complex root systems that are slow to recover and expensive to restore; these resources, as mentioned above, are crucial not only to the Biscayne Bay ecosystem, but to the economy surrounding Biscayne Bay. An unaware public damages not only the fragile ecosystem of Biscayne Bay, but also the community of South Florida as a whole.

In spite of these signs, there appears to be a disregard for boating safety in Miami-Dade County. According to the FWC boating statistics, Miami-Dade is consistently in the top 10 counties for boating accidents in Florida.²⁸ Last year in 2013, Miami-Dade won the title for the number 1 county in boating accidents in Florida.²⁹ A disregard for safely boating in the Preserves leads not only to health and human safety issues, but damages to natural resources within the purview of the Preserves. For example, boats that speed through a No Wake/Manatee Zone puts it and other Preserves users at risk for a crash, and also increases the chances it will strike an endangered Florida Manatee.

²⁷ Biscayne Bay Aquatic Preserves Management Plan p85

²⁸ FWC 2013 Boating Accidents Statistical Report.

²⁹ FWC 2013 Boating Accidents Statistical Report.

The purpose of the implementation of educational signs in marinas is to increase environmental education and awareness, thus improving boating safety and natural resource protection. However, the FWC Boating Accident Report shows that Miami-Dade County is consistently a dangerous boating location; Biscayne Bay managers still need to respond to vessel groundings and propeller scars in both seagrass beds and on coral reefs, and FWC reports 12 manatee mortalities in the county this year alone (as of July 2014).³⁰ Due to the intense frequency of these environmental impacts to natural resources, it appears that recreational boaters are not as informed as they need to be regarding boating safety or natural resource laws, which could mean recreational boaters are not reading and/or understanding the educational signs at the four county boat ramps and marinas.

1.3 Purpose and Significance of Study

The damage caused to natural resources by unsafe boating practices could be easily avoided if the captain or passengers of a boat were knowledgeable about the boating rules and the reasons for the rules, and had the personal motivation to abide by these laws. Overall, the purpose of this study is to determine whether marina signage is an effective route for DEP/BBAP to disseminate information to recreational boaters about natural resource protection and boating safety. This information should be accessible, correct, and trusted by the boaters. Currently, the focus of disseminating the information is through marina signage, but the frequency with which educational signs are read by

³⁰ *ibid*

boaters is unknown. This study will illuminate how many boaters pay attention to the educational signs, and lead to suggestions as to how to increase the attention paid to these signs. Additionally, the results of this study will be analyzed to reveal possible alternatives to current signage options as means of disseminating pertinent information to the boating public.

At the end of this study, the final results and analysis will be made available to Biscayne Bay Aquatic Preserves management, marina managers, and South Florida law enforcement agencies. These agencies can use the study to improve their signage in the marina. For example, marina managers can use results about signage to adjust placement and quantity of signs. Biscayne Bay Aquatic Preserves will use this study in many ways. First, they will use the results to alter the existing signs to make them more attractive to the public, and place them in areas of marinas that are more likely for them to be read. The management will use results and comments from respondents to improve interpretation and create signs that best educate the public on statutes and the importance of natural resources. They will also find out where else, or where better, to reach out to boaters to educate them on the issues surrounding natural resources and boating safety. Adjusting signage to better suit education needs will increase boating safety and improve preservation of natural resources.

2.0 Methods and Materials

2.1 Activity 1: Intercept Surveys

The intercept surveys were conducted during the Labor Day weekend of 2014, with two marinas/boat ramps surveyed per day. This weekend is one of the busiest

boating weekends of the year, providing a large number of boaters at boat ramps and marinas to approach about surveys.

Schedule:

Saturday August 30, morning: Bill Bird Marina in Haulover Beach
Park

Saturday August 30, afternoon: Crandon Park Marina

Sunday August 31, morning: Matheson Hammock Marina

Sunday August 31, afternoon: Pelican Harbor Boat Ramp

Monday September 1: backup day

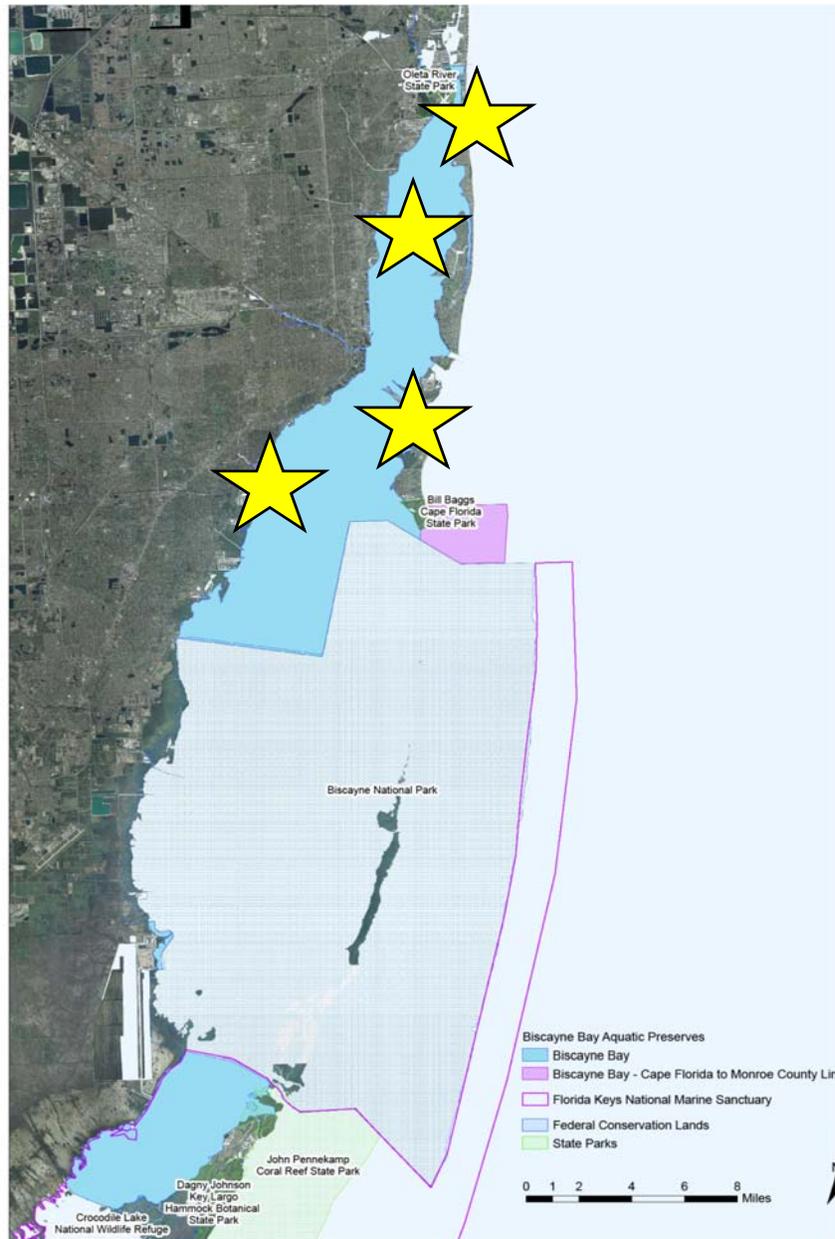


Figure 2
Locations of the intercept survey marina/boat ramps

Each marina/boat ramp was surveyed during the Labor Day weekend with the goal of 15-20 surveys per marina/boat ramp. The four locations were chosen because they are the original four Miami-Dade County public marina/boat ramps that partnered with the Preserves to put the signage in place. The locations are represented by yellow stars on the map in Figure 2. The timing during this summer holiday weekend was chosen to

maximize the number of respondents as well as to increase the diversity of demographics and locations from where the boaters come in from.

The survey is a one-page questionnaire, front and back, that is split into three topic sections. The first section of questions is based on general boating, with questions covering topics such as boat size, zip code, typically used marina/boat ramp, and personal boating history. The second set of questions focuses on signage, focused on sources of boating information, sources of information about natural resources, how often the boater reads the signs, and what would make the signs attract their attention. The last section has observational questions that will round out the survey with demographics, type of vessel, and whether the respondent was seen reading signage. The survey was based off of a questionnaire developed by Dr. Lisa Krinsky from Florida Sea Grant, with further information from the Boating Research Center's 1991 Boat Use and Boat Ramp Survey Questionnaires and "Recreational Boating Activity in Miami-Dade County: Final Report" by Jay F. Gorzelany M.S., 2009.

Two surveyors were present, myself as the lead surveyor with an assistant fluent in Spanish to accommodate non-English speaking respondents. Spanish translations of the survey were available for use when necessary. Respondents were targeted as people who were either entering or exiting the boat ramp, who were waiting for a spot either at the ramp or at the staging area, or while the boat operator was preparing the vessel to depart or return. When the vessel captain was busy, other passengers of the boat were targeted. When approaching respondents, my assistant and I introduced ourselves as representatives of BBAP and asked for the respondent's permission to conduct the survey. The survey took approximately three and a half minutes, as it is streamlined and

focused. Answers were either “yes” or “no” responses or free response with multiple-choice options. All of the multiple choice options for a question were provided verbally when the participants hesitated or asked for elaboration.

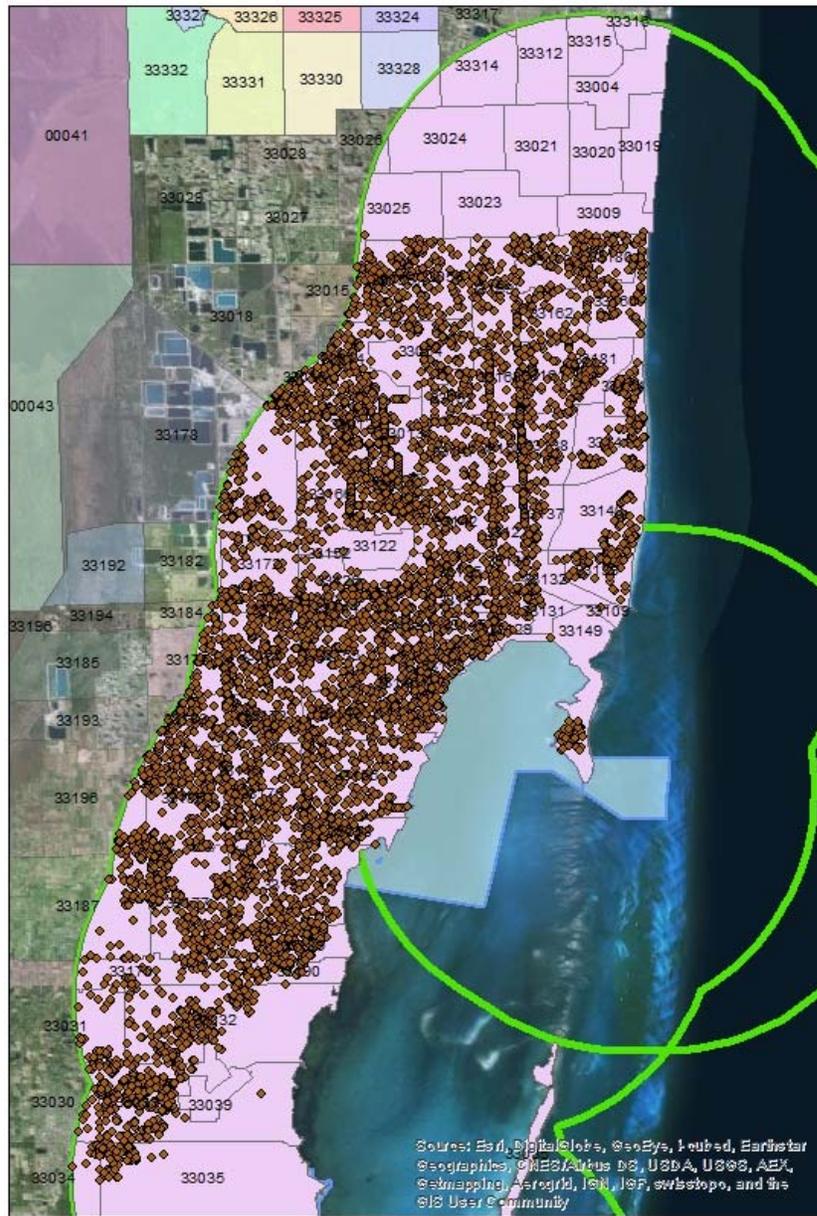
Neon safety vests were worn and county park managers were notified of our presence for safety. A copy of the survey is attached (See Appendix 7.1).

2.2 Activity 2: Mailed Questionnaires

The second activity was a questionnaire mailed to randomly chosen participants. The questionnaire used for the intercept-survey was adjusted to a more general format for use in this activity; ie the question ‘Did you know this marina/boat ramp is in a state Aquatic Preserve?’ from the intercept survey was edited to “Did you know the Haulover, Crandon, Pelican Harbor, and Matheson marinas/boat ramps are in a state Aquatic Preserve?”. Other than some minor edits, the questionnaire was the same.

The Florida Department of Motor Vehicles provided the list of all registered recreational boat owners in Miami-Dade County and their addresses for the purpose of randomly selecting the recipients of the questionnaire. Through ArcGIS, over 45,000 addresses were mapped, at which point a buffer was applied 10-miles around the boundary of BBAP. 10 miles was chosen to select the boat owners closest to BBAP, who are most likely to use the boat ramps, marinas, and the waters within BBAP. Within the table of attributes, 35,327 registered boat-owners were registered within this 10 mile buffer (Figure 3).

Registered Boat Owners of Dade County within 10 Miles of BBAP



Legend

- ◆ Registered Boat Owner Address
- ▭ BBAP Buffer Outline
- ▭ Biscayne Bay Aquatic Preserves
- ▭ Zip Codes within 10mi of BBAP

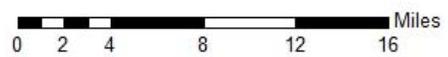
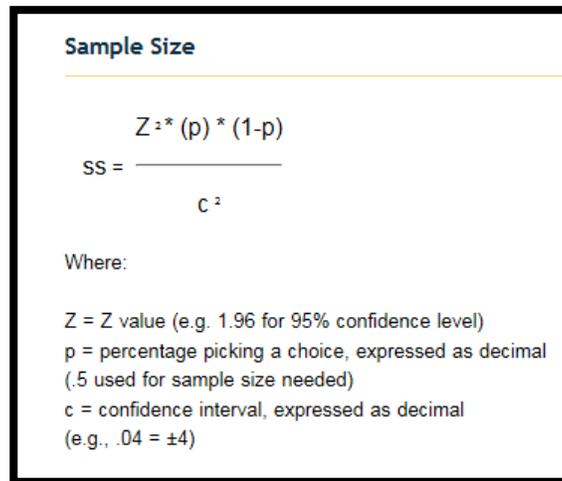


Figure 3

*ArcGIS map displaying the registered boat owners that live within a 10mi radius of
BBAP in Miami-Dade County*

Based on the population size of 35,327 registered recreational boat owners within 10mi of BBAP, an expected response rate of 25%, and a confidence level of 95%, a sample size of 300 registered owners was selected for the mail survey.

The statistics were completed using The Survey System website. The website describes its sample size formula in Figure 4.



Sample Size

$$SS = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

- Z = Z value (e.g. 1.96 for 95% confidence level)
- p = percentage picking a choice, expressed as decimal (.5 used for sample size needed)
- c = confidence interval, expressed as decimal (e.g., .04 = ±4)

Figure 4³¹

The Survey System's sample size formula

BBAP provided letterhead, envelopes, and stamps for 300 questionnaires. The recipients were chosen using an online random number generator to select 300 numbers between 1 and 35,327; when there were duplicate numbers generated, the next consecutive number was used. Next, each randomly generated number corresponded to a street address in the ArcGIS shapefile table of attributes. As each street address was

³¹ Creative Research Systems

selected due to the randomly generated numbers, they were matched to their detailed address in the DMV's excel spreadsheet, providing the full name and address for each questionnaire packet.

The 300 questionnaire packets each contained a one-page cover letter on BBAP letterhead, the questionnaire, and a pre-addressed envelope with prepaid postage to return the questionnaire to BBAP. The one-page cover letter was provided in both English and Spanish; the questionnaire was also provided in both languages. The questionnaire was also made present in both English and Spanish online via Qualtrics, an online survey instrument for survey dispersal and analysis, and the link was provided in the cover letter. Copies of the cover letter and the questionnaire are provided in Appendix 7.2

An abridged version of the cover letter was sent to the members of the Friends of Biscayne Bay Board and volunteers with the survey link provided to be forwarded, in order to increase numbers of responses from Miami-Dade registered boat owners.

The questionnaires were mailed December 22nd, 2014. The close date for the surveys was January 31st, 2015. When received, all returned questionnaires were entered into Qualtrics via the permalink for analysis.

25 questionnaires were also given to a BBAP volunteer to distribute at their boating club.

