PARTICIPATORY MANAGEMENT OF FLORIDA'S MARINE FISHERIES

By

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TABLE OF CONTENTS

page

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAP	Abbreviation for the citizen science program the Angler Action Program.
FWC	Abbreviation for the Florida Fish and Wildlife Conservation Commission, the state fisheries management agency.
NOAA	Abbreviation for the National Oceanographic and Atmospheric Administration.
RPM	Abbreviation for the Reasonable Person Model.
TPB	Abbreviation for the Theory of Planned Behavior.

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Participatory processes can benefit natural resource management, though implementation can be challenging. This research explored stakeholder participation in the management of Florida's marine fisheries. Results revealed that many fisheries stakeholders have negative perceptions of fisheries management and current engagement opportunities. In qualitative interviews with 24 stakeholders, 67% of respondents did not feel able to influence management decisions, with a third dissatisfied with the way management decisions are made. Similarly, a quantitative survey of 12,348 recreational license holders found that while 89% of respondents agreed that public input should be included in management decision-making, only 19% agreed that it currently is, and while 41% agreed they would like to be part of the process, only 15% agreed that there are opportunities for them to participate. Overall, 42% were on average dissatisfied with management, with a significant correlation between satisfaction with management and whether they perceived they had meaningful ways to participate in the management process.

The research also revealed a number of factors motivating stakeholder participation. A survey of 7,019 citizen science (Angler Action Program) participants

found that improving the quality of fisheries data was the most important motivator (mean score of 4.65 out of 5.0), with altruism more important than collectivist or egoistic motivations (mean score of 4.41 versus 4.01 and 3.88). Subjective norms and rewards were relatively unimportant (mean scores of less than 3.0), and participants disagreed that others are aware of the program (mean score of 2.70 out of 5.0). A survey of 2,162 recreational, 1,245 charter, and 3,938 commercial fishers revealed that social norms, perceived control, and attitudes significantly predicted intention to use barotrauma mitigation, with norms predicting the highest increase in intention. Though respondents on agreed that barotrauma mitigation will mean more fish to be caught in the future (mean scores of 3.69-3.93 out of 5.0), they did not see a link between their actions and changes in management or harvest regulations. Taken together, results demonstrate the importance of creating opportunities for stakeholder engagement that participants view as genuine and meaningful and that are advertised widely while taking into account factors motivating stakeholders to participate.

CHAPTER 1
INTRODUCTION

Background

The term “fishery” describes a system which results in the harvesting of fish or other marine or aquatic animals (FAO 2014). A fishery can be defined based upon the species or type of fish (or other animal), the people involved, the area of water or seabed that is fished, the method of fishing, the boats involved, and/or the purpose of the activities (Fletcher et al. 2002). Fisheries systems are complex in nature and include the biological attributes of the fish population as well as habitat and environmental attributes, stakeholder attributes, market attributes, and institutional arrangements (with the addition of the technical and biological attributes of aquaculture when applicable), all of which interact to drive stakeholder actions as well as fisheries outcomes (Lorenzen 2008).

Many fisheries, and in particular marine fisheries, operate as common pool resources and are therefore vulnerable to overexploitation without the imposition of some sort of management structure (Hardin 1968); consequently, fisheries management institutions have arisen worldwide to handle this issue. However, there is no broadly accepted definition for fisheries management (Cochraine and Garcia 2009), and while at the most basic level most management policies agree in that they focus on maintaining the long-term sustainability of fish stocks (Mardle et al. 2006), their consideration of other objectives varies. Though traditional management has focused on maximizing yield and employment in commercial fisheries, the importance of other biological, economic, social, and political outcomes is becoming increasingly recognized (Anderson et al. 2015, Dengbol et al. 2006, Hilborn and Walters 1992), as is the

inherent tradeoffs in balancing objectives (Hilborn and Walters 1992, Pascoe et al. 2016, Camp et al. in press). In this dissertation, I use a broad understanding of fisheries management and consider fisheries management to include all actions aimed at maintaining the biological, economic, social, and political sustainability of the resource.

Fisheries management can take many forms. For example, management power can be held entirely by the state through government-based management or, conversely, entirely by the community in what is often known as community-based natural resource management (Jentoft and McCay 1995, Sen and Nielson 1996, Pomeroy and Berkes 1997). In this dissertation, I focus on participatory management, in which resource users and government collaborate in the management process.

Participatory Management

What is Participatory Management?