3.0 Results

3.1 Activity 1: Intercept Surveys

64 total intercept surveys were completed. The goal was to complete between 15 and 20 surveys at each site. Table 1 displays how many responses were collected at each site.

The location was also the first answer on the survey.

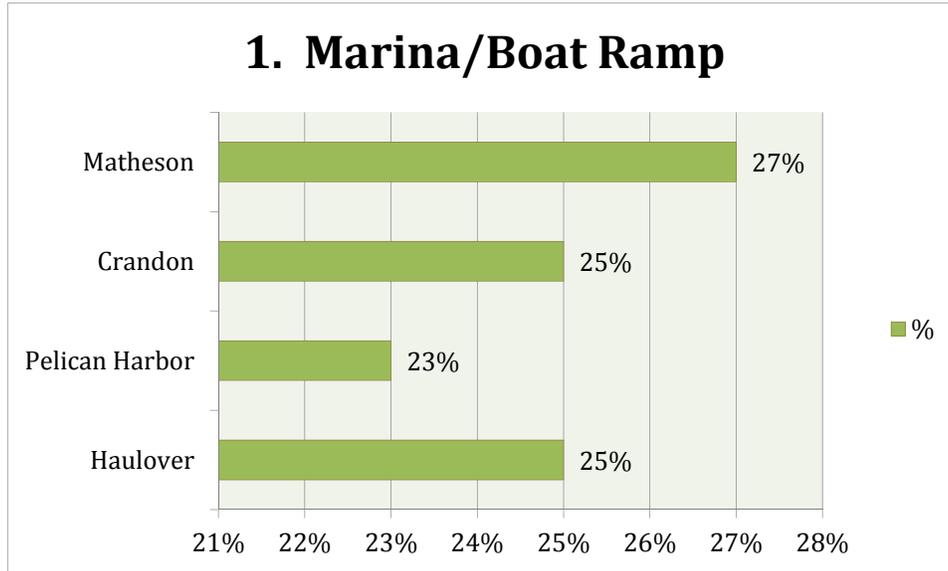


Table 1

The goal was achieved, with at least 15 surveys completed at each site. The lowest number of surveys, 15, was collected at Pelican Harbor. Haulover and Crandon had equal numbers of surveys, each at 16. Matheson had the greatest number at 17. However, the standard deviation is only 1.14, and the response rates are nearly equal.

Below are the results of the questions of the intercept surveys.

2. How long have you been boating on Biscayne Bay?

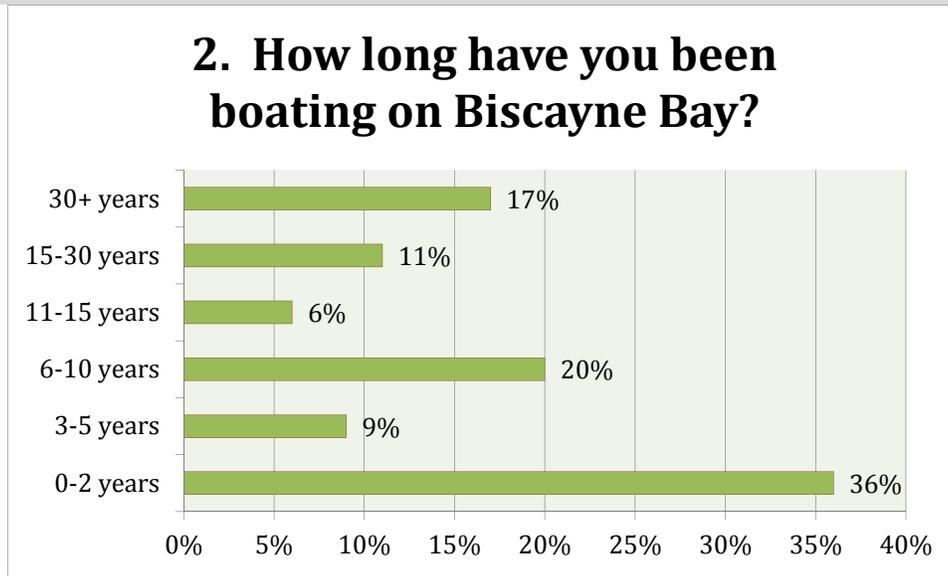


Table 2

0-2 years write-in answers
20+YEARS IN GENERAL
3 MONTHS TOTAL
30 YEARS+ IN GENERAL
30 YEARS+ IN GENERAL
1ST TIME ON BISCAYNE BAY

3. What is your zipcode?

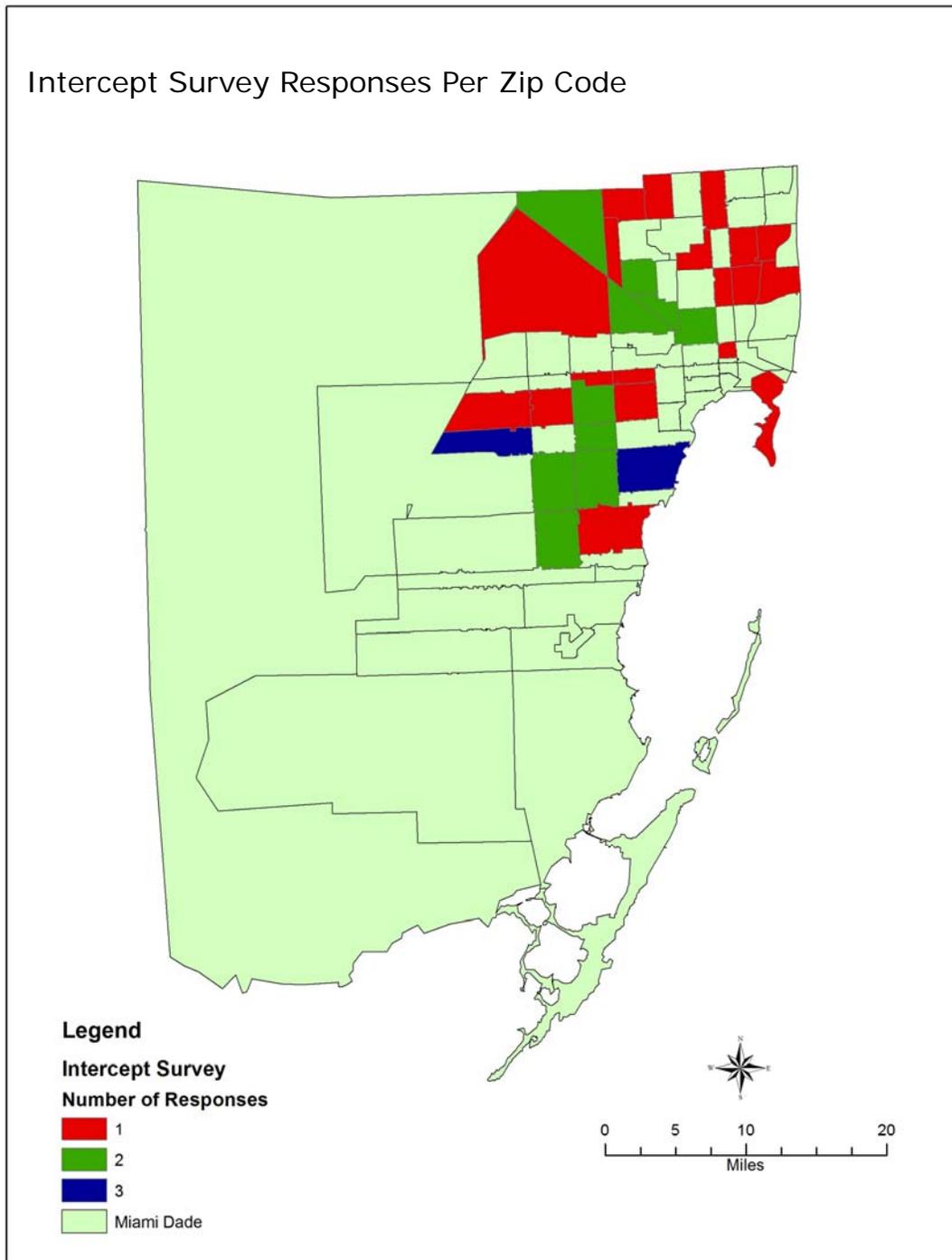


Figure 5

4. What size is your boat?

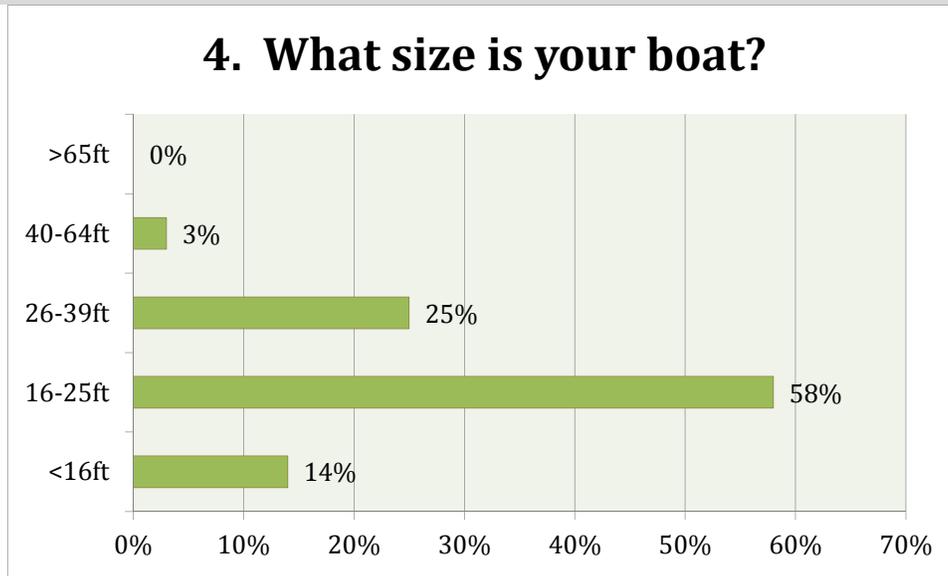


Table 3

5. What boat ramp do you usually use?

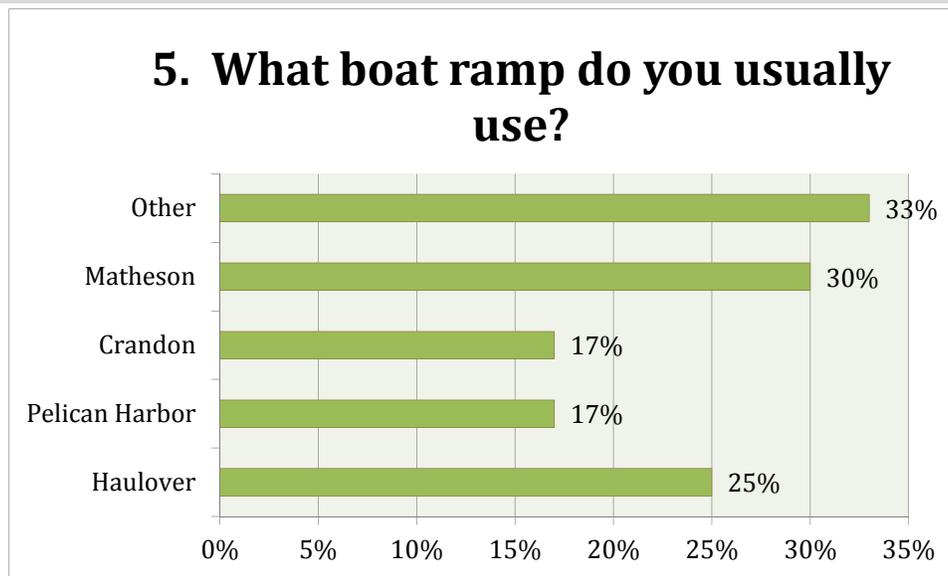


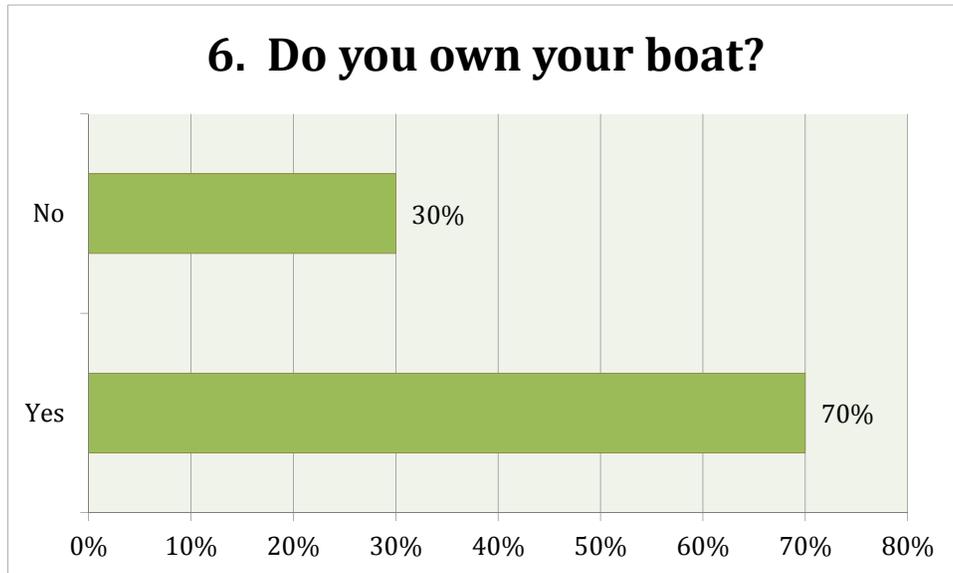
Table 4

Other

Answer	Frequency
Haulover Commercial Marina	3
Boynton	
Blackpoint	5

Keys	2
House/Home Dock	3
1 st time on Biscayne Bay	2
West Palm/Palm Beach	2
Oleta	
Others: Lots, PJ	

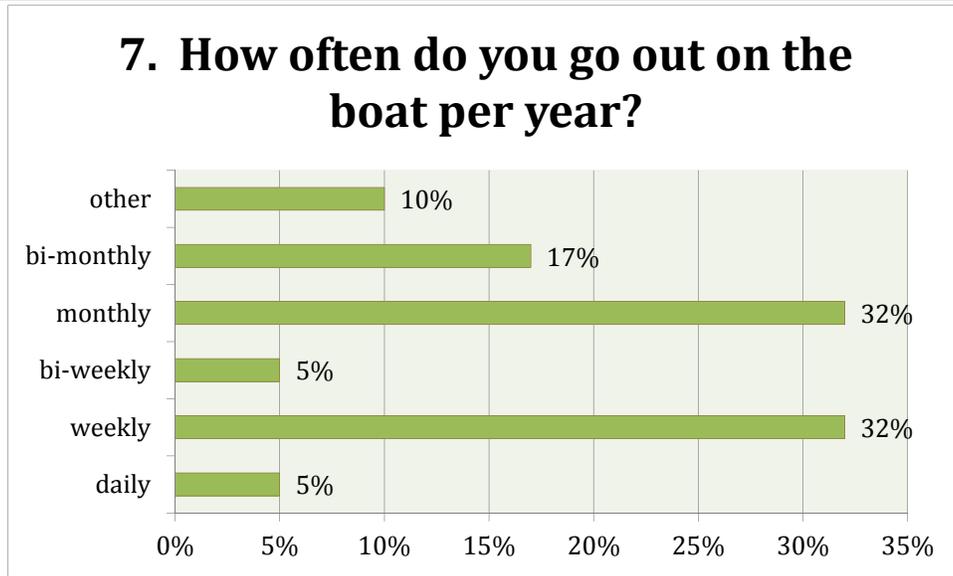
6. Do you own your boat?