Participatory management is management that includes stakeholders in the management process. There are a number of different ways this cooperation is explored in the literature, such as through co-management or collaborative management (in which stakeholders and managers share power in management decision-making), adaptive collaborative management (the linking of co-management and adaptive management), and participatory research (in which stakeholders collaborate with managers in data collection and scientific research). In addition, stakeholders can participate in management through their interactions with the resource and specifically through voluntary actions taken to maintain sustainability. For the purposes of this dissertation, I will include all of these concepts under the umbrella of ‘participatory management.’

Why Participatory Management?

Participatory management has been shown to have a number of positive outcomes for the management of marine fisheries. Participatory management approaches empower resource users (both individuals and communities) in the management process (Ostrom 1999, Jentoft 2000, Castro and Nielsen 2001, Gelcich et al. 2009), allowing those whose livelihoods are affected by management decisions to have a say in how those decisions are made (Berkes 2009) and in some cases helping to restore communities (Castro and Nielsen 2001). Participatory approaches also facilitate learning across groups (Armitage et al. 2009, Berkes 2009), and by linking scientists, resource users, government managers, and other stakeholders allow for the incorporation of a diversity of perspectives in collaborative problem solving (Armitage et al. 2009, Armitage et al. 2008, Carlsson and Berkes 2005, Berkes 2009, Carr and Heyman 2012). Participatory approaches can also improve science through the inclusion of local ecological knowledge (Ostrom 1999, Linke and Bruckmeier 2015, Moller et al. 2004, Nielson et al. 2004, Stephenson et al. 2016), and collaborative, participatory approaches can help managers navigate ecological uncertainty (Armitage et al. 2009). Government-based management can create adversarial environments, pitting user groups against each other (Armitage et al. 2009), and participatory approaches can help reduce stakeholder conflict (Castro and Nielson 2001, Lopes et al. 2013, Pomeroy 1995, Obiero et al. 2015). By including resource users in the decision-making process, participatory approaches can increase “buy-in” to management decisions and regulations and thereby improve compliance and reduce enforcement costs (Ostrom 1999, Berkes et al. 2001, Ho et al. 2016). Finally, participatory management can directly benefit fisheries resources themselves, with examples in the

literature of such approaches decreasing landings and effort and increasing revenues (Defeo et al. 2014) or stabilizing harvest and yield (McClenachan et al. 2015).

Challenges in Participatory Management

There are many challenges associated with implementing participatory management. Participatory approaches can take a great deal of time to develop (Armitage et al. 2009, Carlsson and Berkes 2005, Berkes 2009, Jentoft 2005). Unfortunately, when participatory management is initiated in response to dissatisfaction with other forms of management there can be a sense of urgency and hope for rapid results; when quick fixes do not result, users and managers may become disillusioned or disappointed (Chuenpagdee and Jentoft 2007). Trust is an important component of successful participatory management, but can easily erode over time with new changes or the introduction of new actors into a system (DeVos and Tatenhove 2011, Armitage et al. 2009), and histories of mistrust or disenfranchisement may limit stakeholder willingness to participate (Carr and Heyman 2012, Trimble et al. 2014, Finkbeiner and Basurto 2015). In addition, it can be difficult to determine who should be included in a participatory approach and how (Armitage et al. 2008). In particular, it is important that participatory approaches deal with power differentials and ensure the inclusion and empowerment of marginalized groups (Armitage et al. 2009, Berkes 2009, Noble 2000, Smith 2012, Heylings and Bravo 2007), and that participatory approaches do not result in elite capture (Berkes 2009). Communities are not homogenous and may include a diversity of subgroups differentiated by class, gender, ethnicity, values, fishing approaches, and expectations (Armitage et al. 2008, Berkes 2009, Carlsson and Berkes 2005). Participatory approaches must manage the relationships among these heterogeneous groups (Natcher et al. 2005) and should consider what roles different

stakeholder types are best suited for (Brewer and Moon 2015). Furthermore, determining the scale of participatory approaches can be difficult (McCay et al. 2014, Nielson et al. 2004), and the synthesis of local ecological knowledge with traditional science can be challenging in practice (Dale and Armitage 2011, Linke and Bruckmeier 2015, Berkes 2009).

When Does it Work Well?