No
HUSBAND
HUSBAND
DAD
FRIEND'S
FRIEND'S DAD
BROTHER'S
COUSIN
FRIEND
FIANCE

Table 5

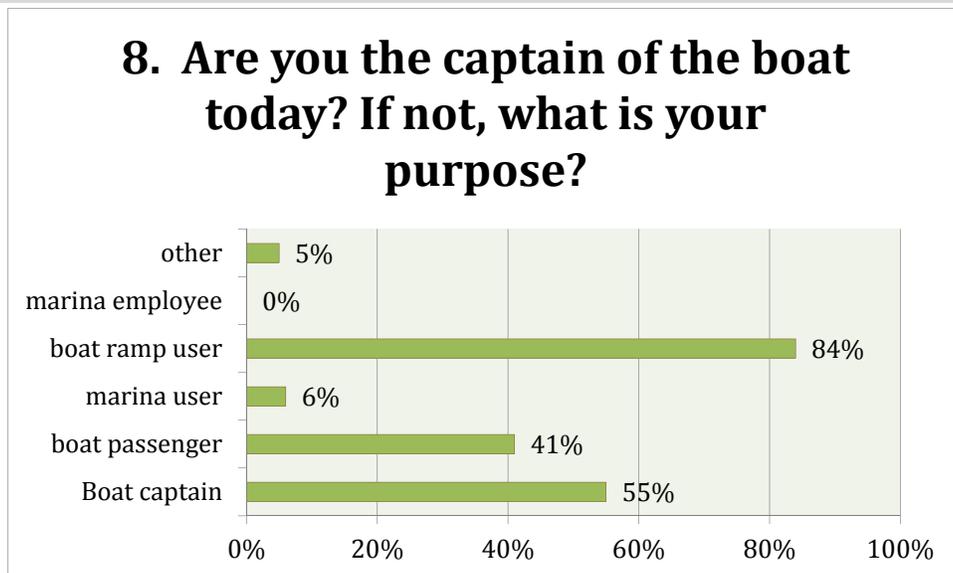
7. How often do you go out on the boat per year?



other
30-40
6-8X SUMMER
8X A YEAR
1 OR 2 X
NA
SEASONAL

Table 6

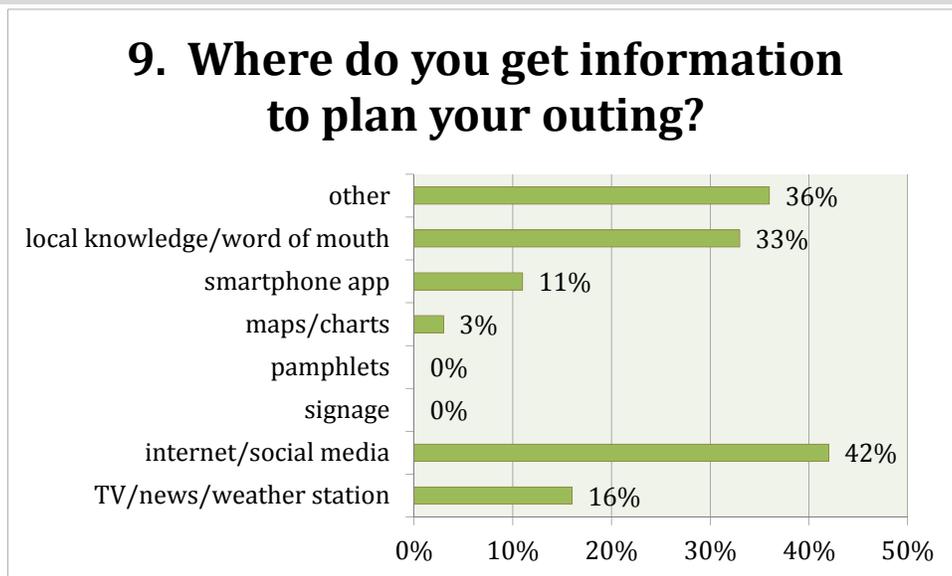
8. Are you the captain of the boat today? If not, what is your purpose?



other
OWNER
MATE
FUELING

Table 7

9. Where do you get information to plan your outing?

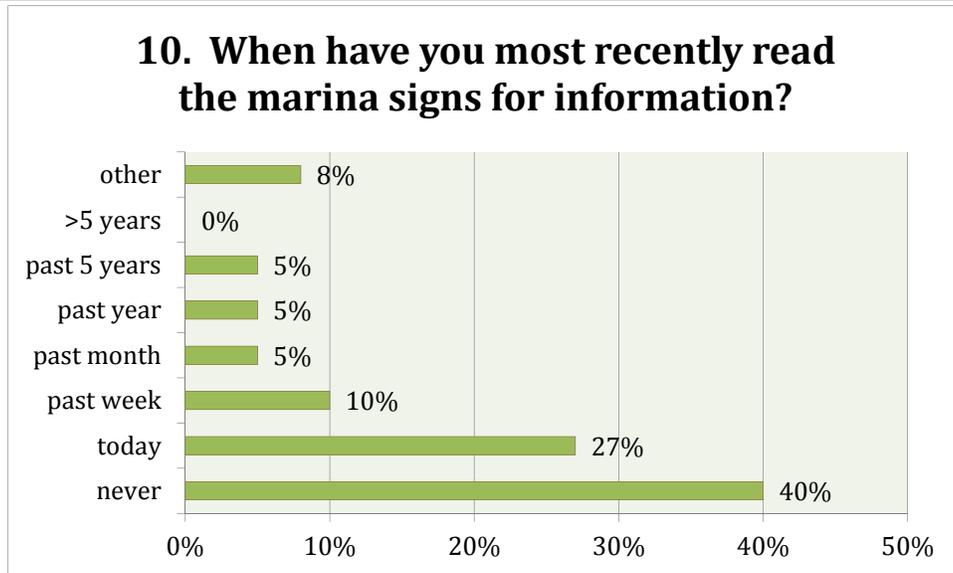


other	
Answer	Frequency (%)
vhf radio	1.5%
Dive Shop	1.5%
Google	1.5%
Make it up	1.5%
Experience	10.9%
Family/husband/fiance	4.7%
Boat safety course	1.5%
Weather by looking outside	1.5%
GPS	3%
Magazines, Radio	1.5%

Friends	1.5%
Fishing club	1.5%

Table 8

10. When have you most recently read the marina signs for information?



other
OCCASIONALLY
HUSBAND-PAST MONTH
NA
NA
UNSURE, POSSIBLY LAST 5 YEARS

Table 9

11. Have you learned information about natural resources from these signs?

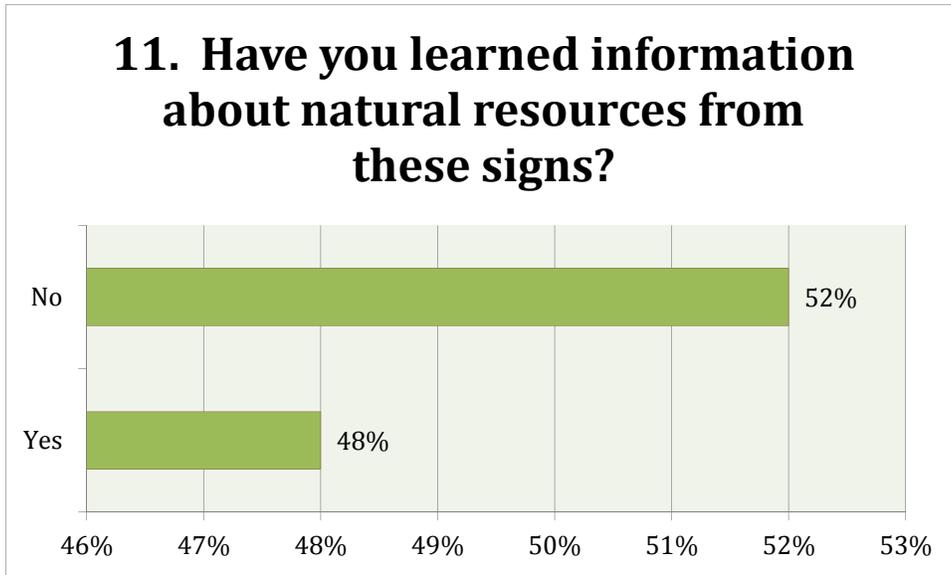


Table 10

12. Have you learned information about boating safety from these signs?

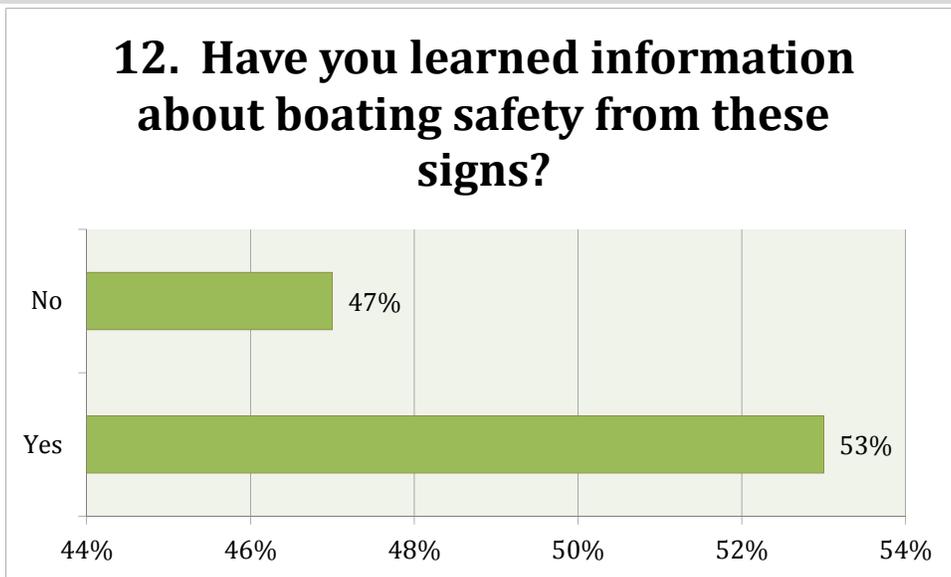


Table 11

13. Does the current marina signage meet your needs?

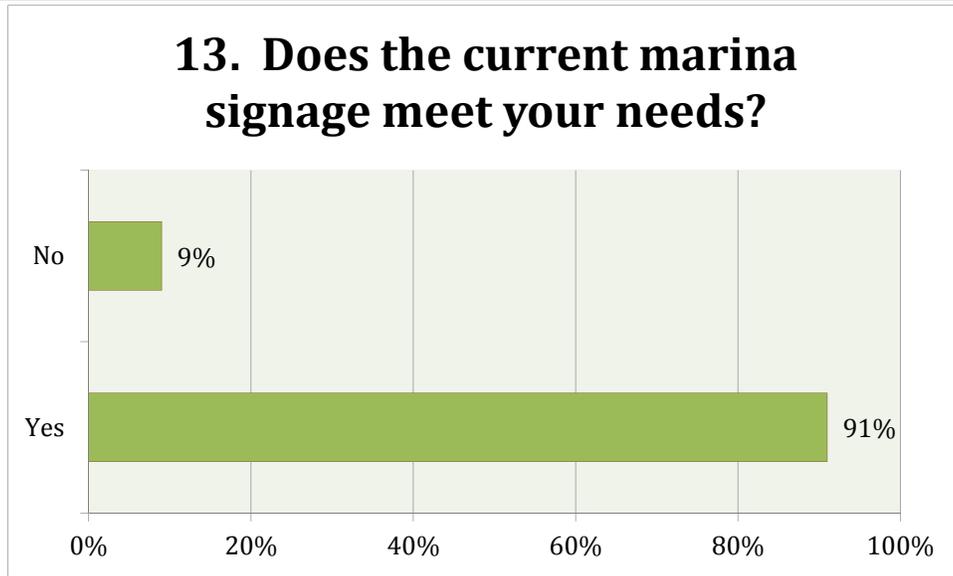


Table 12

14. From what you've seen, do you feel there is too little, too much, or an adequate amount of wording on the signs?

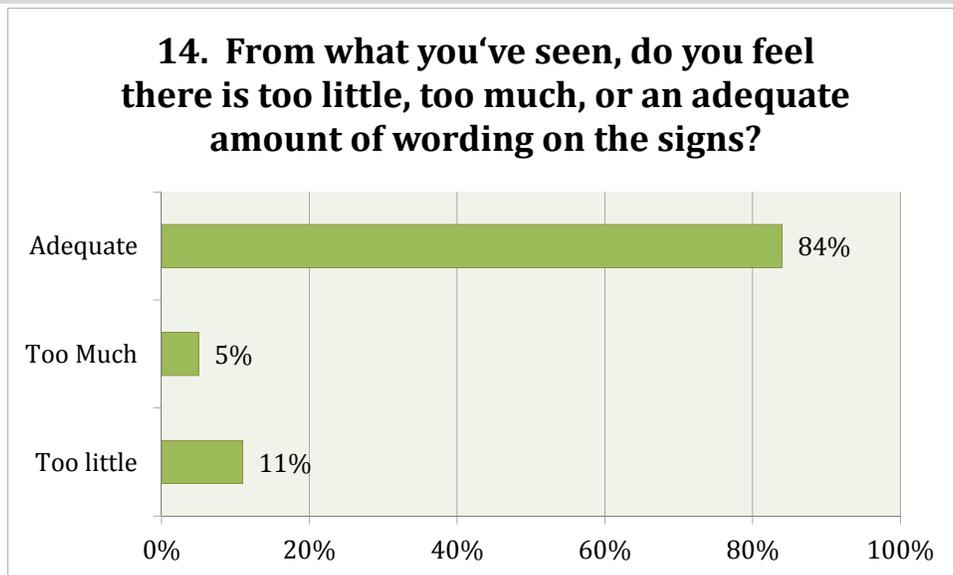
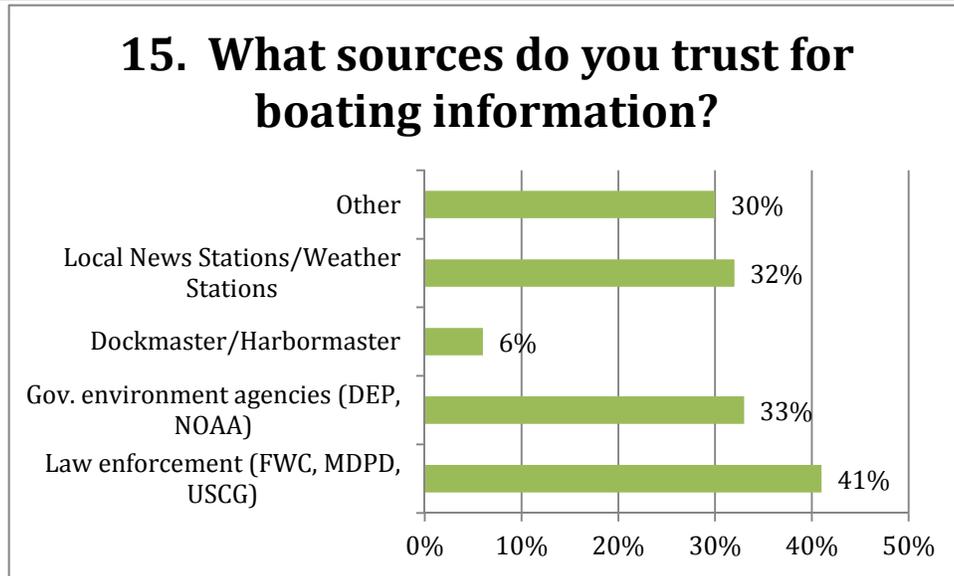


Table 13

15. What sources do you trust for boating information?



Specific Law Enforcement:	Specific Gov. Environment Agencies:	Specific Local News Stations/Weather Stations:	Other:
USCG	NOAA	WEATHER STATIONS	NO ANSWER
FWC	NOAA	WEATHER STATIONS	SIGNS
FWC	NOAA	WEATHER STATIONS	VHF RADIO
FWC		WEATHER STATIONS	ONLINE, GOOGLE
FWC			INTERNET
			OTHER BOATERS
			LAW
			ENFORCEMENT
			IS MORE OF A
			HINDRANCE;
			OTHER CAPTAINS
			AND MARINAS
			BOAT US
			NA
			HUSBAND
			NA
			EVERYBODY
			NA
			PEOPLE
			GOOGLE
			OWN SKILLS
			HIMSELF,
			DOESN'T TRUST
			"CONTROL"
			AGENCIES

Table 14

16. Did you know this marina/boat ramp is in a state Aquatic Preserve?

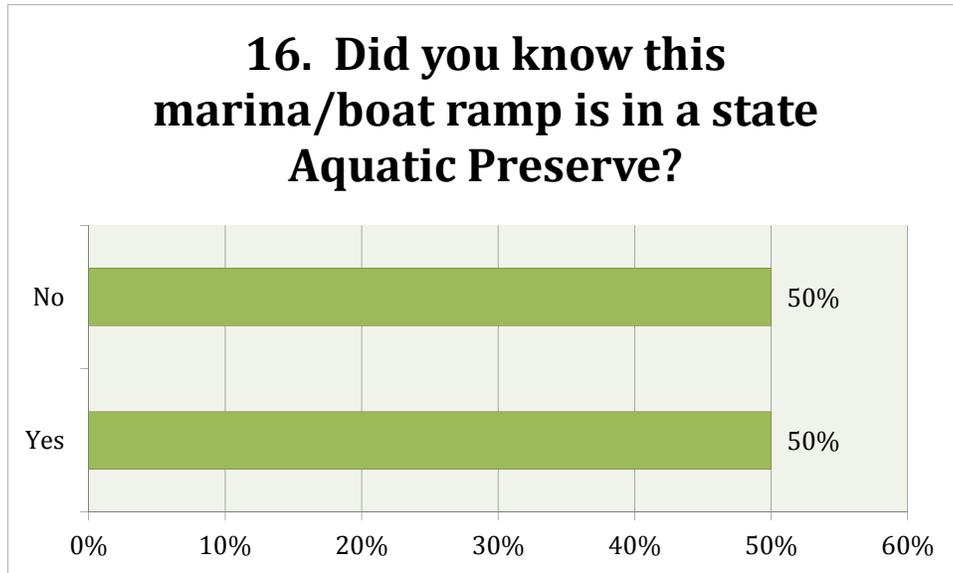
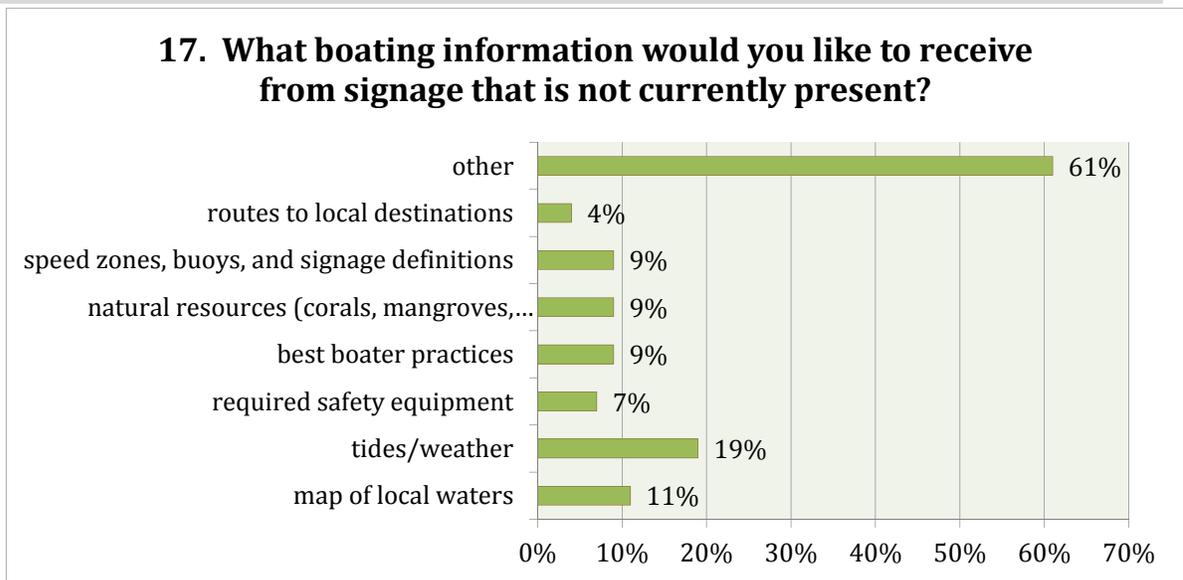


Table 15

17. What boating information would you like to receive from signage that is not currently present?

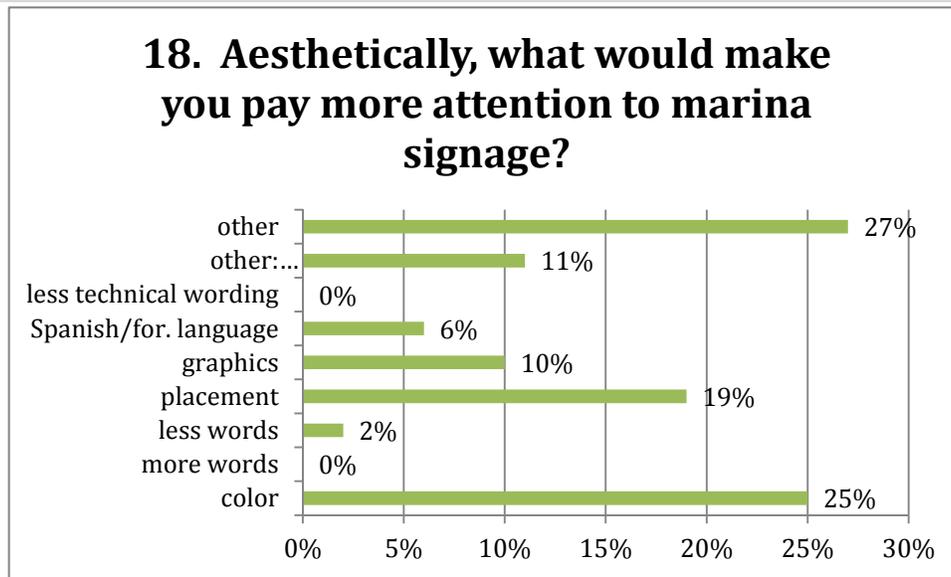


Other	
Answer	Frequency
BUI	2
Fishing	

No brakes on boats	
Fine the way they are; good	2
Where to pay and launch	
When the boat ramp is full or how long the wait is	
Velocity	
Beach access	
None	

Table 16

18. Aesthetically, what would make you pay more attention to marina signage?



other	
Answer	Frequency
Brighter	1
Not faded	1
Different types	1
Bigger	2
Pretty	1
Smaller signs	1

Placement	1
Animals	1
BUI	1
Bigger wording/bullet points	3
More information	2
Ok as they are	3

Table 17

Part 2: Demographics

19. Sex

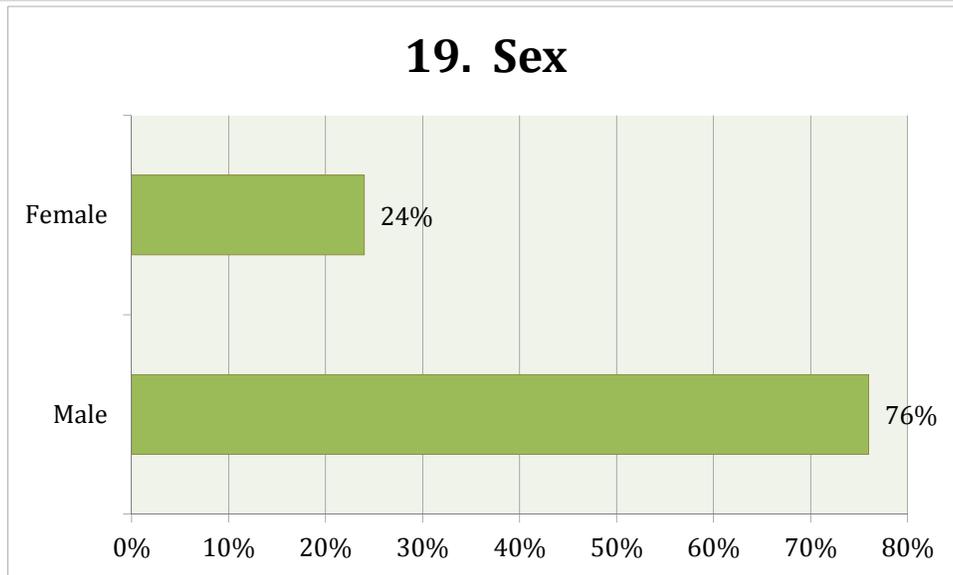


Table 18

20. Age

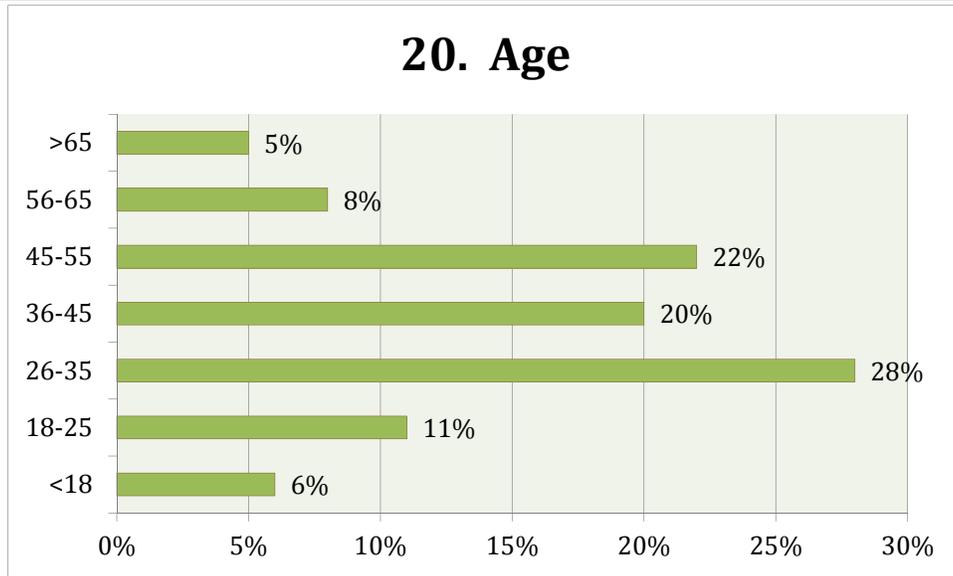


Table 19

21. Did you see the respondent read any marina signage?

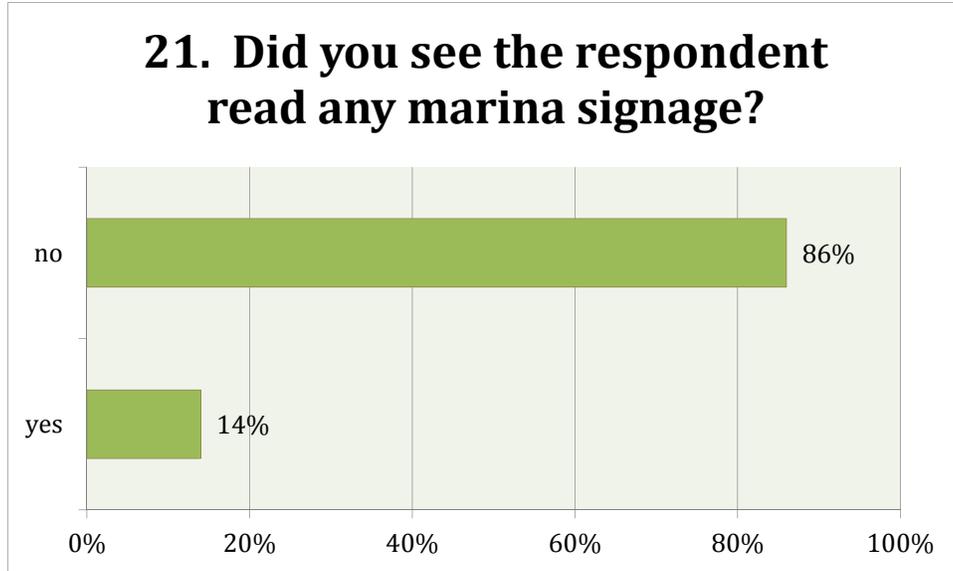


Table 20

22. Which state is the vessel registered in?

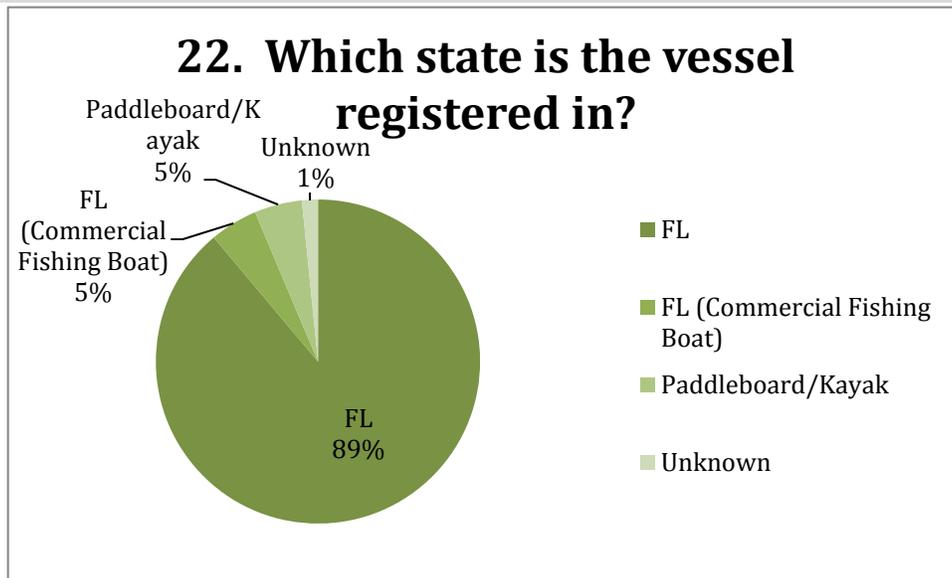


Table 21

23. Was the respondent entering or exiting the boat ramp?

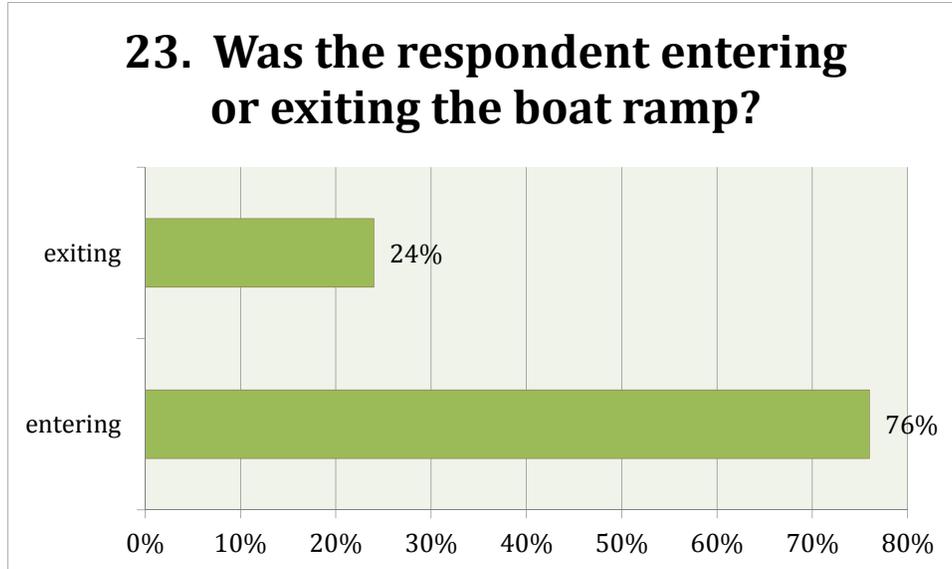


Table 22

24. What was the vessel type?

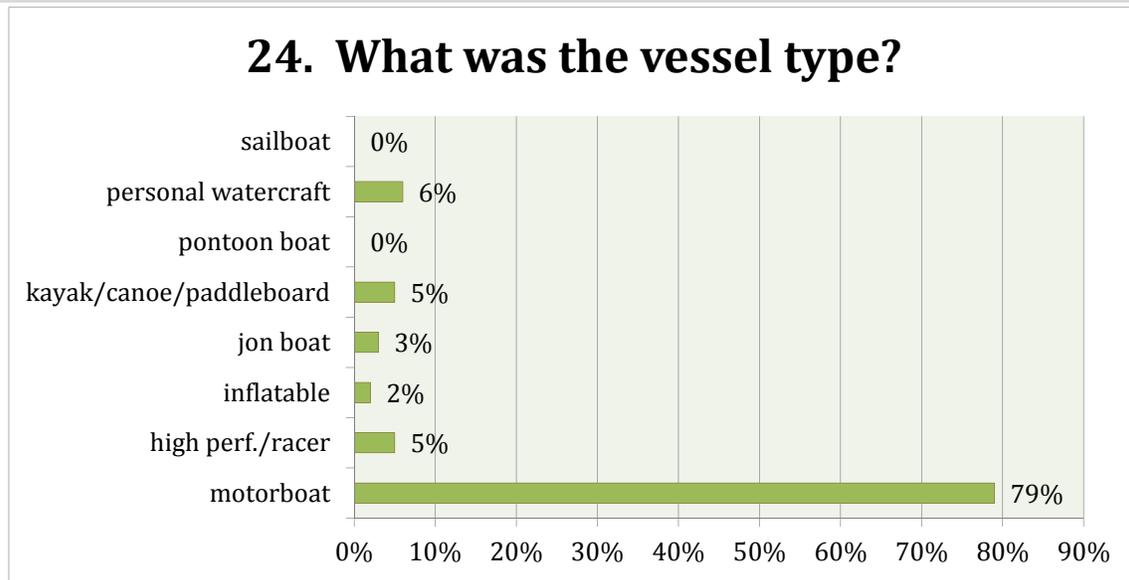


Table 23

3.2 Activity 2: Mailed Questionnaires

40 Questionnaires were returned by mail, 1 questionnaire was completed online. 5 questionnaires were returned to sender. Removing the 5 undeliverable surveys from the equation, there was a 13.89% return rate. The questionnaires distributed by the BBAP volunteer had a 0% return rate by mail, however due to the anonymous nature of the questionnaire, it is unknown which group the 1 online questionnaire came from.