There are many factors identified in the literature as important to the success of participatory management approaches. Local leadership, for example, is important (Ayers and Kittinger 2014, Berkes 2009, Chuenpagdee and Jentoft 2007, Ho et al. 2016, Guitierrez et al. 2011), as is clear support from government (Armitage et al. 2009, Chuenpagdee and Jentoft 2007, Gelcich et al. 2009, Heylings and Bravo 2007, Jentoft 2005, Noble 2000). The development of trust and social capital also contributes to successful collaborations (Berkes 2009), as does the inclusion of bridging or external support organizations (Berkes 2009, Pomeroy et al. 2004). Participatory approaches may be more successful when representatives from all groups participate and when participants are able to speak with one unified voice (Noble 2000, McCay et al. 2014). In addition, the integration across knowledge sources can be important to success (Berkes 2009, Armitage et al. 2009, Trimble and Berkes 2015). Conflict or perceived resource depletion can help initiate participatory management and may play an important role in prompting stakeholders and managers to collaborate (Castro and Nielson 2001, Ayers and Kittinger 2014), and capacity building among participants is an important component of empowerment (Jentoft 2005).

Application to Florida's Fisheries

The benefit of working with resource users is a recurring theme in the natural resource management literature. In this dissertation, I will explore ways that the public is and can be included in the management process, focusing on marine fisheries in the U.S. state of Florida.

Florida Fisheries Background

Marine Fishing in Florida

The catching of aquatic life, or fishing, is comprised of both commercial and recreational sectors. While commercial fishing focuses on harvesting for profit, recreational fishing is motivated by a complex array of satisfaction measures and catch and/or harvest-oriented objectives (Fedler and Ditton 1986, Holland and Ditton 1992). The recreational fishing sector has grown substantially over the past century. In the United States (U.S.), participation in marine recreational fishing increased 2.7 times between 1955 and 1980 (Schmeid and Burgess 1987), and in 2002, recreational fishing accounted for 4% of total marine fish harvest in the U.S. (10% when industrial fisheries like menhaden and pollock were excluded) (Coleman et al. 2004), with an estimated 11 million Americans participating in marine recreational fishing in 2011 (NMFS 2012).

Florida has approximately 1300 miles of coastline (Hanson and Sauls 2011), and marine fishing in Florida can be traced back to the earliest recorded accounts of human history (Tilmant 1989). In the early 1900's Florida's fisheries were mainly commercial-based, but improvements in transportation, increased development, and population growth all led to an increase in sportfishing activities (Tilmant 1989). Obtaining the rights to harvest fish recreationally in Florida simply requires the purchase of a fishing license ($17 for Florida residents, with the fee waived for shore-based anglers and a license

exemption for those over the age of 65 and for those on government assistance who fish from shore) (myfwc.com). There are over 6 million recreational saltwater anglers in the state of Florida (NOAA Fisheries 2015), and Florida is one of the top fishing destinations in the country (Ditton et al. 2002). Much of Florida's coastal economy is linked with fisheries, and saltwater recreational fishing alone supports more than 109,000 jobs with an economic impact of US$7.6 billion (NOAA Fisheries 2012). In addition, Florida is home to a growing for-hire charter and fishing guide industry, in which captains are hired by recreational anglers to take them fishing (Schittone 2001).

There are currently no limits on the number of recreational fishing licenses sold in the state of Florida. The most recent census found Florida's population to be around 20 million people (U.S. Census Bureau 2015), and projections estimate that the state's population will reach 36 million people by the year 2060 (Cerulean 2008). Florida attracts a large number of retirees, with almost 20% of its population over the age of 65 (U.S. Census Bureau 2015); many of these individuals move to Florida to fish, and it is projected that future population increases will likely be accompanied by an increase in the number of people fishing. During the past decade, an average of 30 million saltwater recreational fishing trips were made annually; projections linked to population growth estimate an increase in trips to almost 60 million/year by 2060, while estimates linked to the current rate of trip increase (2.5% annually) predict 120 million trips/year (Cerulean 2008). Such an increase in fishing effort will mean greater pressure on local fish populations across the state. However, this increase could be mitigated by the fact that catch and release fishing is becoming more of a norm among anglers, and therefore an increase in effort may not correspond to an increase in harvest.

Conflict is already prevalent in Florida's fisheries, both among stakeholder groups and between stakeholders and fisheries professionals (e.g., managers and scientists); an increase in pressure may only serve to exacerbate these conflicts. In this light, it is important to explore how stakeholders participate in the management process, as participatory management approaches have been shown helpful in navigating and reducing conflict (Pomeroy et al. 2007).