Statistics:

Population Size: 35, 327 registered recreational boat owners within 10mi of BBAP

Actual Response Rate: 13.89%

Confidence Interval: 3.9

1. How long have you been boating on Biscayne Bay?

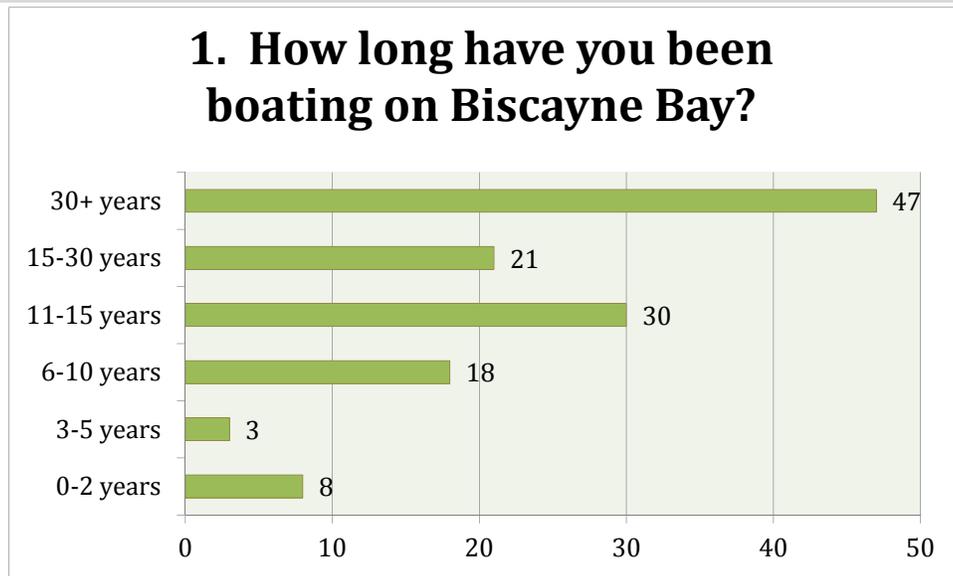


Table 24

2. What is your zipcode?

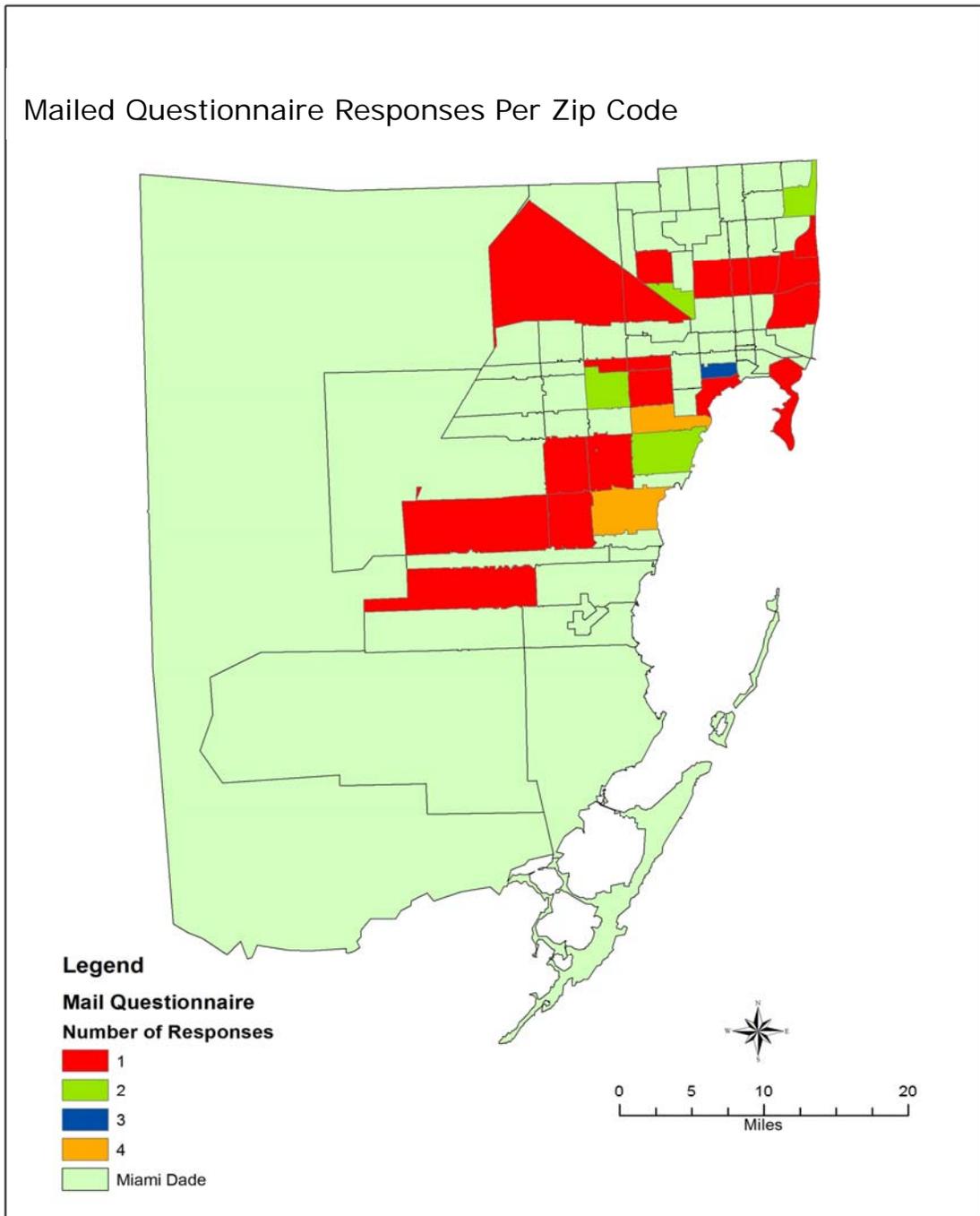


Figure 6

3. What size is your boat?

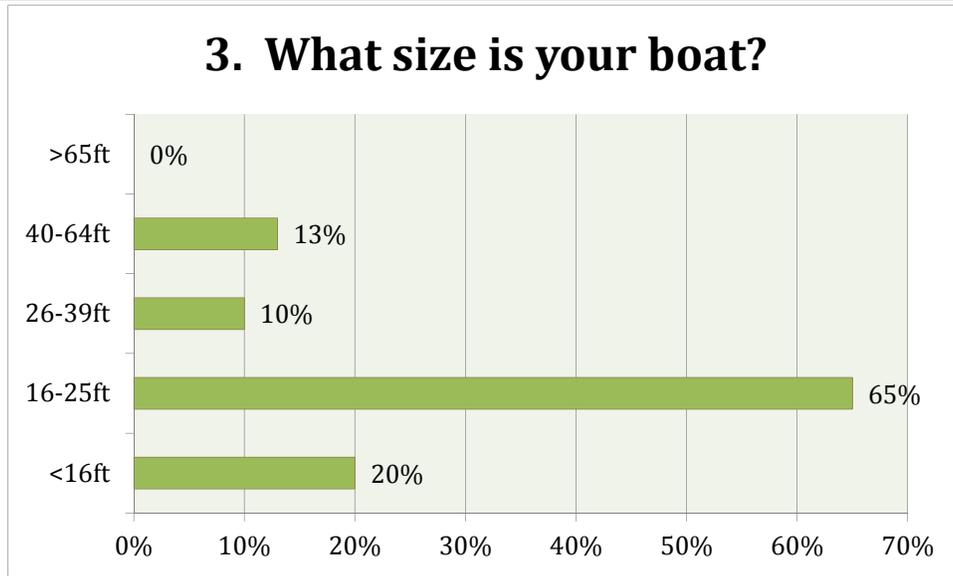
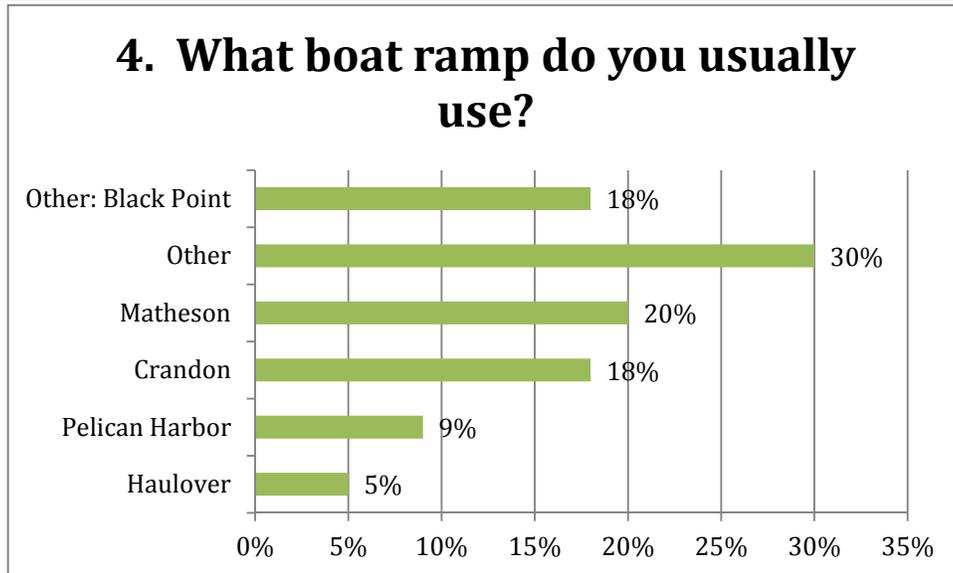


Table 25

4. What boat ramp do you usually use?



Other	
Boat ramp	Frequency
Dinner Key	2

Homestead	2
Miami Beach	1
Bayfront	1
Pine Key	1

Table 26

5. Do you own your boat?

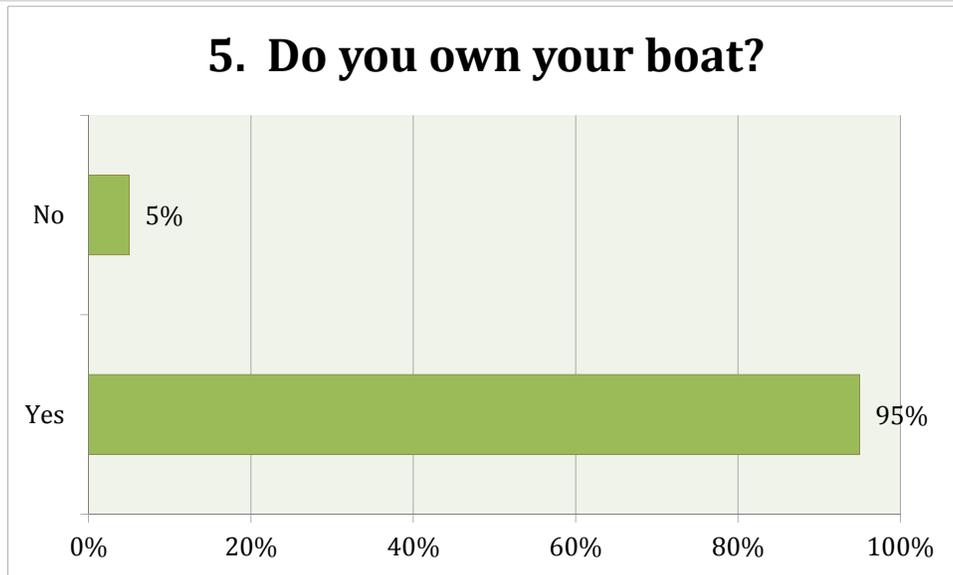
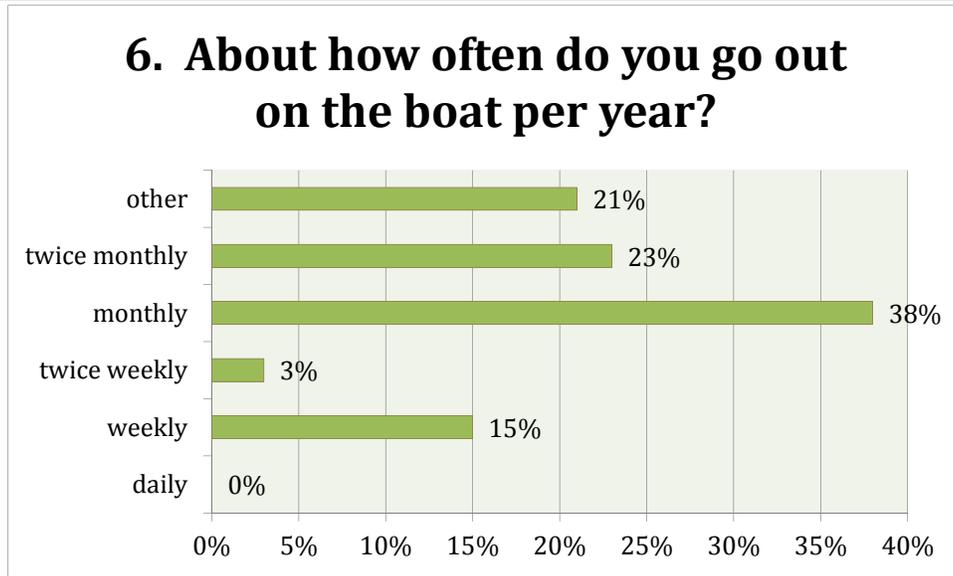


Table 27

6. About how often do you go out on the boat per year?



other
every 4-6 weeks
liveaboard
few times a year
3-4 times a year
when i have the chance
4-5x a year

Table 28

7. Which role(s) do you typically identify with? (select all that apply)

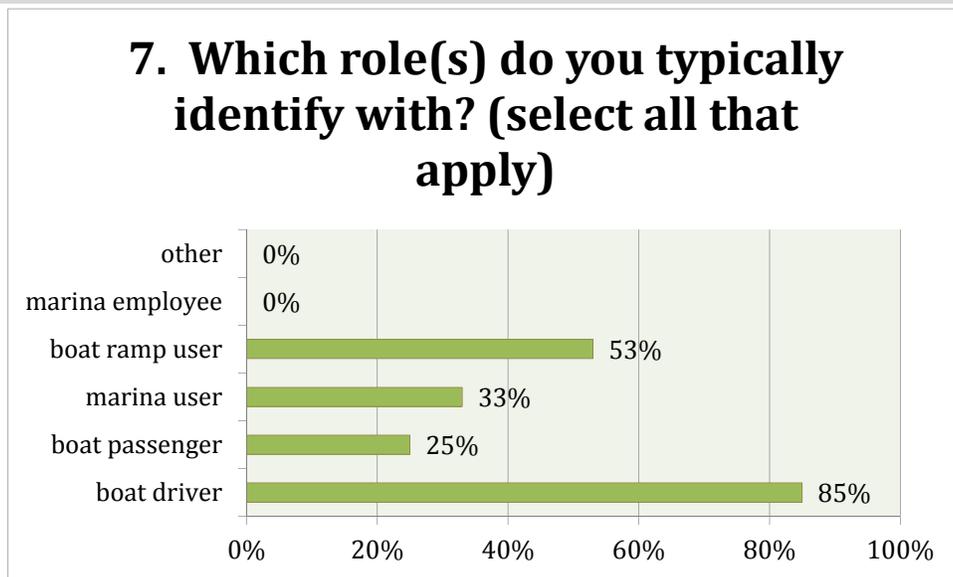
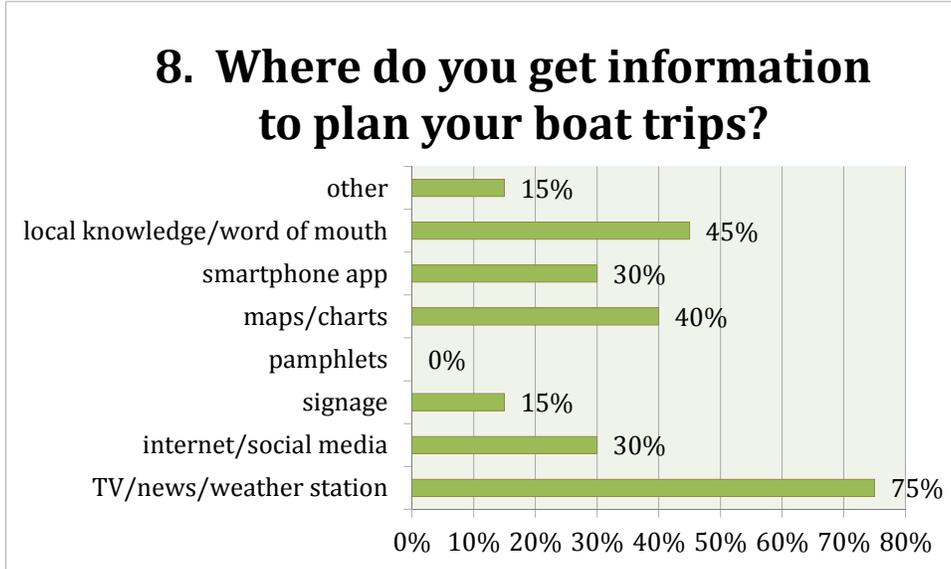


Table 29

8. Where do you get information to plan your boat trips?



other
windguru.com
NOAA
Coastal Angler (magazine)
Florida Sportsman, Fishing Planner magazines
guide books