Current Management of Florida's Marine Recreational Fisheries

Florida's marine fisheries are management by two entities. Inshore and coastal waters (up to 3 nautical miles offshore in the Atlantic Ocean and up to 9 nautical miles offshore in the Gulf of Mexico) fall under state jurisdiction and are managed by the Florida Fish and Wildlife Conservation Commission (FWC). State management includes many popular inshore species, such as red drum (*Sciaenops ocellatus*), snook (*Centropomus undecimalis*), and spotted seatrout (*Cynoscion nebulosus*). Further offshore, marine fisheries fall under federal jurisdiction and are managed by the Fisheries branch of the National Oceanographic and Atmospheric Administration (NOAA). Federal fisheries management includes many contentious offshore and reef species, such as those for red snapper (*Lutjanus campechanus*) and red and gag groupers (*Epinephelus morio* and *Micteroperca microlepis*).

Federal. Federal marine fisheries management in the United States was established under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in 1976, which established eight Regional Fisheries Management Councils for the purpose of making policy and regulatory decisions. As a peninsula, Florida spans two Council zones: along the east coast, federal fisheries are governed by the South Atlantic Fisheries Management Council, while federal fisheries off the west coast fall

under the jurisdiction of the Gulf of Mexico Fisheries Management Council. Federal fisheries are managed on relatively large spatial scales, with stock management in most cases spanning the entire Gulf of Mexico or south Atlantic.

Federal fisheries management in the U.S. is often considered an example of participatory management (Jentoft and McCay 1995, Pomeroy and Berkes 1997) as members of the Regional Councils come from variety of stakeholder groups. However, council members are appointed through a highly political process in which they are nominated by state governors and appointed ultimately by the U.S. Secretary of Commerce (Fricke 1995). In some cases, additional stakeholders may be engaged through Advisory Panels, but participation by the rest of the public is restricted to public hearings held throughout the planning process (Pomeroy and Berkes 1997).

State. The FWC was established in 1999 with the merger of Florida's Marine Fisheries Commission, Florida Department of Environmental Protection's (FDEP) Division of Marine Resources and Law Enforcement, and Florida's Game and Freshwater Fish Commission, with a mission to "exercise the regulatory and executive powers of the state with respect to wild animal life and fresh water aquatic life" as well as to "exercise regulatory and executive powers of the state with respect to marine life" (Florida Constitution Article IV, Section 9). In 2004, the agency was reorganized and components of the Division of Wildlife, the Division of Freshwater Fisheries, and the Florida Marine Research Institute were merged to create the Fish and Wildlife Research Institute (FWRI) (McRae 2010).

The present FWC consists of three principle units: the Office of the Executive Director (OED, headed by the Executive Director), five Divisions, and the FWRI.

Divisions include Hunting and Game Management, Freshwater Fisheries Management, Law Enforcement, Habitat and Species Conservation, and Marine Fisheries Management. Marine recreational fisheries in Florida state waters fall under the Division of Marine Fisheries Management, whose duties include creating regional and commercial fisheries outreach and education programs, facilitating artificial reef development and deployment, preparing fisheries strategic plans, issuing special activities licenses, conducting wholesale fisher audits, and assisting with trap retrieval efforts, as well as coordinating with the Federal Fisheries Management Councils.

The agency is headed by the Commission, which consists of seven commissioners appointed by the Governor who serve staggered 5-year terms. The Commissioners meet 5 times each year at varying locations to hear staff reports, consider rule proposals, and conduct other commission business. The Commission is also responsible for appointing the Executive Director. Again, stakeholder involvement in the decision-making process is largely restricted to input received through comments at public meetings and websites and occasional surveys and workshops, with some attempts at more cooperative processes (for example, through the snook workgroup). Similar to Federal waters, most species are managed on relatively large spatial scales (though in this case management is restricted by state lines), with stock management spanning the entire Gulf of Mexico or Atlantic coasts of Florida.

Dissertation Objectives

This dissertation aims to explore stakeholder participation in the management of Florida's marine fisheries, with a focus on three case studies. First I explore stakeholder participation in the management decision-making process as an initial step in a larger project testing the concept of place-based, community engagement through "fisheries

forums” piloted in southwest Florida. Chapter 2 consists of qualitative interviews to assess initial reactions to the idea of place-based management as well as how stakeholders feel about current engagement. Chapter 3 consists of a quantitative survey conducted to gather baseline data on stakeholder attitudes toward management and the management process.