Table 30

9. When have you most recently read the educational marina signs for information?

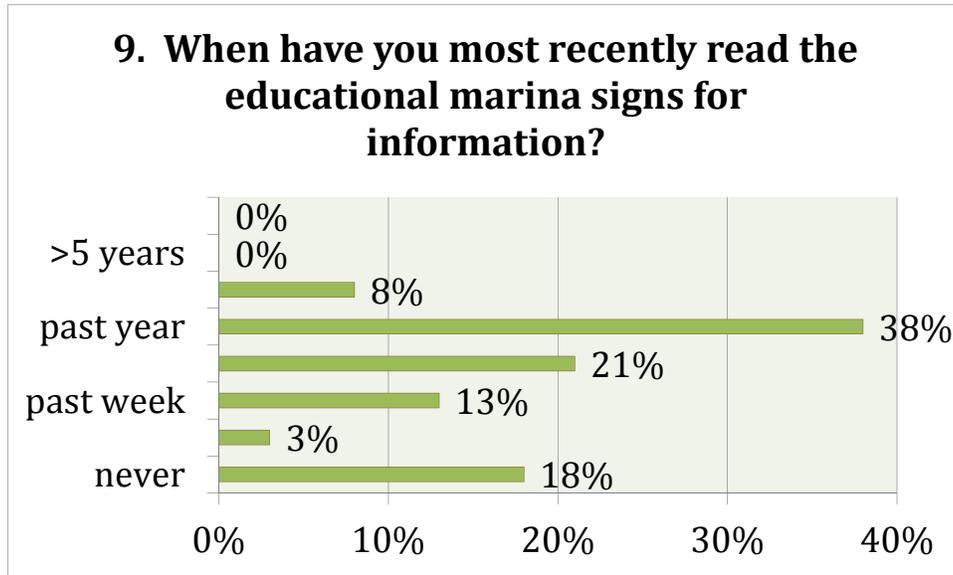


Table 31

10. Have you learned information about natural resources from these signs?

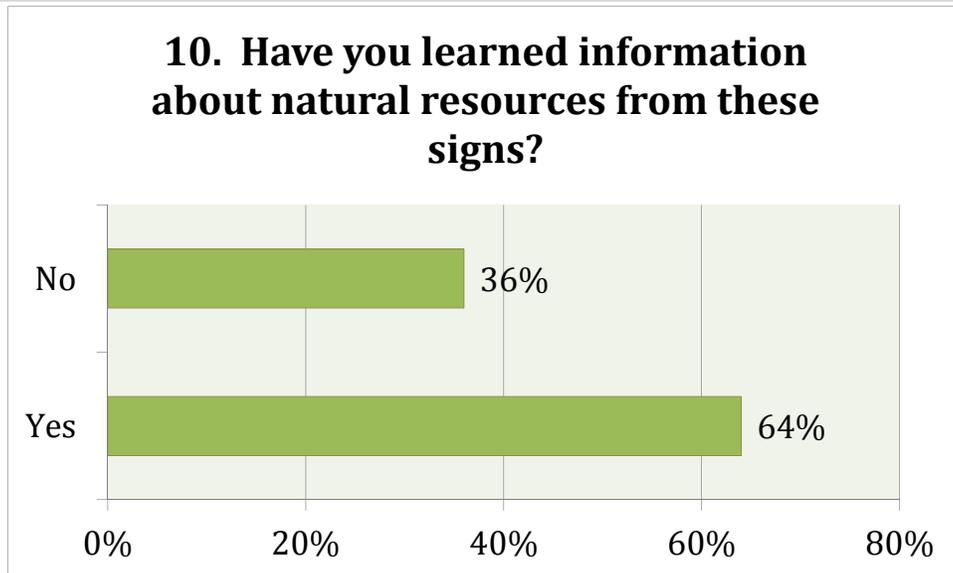


Table 32

11. Have you learned information about boating safety from these signs?

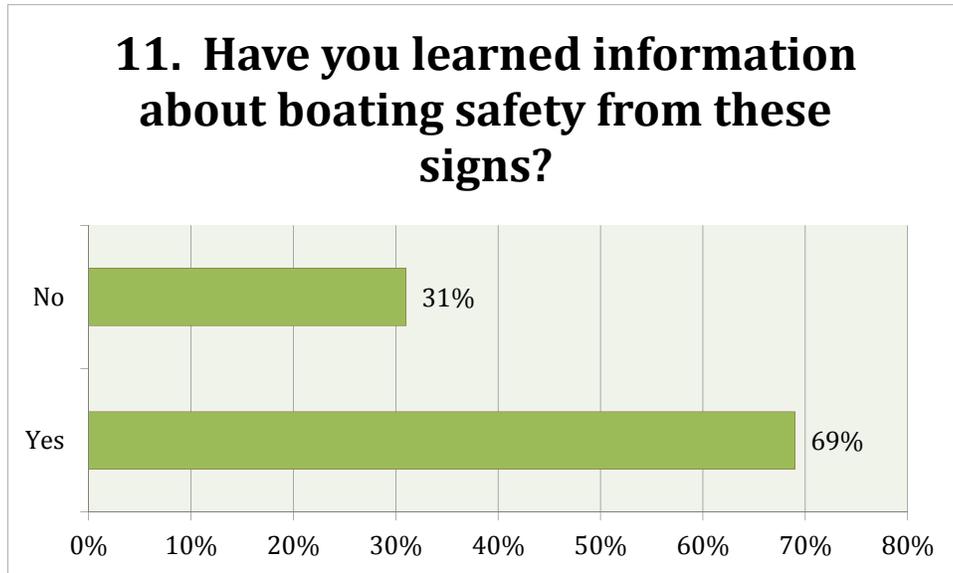


Table 33

12. Does the current educational marina signage meet your needs?

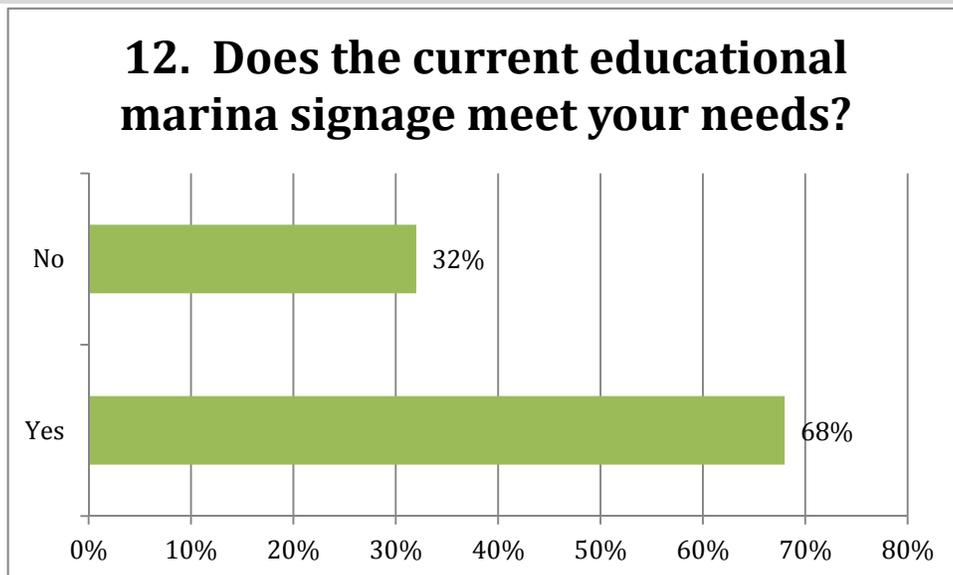


Table 34

13. From what you've seen, do you feel there is too little, too much, or an adequate amount of wording on the signs?

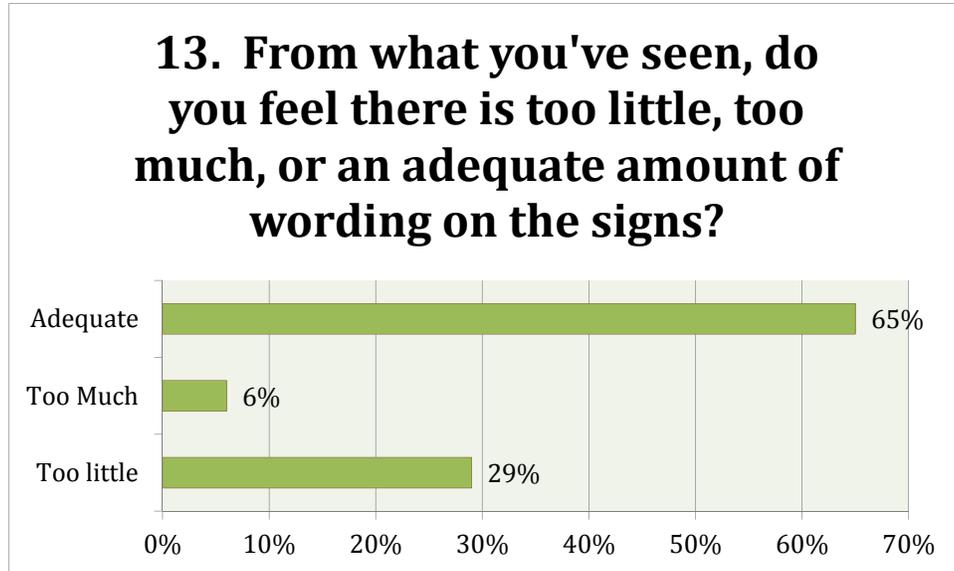
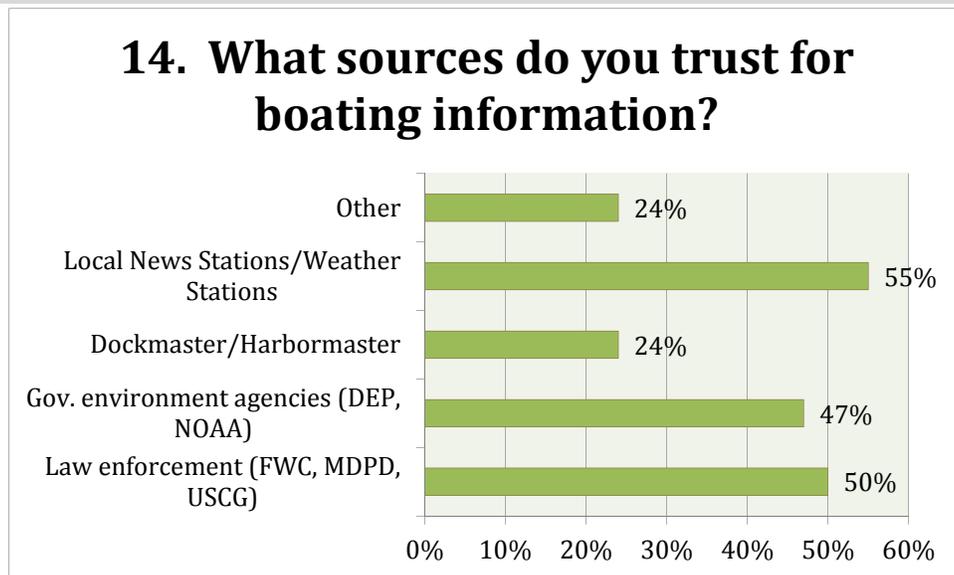


Table 35

14. What sources do you trust for boating information?



other
NOAA internet
My memory
me
Any recent changes in catch sizes
Internet size limits
Internet
Guide books
Internet
Internet
Weather stations
FWC, USCG
USCG
NOAA

Table 36

15. Did you know this marina/boat ramp is in a state Aquatic Preserve?

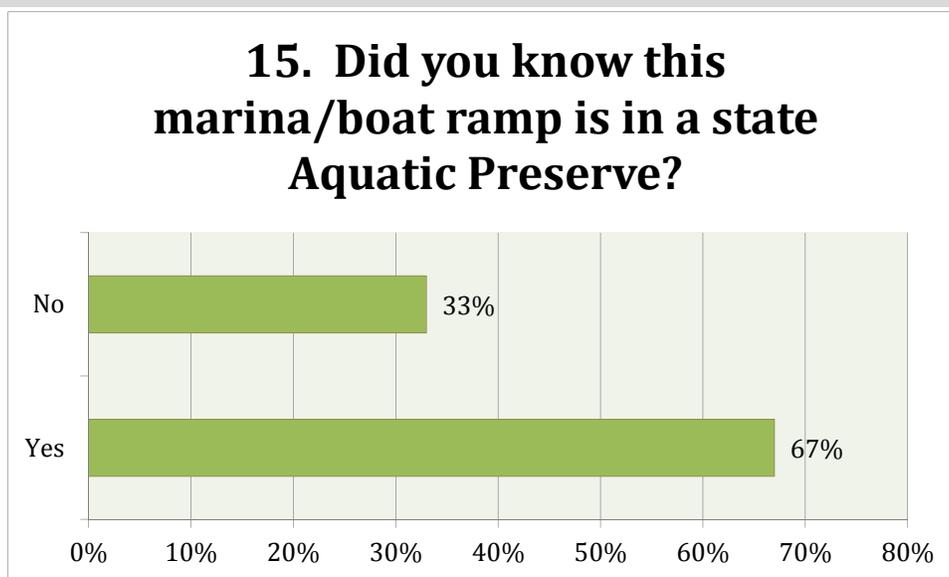
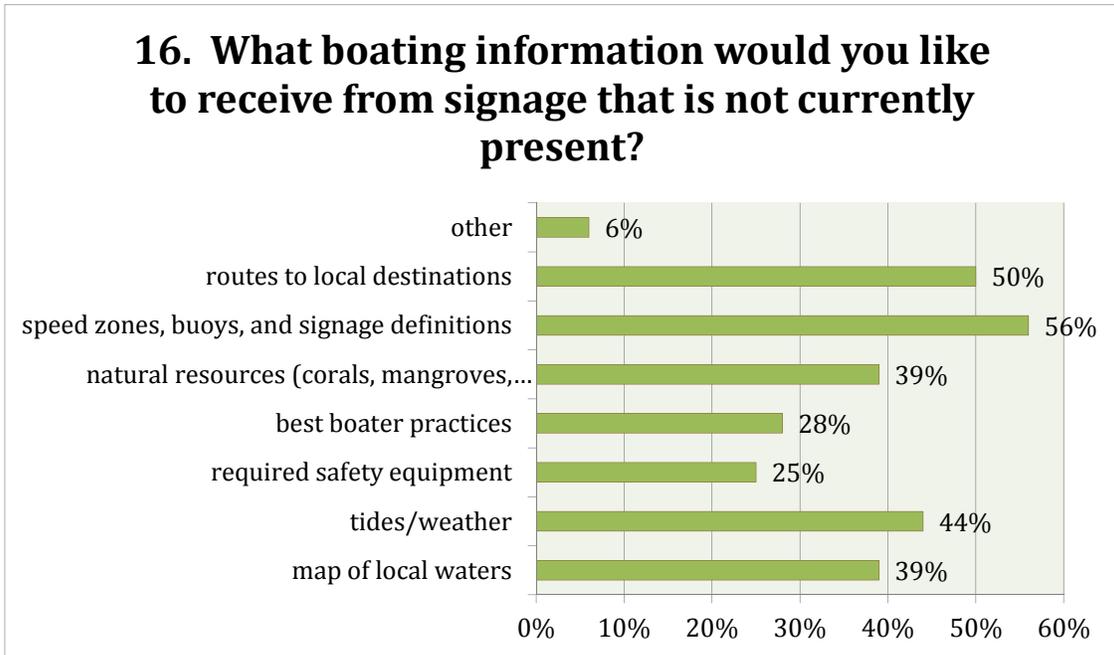


Table 37

16. What boating information would you like to receive from signage that is not currently present?



other
follow navigational rules; be courteous to fellow boaters, respect sea wildlife (and protect); you will be fined; rules strictly enforced
NOAA Chart 11465 should be posted at all marinas south of Miami River