Participation in decision-making is not the only avenue through which stakeholders can engage in the management process. Chapter 4 centers around stakeholder participation in research and data collection, in this case identifying motivations and barriers associated with participation in a citizen science effort known as the “Angler Action Program”. Chapter 5 then focuses on stakeholder participation in management through voluntary actions taken to improve fish survival, in this case through the use of barotrauma mitigation methods to reduce mortality; specifically, I identify which tools are being used by different sectors and why. Chapter 6 then synthesizes my findings. In full, the results of these chapters will aid in understanding Florida’s stakeholders and their participation in the management of Florida’s fisheries.

CHAPTER 2
STAKEHOLDER PERSPECTIVES ON PLACE-BASED MANAGEMENT AND CURRENT ENGAGEMENT

Place-Based Management Background

There is growing interest in place-based approaches to natural resource management (McIntyre et al. 2008). The spatial dimensions of marine fisheries in particular have been increasingly recognized (Lorenzen et al. 2010), and a shift toward more localized, place-based management would have important implications for the management of marine fisheries resources. This study represents the first in a series exploring place-based management of fisheries, focusing in this case on Florida's coastal marine fisheries.

Place-based management is defined as management that is geographically bounded (Olsen et al. 2011). Focusing management on a specific area allows for the spatial heterogeneity of organisms, habitats, and human activities and values to be taken into account (Brown et al. 2002, Young et al. 2007, Olsen et al. 2011). In addition, focusing on place allows for a "cross-sector" approach to managing natural resource issues (Postchin and Haines-Young 2013). Integrating across sectors would be helpful in addressing concerns about water quality, for example, which is a "wicked" problem in Florida influenced by a variety of players, including residential, commercial, agricultural, and industrial runoff and associated increases in nutrient input (Turner et al. 2006). A place-based approach also facilitates adaptive management (Young et al. 2007), and many believe natural resource management is most effective when based on adaptive, science-based, place-centered approaches (Davenport and Anderson 2005). People assign meaning to places and derive meaning in their lives from places (Davenport and Anderson 2005), and may value geographically near places more highly than distant

ones (Brown et al. 2002); place-based management recognizes the strong bonds people have with natural places and the need they have to be involved in influencing the future direction of change in places they value (McIntyre et al. 2008) and provides a frame in which resource users can be engaged and natural resource problems can be discussed (Postchin and Haines-Young 2013). Place-based engagement also allows for stakeholders to interact in person on a regular basis, which can help prevent resource overuse (Ostrom 1999).

One of the biggest challenges in place-based management is defining the "place" to be managed in a manner considered appropriate by resource users and managers (Young et al. 2007, Crowder and Norse 2008). This can be particularly difficult in marine systems (Olsen et al. 2011), which are three-dimensional and relatively opaque when compared to terrestrial systems (Young et al. 2007). Typically, marine systems are easier to define at their centers than at their edges, with boundaries hard to delineate (Young et al. 2007). In addition, users and managers may define place in different ways and on different scales. However, collaboration between stakeholders and managers may help to define places in an appropriate manner.

This study explored the potential for place-based management of marine fisheries in Florida. Qualitative, semi-structured interviews were chosen as they allow in-depth understanding of respondent viewpoints (Esterberg 2002). An important first step in exploring a shift toward place-based management is understanding how it would be received by stakeholders. In addition, it is important to explore whether or not place-based approaches would be beneficial in addressing fisheries issues. Therefore, interview objectives were to 1) gain insight into stakeholder perspectives about

localized, place-based management as well as to 2) understand what issues stakeholders perceive to be impacting fisheries at the local scale and whether or not these could be better addressed using a place-based approach. In addition, previous authors have proposed that stakeholder engagement may be more successful at smaller, localized scales (Cheng and Daniels 2002), therefore the interviews also sought to 3) understand stakeholder perceptions of current management engagement and how connected they feel to the management process, with the goal of exploring in future how place-based engagement strategies might compare to current approaches.