Table 38

17. Aesthetically, what would make you pay more attention to marina signage?

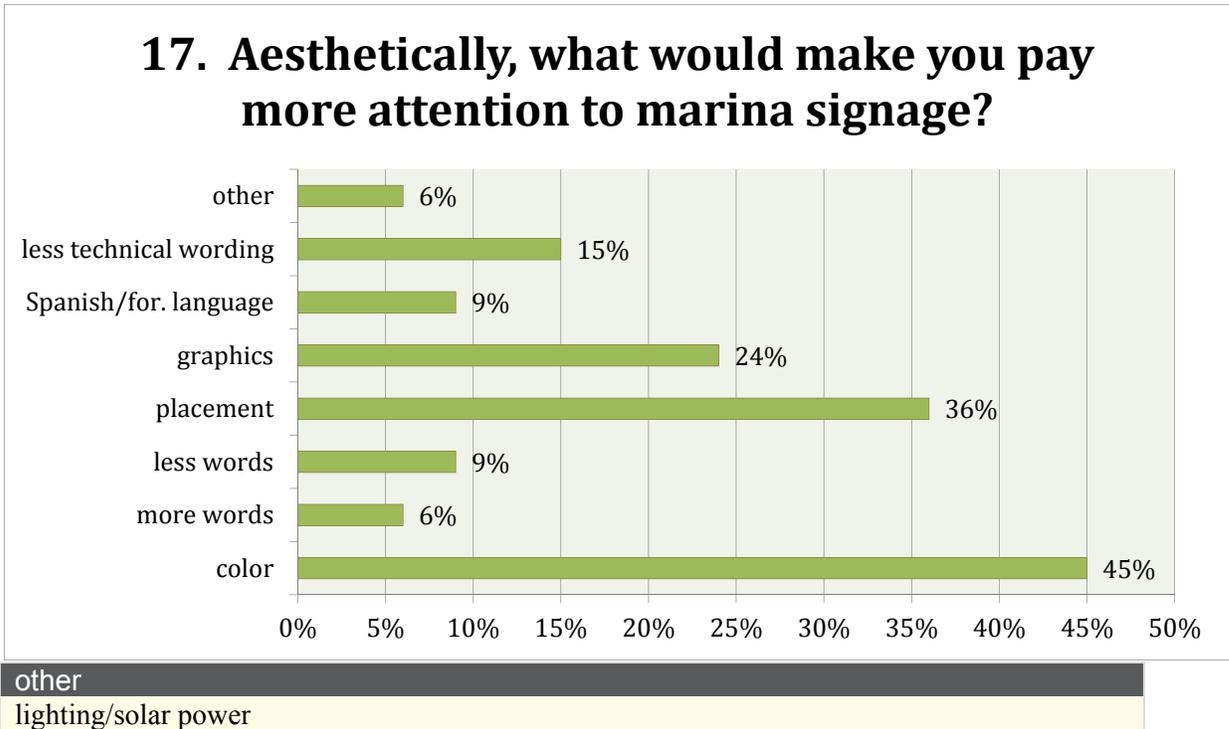


Table 39

18. Sex

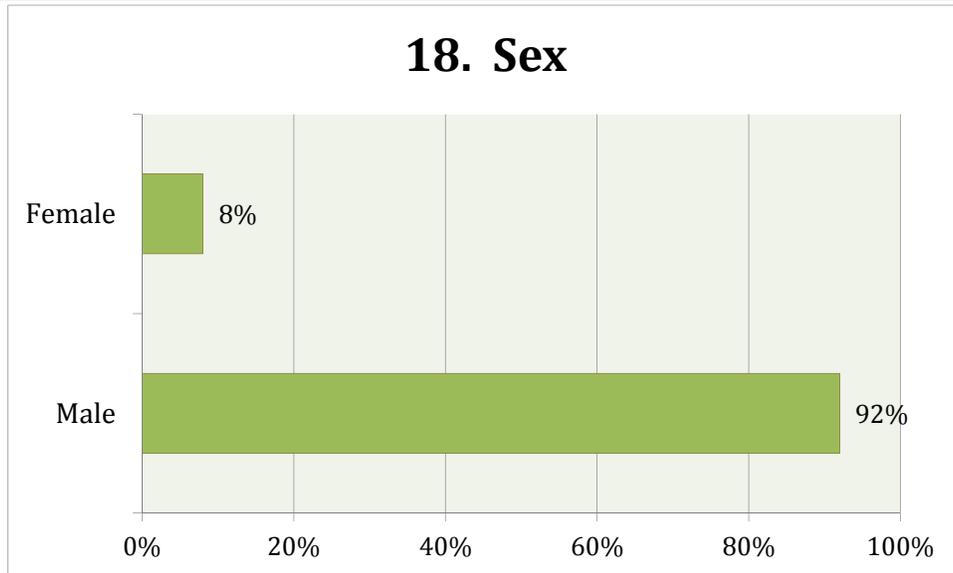


Table 40

19. Age

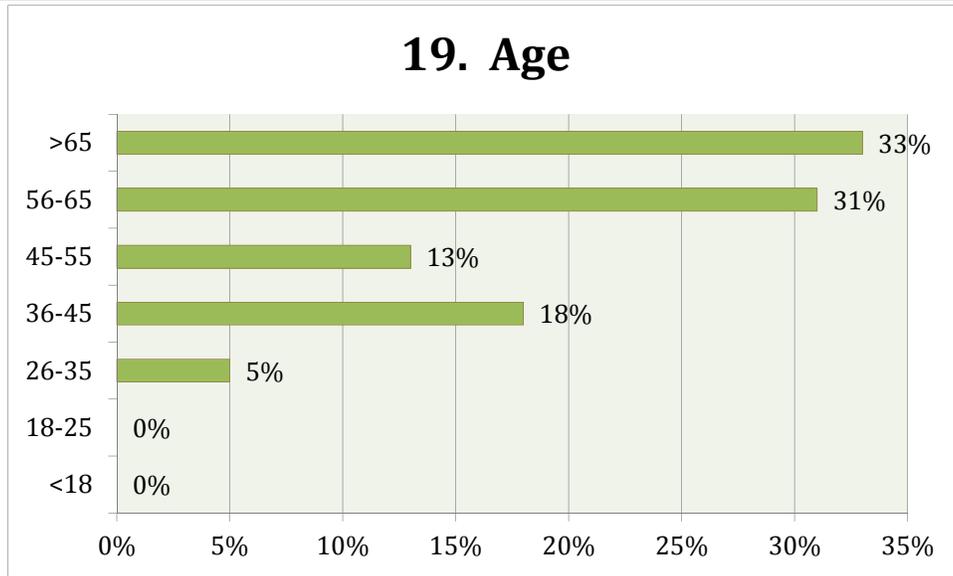


Table 41

20. Which state is your vessel registered in?

All registered in Florida

21. What is your vessel type?

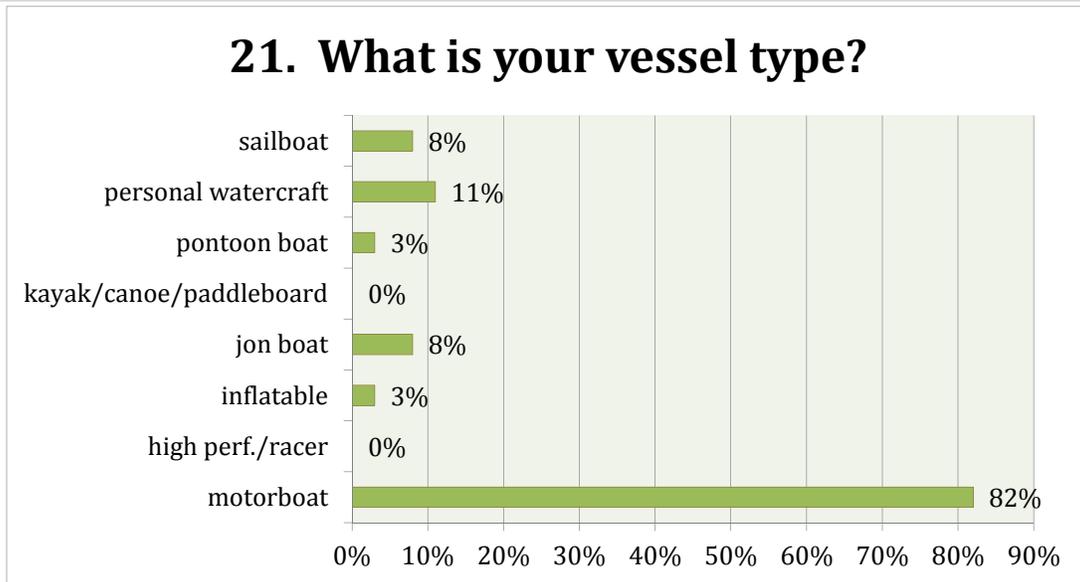


Table 42

4.0 Discussion

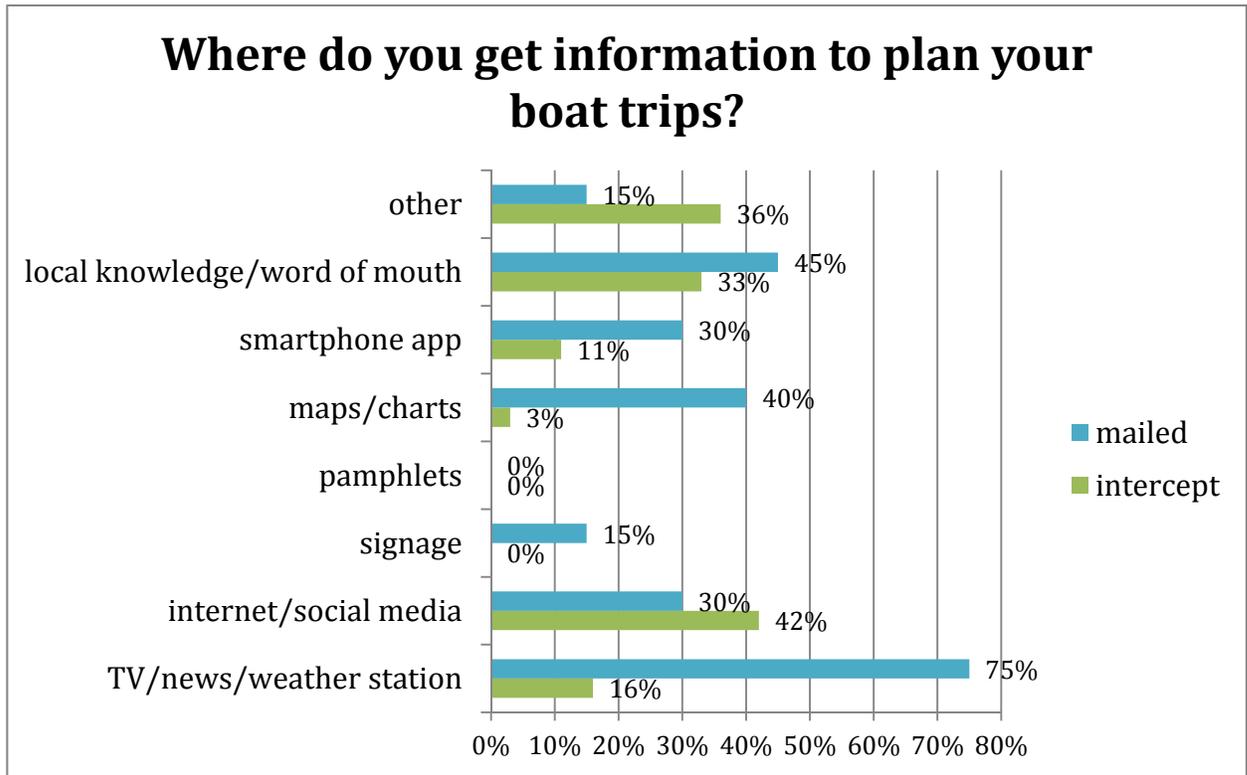


Table 43

Both groups of respondents expressed little effect of signage on planning boat trips. However, despite the two very different age groups, they showed a similar dependence on internet and social media for planning their trips, as intercept survey respondents selected this option 42% overall and mailed questionnaire respondents chose this 30% overall. Mail respondents and intercept respondents both cited local knowledge/word of mouth as important sources of information for planning boat trips. TV/news/weather stations were very important to mailed questionnaire respondents, being answered 75% of the time. Signage was selected minimally, at 0% and 15%. This is a slight increase over pamphlets, however signage is clearly not being used by boaters when planning to go out on the water.

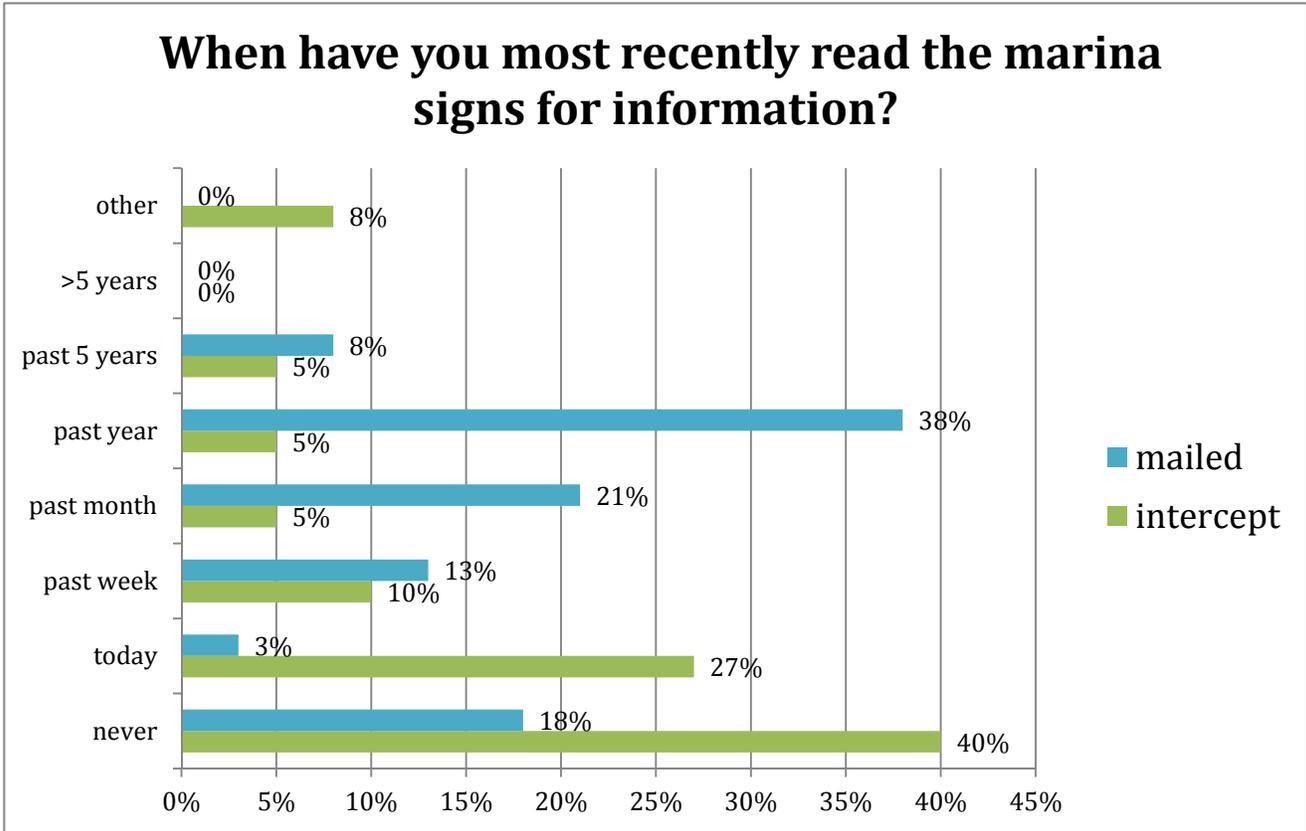


Table 44

A surprising amount of respondents admitted to never having read the signage. Despite 64% of mailed respondents being 56 years of age and older, almost 20% had never read one of the educational signs in their entire lives. And 40% of intercept survey respondents admitted to never having read the signs either. This shows that in addition to the boaters not using the information from the educational signage, they are not even reading the signs in the first place.

What sources do you trust for boating information?

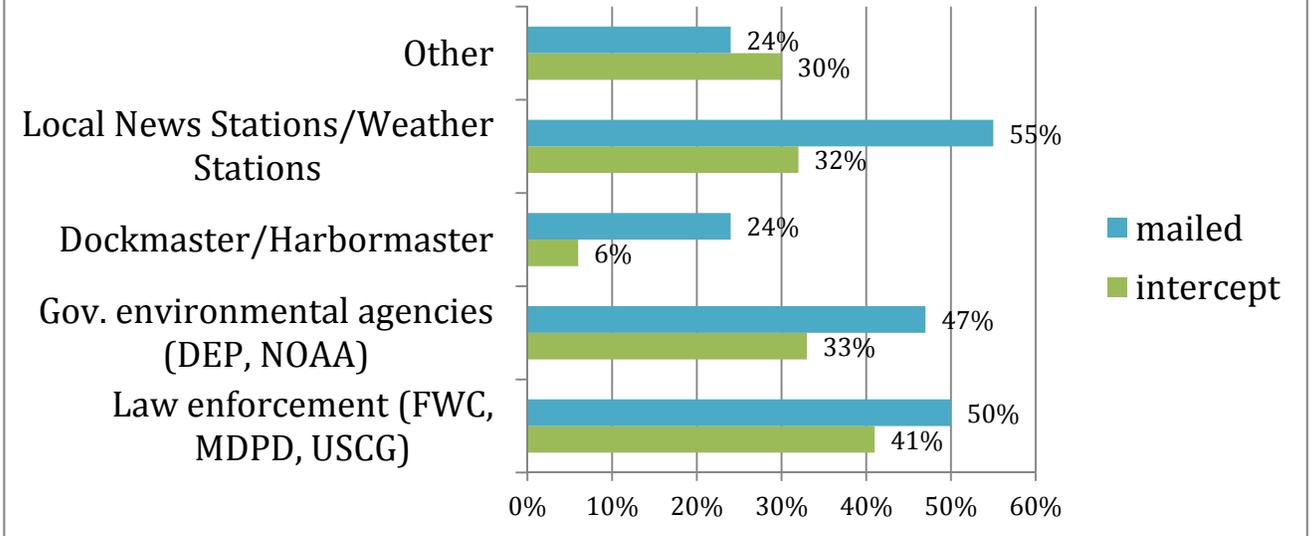


Table 45

Both respondent groups trust law enforcement, government environmental agencies, and local news stations/weather stations.

Aesthetically, what would make you pay more attention to marina signage?

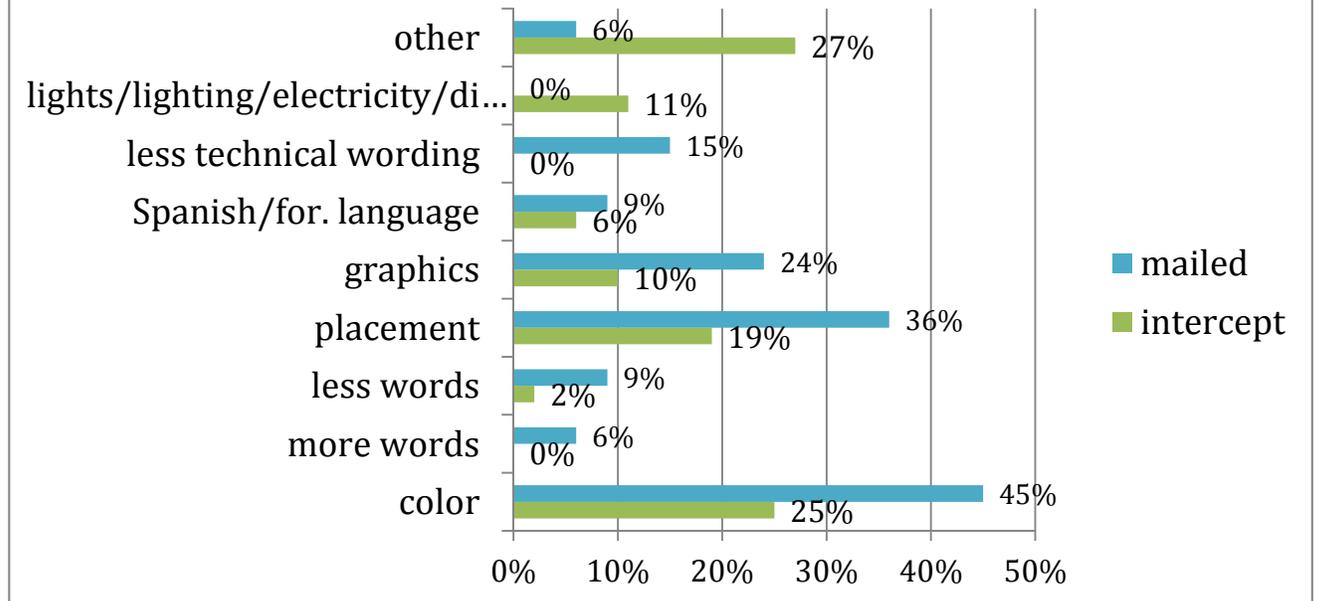


Table 46

Color and placement received the most focus from respondents in both activities.

Color had 25% support from intercept respondents and 45% support from mail respondents. Placement received 19% of responses from intercept respondents and 36% from mail respondents. Lights/lighting/electricity/digital represented a significant portion of intercept respondents, and was also mentioned in the mailed questionnaire respondents' other responses.

4.1 Discussion Activity 1: Intercept Surveys

The most prevalent answer to “How long have you been boating on Biscayne Bay” was 0-2 years; this dominated the next most prevalent answer by over 16%, with 36% of boaters replying 0-2 years, and 20% of the boaters replying they had been boating on Biscayne Bay for 6-10 years.

Because most people boating on Biscayne Bay have been boating 0-2 years, they likely have less experience. They are probably newer boaters, or if they have been boating previously, have not garnered experience in the unique boating conditions of Biscayne Bay.

The majority age range is 26-55.

There are no specific places where the boaters are coming from, they travel from a wide variety of places to boat on Biscayne Bay; targeting specific marinas and boat ramps are no longer going to be effective. When answering what other ramps they use, such a wide variety were answered that it would not be possible to place signs in every location that boaters use to access BBAP: the use of BBAP's fiscal and personnel resources would be inefficient, especially now that we see that boaters are not reading the signs.

40% of the intercept survey respondents- almost half- admitted to never having read educational marina signage. This is clearly very telling that boaters are not paying attention to educational signage. The next highest percentage of answers was 27% having claimed to have read it "today"; however, the truthfulness of respondents' answers may be compromised due to the intimidation factor of answering face-to-face with the surveyor. That is still a 13% difference, and the difference between blatantly never having read the educational sign, and having read it just once. Using this population sample as a representative of all boaters in Biscayne Bay Aquatic Preserves, almost half of the boaters have never read educational marina signage.

Only about half of the respondents claimed to learn information about either boating safety or natural resources from the signs, showing that those who have read the signs,

only half are even learning anything. Either they knew the information from the signs previously, or more likely, the boaters did not read the signs. Either way, the signs are not proving to be effective.

Despite 91% of boaters saying the current marina signage meets their needs, the boating and natural resource statistics do not add up. If boaters are happy with the signs the way they are, and are not reading nor learning from them, then different routes of communication may be necessary for more efficient communication.

Boaters use various methods to gather information. 42% use internet and/or social media- by far the most prominent source for information. Boaters also responded that they rely on local knowledge/word of mouth/ and experience as well. Least popular were signs and pamphlets, each with no support from boaters; maps and charts were given 2 answers, representing 3% of the boaters.

It is also interesting to note that while 25/62 respondents said they had never read the signs, 31/64 claim to have learned information about natural resources from these same signs, and 34/64 claim to have learned about boating safety. 91% of respondents said current signage meets their needs, showing that they do not feel any more signs are necessary, and probably do not care about the signage.

4.2 Activity 2: Mailed Questionnaires

The experience level of Mailed Questionnaire respondents was radically opposite to the Intercept surveys: 47% of the respondents have 30 years of experience boating on Biscayne Bay. The respondents were typically older as well, with 64% of respondents being over the age of 55. However, many other results remain the same.

Despite being an older age group than the intercept surveys, gathering information for

boat trips similarly focuses on local news/weather stations, knowledge/word of mouth, smartphone apps, and internet/social media. Internet/social media represented nearly a third of all responses at 30%. Maps and charts played a bigger role in the questionnaire than in the intercept surveys, representing 40% of the answers. TV/news/weather stations was by far the most prevalent, with 75% of the responses. Signage was mentioned 6 times, representing 15% of the responses, equal to “other”, which was primarily magazines and guide books, also mentioning NOAA and a website. While being mentioned 6 more times than in the intercept surveys, it only represents a small percentage of the responses, not particularly a prevalent source of information. Pamphlets received 0 responses, much like in the intercept surveys.

In addition to internet being a common source of information, the internet was mentioned 5 times out of 13 as an “other” response to “What sources do you trust for boating information?”.

Limitations

Sending more than 300 mailed surveys would have been most preferable for the most accurate results and a higher confidence interval, however, the budget did not allow for more than 300 to be sent. I also did not have access to the email addresses of the registered boat owners, the DMV only was able to provide physical addresses.

Many of the respondents may have confused educational signage with regulatory signage. While we attempted to assuage this issue during the intercept survey by pointing out educational signage, it was not always visible or we did not have enough time. Respondents may still have not understood that there is a difference.

Another limitation is the level of honesty. Because Although, this could also be confusion; the variety of protected areas in Biscayne Bay with different titles are difficult to keep straight. Many people may have thought that an “aquatic preserve” was a general title for any protected area of water, and not a specific state protected area of water under a specific state aquatic preserve program.

The type of people who chose to read through the mailed questionnaire and then take the time to respond may be different than those who were approached at the boat ramps/marinas. The questionnaire respondents were more willing to take the time out of their day to read through the cover letter and questionnaire, fill out the questionnaire, and then return it. They may feel that participating in this project is advantageous and feel more strongly about preserving natural resources and human health and safety. However, the respondents at the boat ramps and marinas had less at stake: they were waiting around and only had to answer some questions while sitting on their boat or waiting by the dock.

5.0 Recommendations

Due to the results of both activities, educational marina and boat ramp signage is not currently an efficient method of communicating with boaters. If organizations choose to or are required to remain communicating with boaters by educational signage, they should incorporate digital and electronic displays. For example, during high boating traffic weekends, digital signs typically used for traffic pattern changes could be placed in the marinas and boat ramps with scrolling messages about safe boating and protecting natural resources. Educational signs also need to be more vibrant, with more color to attract boaters’ attention.

Placement also needs to be addressed, with signs in areas more easily accessible to boaters. Signs should be placed along docks, where boaters wait for boats to be placed in the water as well as while they are loading and unloading the boat. Currently, the signs are located out of the way, far from the activity. By placing signs closer to the areas of high activity, boaters will be more likely to read and retain the information on the educational signage.

Instead of investing large amounts of resources into signage, BBAP and other agencies should instead use the internet to efficiently communicate with boaters. It is evident through the survey and the questionnaire that boaters on Biscayne Bay are looking to the internet for guidance.

BBAP should continue to foster relationships with other government agencies and law enforcement. These are the sources that boaters trust the most, and by combining them, the education is likely to become more widespread. Partnerships also open up opportunities to share resources and funding. Boaters also trust news channels and weather stations, which can be another strong partnership.

The use of the internet can be combined with these partnerships, and utilize their internet resources. For example, the boaters have shown they rely on news and weather stations for information. Because of the use of internet, the boaters are likely looking up the weather on these stations' websites. BBAP can partner with these groups to promote safe boating tips, alerts, and educational facts about the local marine life. By placing pop-ups or educational banners on the weather websites or by sharing information via another agency's website, a wider variety and amount of boaters will be reached than through signage.

Social media presents potential as well. For example, social media campaigns similar to anti-smoking and anti-drugs campaigns can be used about the dangers of Boating Under the Influence. Social media is a platform to educate boaters throughout the year about important safety and natural resource issues. Partnerships with larger organizations would be beneficial in this aspect, as those organizations's posts would have a wider reach.

The purpose of the project is to determine the efficacy of marina and boat ramp educational signage, and the results show this signage is not as efficient as alternative methods or updated signs. BBAP and similar agencies need to channel their resources into more efficient means of communication, such as internet communication and fostering partnerships with local news stations, weather stations, government environmental agencies, and law enforcement. If signs are to still be used, whether by choice or by requirement, then signs need to have more color, thoughtful placement, and electric or digital aspects.

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7.0 Appendices

7.1 Appendix 1: Intercept Survey

Marina/Boat Ramp: _____ Date: _____ Time: _____

BOATING

1. How long have you been boating on Biscayne Bay?

0-2 years 3-5 years 6-10 years 11-15 years 15-30 years 30+ years

2. What is your zipcode? _____

3. What size is your boat? <16ft 16-25ft 26-39ft 40-64ft >65ft

4. What boat ramp do you usually use?

Haulover Pelican Harbor Crandon Matheson Other _____

5. Do you own your boat? Yes No _____

6. How often do you go out on the boat per year?

Daily Weekly Bi-Weekly Monthly Bi-Monthly Other _____

7. Are you the captain of the boat today? If not, what is your purpose?

- | | |
|-------------------|--------------------|
| a. Boat captain | d. Boat ramp user |
| b. Boat passenger | e. Marina employee |
| c. Marina user | f. Other _____ |

8. Where do you get information to plan your outing?

- | | |
|----------------------------|----------------------------------|
| a. TV/news/weather station | f. smartphone app |
| b. Internet/social media | g. local knowledge/word of mouth |
| c. signage | h. other _____ |
| d. pamphlets | |
| e. maps/charts | |

SIGNAGE

9. When have you most recently read the marina signs for information?

Never Today Past Week Past Month Past Year Past 5 Years >5 Years

10. Have you learned information about natural resources from these signs? Yes No

11. Have you learned information about boating safety from these signs? Yes No

12. Does the current marina signage meet your needs? Yes No

13. From what you've seen, do you feel there is too little, too much, or an adequate amount of wording on the signs? Too Little Too Much Adequate

14. What sources do you trust for boating information?

- a. Law enforcement (FWC, MDPD, USCG)
- b. Gov. environment agencies (DEP, NOAA)
- c. Dockmaster/Harbormaster
- d. Local News Stations/Weather Stations
- e. Other_____

15. Did you know this marina/boat ramp is in a state Aquatic Preserve?

Yes No

16. What boating information would you like to receive from signage that is not currently present?

- a. Map of local waters
- b. Tides/weather
- c. Required safety equipment
- d. Best boater practices
- e. Natural resources (corals, mangroves,
- f. manatees, seagrasses. Etc.)
- f. Speed zones, buoys, and signage definitions
- g. Routes to local destinations
- h. Other

17. Aesthetically, what would make you pay more attention to marina signage?

color more words less words placement graphics

Spanish/for. language less technical wording other_____

Observational

1. **Sex** Male Female

2. **Age** <18 yrs 18-25 26-35 36-45 45-55 56-65 >65

3. **Did you see the respondent read any marina signage?** Yes No

4. **What state is the vessel registered in?** _____

5. **Was the respondent entering or exiting the boat ramp?** Ent Exit

6. What was the vessel type?

- a. Motorboat
- b. High Perf. / Racer
- c. Inflatable
- d. Jon Boat
- e. Kayak / Canoe
- f. Pontoon Boat
- g. Personal Watercraft
- h. Sailboat

7.2 Appendix 2: Mailed Questionnaire and Cover Letter

Please circle the appropriate item(s) or fill in the blank(s). If the provided answers do not adequately describe your answer, please feel free to write in an answer.

BOATING

18. How long have you been boating on Biscayne Bay?

0-2 years 3-5 years 6-10 years 11-15 years 15-30 years 30+ years

19. What is your zipcode? _____

20. What size is your boat? <16ft 16-25ft 26-39ft 40-64ft >65ft

21. What boat ramp do you usually use?

Haulover Pelican Harbor Crandon Matheson Other _____

22. Do you own your boat? Yes No _____

23. About how often do you go out on the boat per year?

Daily Weekly Twice Weekly Monthly Twice Monthly Other _____

24. Which role(s) do you typically identify with? (select all that apply)

- | | |
|-------------------|--------------------|
| a. Boat driver | d. Boat ramp user |
| b. Boat passenger | e. Marina employee |
| c. Marina user | f. Other _____ |

25. Where do you get information to plan your boat trips?

- | | |
|----------------------------|----------------------------------|
| i. TV/news/weather station | n. smartphone app |
| j. Internet/social media | o. local knowledge/word of mouth |
| k. signage | p. other _____ |
| l. pamphlets | |
| m. maps/charts | |

SIGNAGE

26. When have you most recently read educational marina signs for information?

Never Today Past Week Past Month Past Year Past 5 Years >5 Years

27. Have you learned information about natural resources from these signs? Yes No

28. Have you learned information about boating safety from these signs?
Yes No

29. Does the current educational marina signage meet your needs? Yes
No

30. From what you've seen, do you feel there is too little, too much, or an adequate amount of wording on the signs? Too Little Too Much
Adequate

31. What sources do you trust for boating information?

- | | |
|--|---|
| a. Law enforcement (FWC, MDPD, USCG) | c. Dockmaster/Harbormaster |
| b. Gov. environment agencies (DEP, NOAA) | d. Local News Stations/Weather Stations |
| | e. Other_____ |

32. Did you know this marina/boat ramp is in a state Aquatic Preserve?

Yes No

33. What boating information would you like to receive from signage that is not currently present?

- | | |
|--|--|
| a. Map of local waters | manatees, seagrasses. |
| b. Tides/weather | Etc.) |
| c. Required safety equipment | f. Speed zones, buoys, and signage definitions |
| d. Best boater practices | g. Routes to local destinations |
| e. Natural resources (corals, mangroves, | h. Other |

34. Aesthetically, what would make you pay more attention to marina signage?

color more words less words placement graphics

Spanish/for. language less technical wording other_____

Demographics

7. **Sex** Male Female

8. **Age** <18 yrs 18-25 26-35 36-45 45-55 56-65 >65

9. **What state is your vessel registered in?** _____

10. What is your vessel type?

- | | |
|-----------------------|------------------------|
| i. Motorboat | n. Pontoon Boat |
| j. High Perf. / Racer | o. Personal Watercraft |
| k. Inflatable | p. Sailboat |
| l. Jon Boat | |
| m. Kayak / Canoe | |