Methods

Study Area

Interviews were conducted in Southwest Florida from Pinellas County south to Collier County (see map Figure 2-1). Southwest Florida lies along the eastern edge of the Gulf of Mexico and is home to a variety of nearshore and offshore saltwater fisheries. Inshore and nearshore waters (up to 9 nautical miles offshore) are managed by the state through the Florida Fish and Wildlife Conservation Commission. Inshore and nearshore habitats are dominated by coastal saltmarshes, mangroves, and seagrasses, and fisheries include popular recreational and commercial species such as snook (*Centropomus undecimalis*), red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), pompano (*Trachinotus carolinus*), tarpon (*Megalops atlanticus*), blue crab (*Callinectes sapidus*) and mullet (*Mugil cephalus*) (Livingston 1976, Tremain and Adams 1995, Paperno et al. 2001, Dawes et al. 2004). Further offshore, fisheries are managed federally by the Fisheries branch of the National Oceanographic and Atmospheric Administration (NOAA). Offshore fisheries are characterized by reef fish species, such as greater amberjack (*Seriola dumerilli*), groupers (Serranidae sp.), and

red snapper (*Lutjanus campechanus*) (Bohnsack et al. 1994, Koenig et al. 2000), as well as migratory pelagic species such as king mackerel (*Scomberomorus cavalla*) (Reed 2002), sailfish (*Istiophorus albicans*), and marlin (*Makaira nigricans*) (Richardson et al. 2009). In both cases, fisheries are currently managed on a relatively large spatial scale, with Gulf-wide regulations for many offshore species and coast-wide or region-wide regulations for state-managed species.

The south Florida region has many canals, levees, and other water control structures built to control flooding and to provide for residential and agricultural needs; such water control efforts (and the subsequent alteration of water flows) have negatively impacted ecosystems in the region by creating periods of too much or too little freshwater inputs and by transporting high levels of nutrients to the coast (Wang et al. 2012, Angelo 2015). In addition, habitat loss is of increasing concern in the region. In the Charlotte Harbor region of Southwest Florida, for example, it is estimated that 15% of coastal wetlands have been lost since pre-Columbian times, with over 41% of the estuary's wetland shorelines lost or significantly altered (Beever et al. 2009) and an estimated one-fourth of the region's seagrass lost or damaged (Pierce et al. 2004). The coastal population of Florida is projected to increase in the coming decades (Cerulean 2008), with habitat loss and degradation likely to increase correspondingly.

Case Study: the Common Snook Fishery

To focus the interviews, common snook (*Centropomus undecimalis*, from now on "snook") was chosen as a case study species. Snook are typically found in estuaries, adjacent rivers, and nearshore waters across the tropical and subtropical Atlantic (Rivas 1986) and utilize mangrove and seagrass habitats (Gilmore et al. 1983, Muller and Taylor 2012). Snook are a popular sport fish in the state of Florida with a major following

(for example, anglers have formed the Snook and Gamefish Foundation, and the state hosts a Snook Symposium every few years to review research and discuss management). Snook are only targeted recreationally (they have been closed to commercial harvest in Florida since 1957), simplifying the case study. In January 2010, prolonged cold conditions resulted in a high level of mortality in snook, and the fishery was closed to recreational harvest in response (Muller and Taylor 2012); at the time of interviews, management was considering the reopening of the fishery in the Gulf of Mexico.

Sampling

There are many stakeholder groups involved in fisheries in southwest Florida, including commercial fishers, recreational anglers, charter fishing guides (the “for-hire” sector, who are hired by anglers to take them recreational fishing), and those who work at bait and tackle shops (which sell gear to fishers). In this case I focused on stakeholders connected to the recreational sector, as there is no commercial fishery for snook. Snowball and opportunistic sampling were used to identify potential interview respondents. The snowball sampling was initiated by contacting 2 local Sea Grant extension agents, who provided contact information for potential initial interviewees. Each interview participant was then asked to recommend other individuals for interviews. This method enabled the recruitment of locally engaged stakeholders, including charter captains, recreational anglers, and outreach/extension professionals. Opportunistic sampling was used simultaneously to recruit bait and tackle shop stakeholders for interviews, and consisted of visits to 8 shops in the study areas. Bait and tackle shops were identified through a combination of Internet searches and physical searches (driving by car), and all shops that were located were approached for

interviews; respondents were recruited by asking the person working behind the desk if they would be interested in participating in interviews.

Semi-structured, qualitative interviews were conducted in-person from January-April 2013. As the first study to investigate stakeholder perspectives with regard to management engagement and place-based management in the region, interviews were exploratory in nature, and my objectives were first to gain insight into stakeholder views on place-based management and on their current engagement in the management process as well as to explore what issues they felt were impacting their local fisheries (to see whether their issues of concern could be addressed using place-based approaches). The interview guide therefore consisted of 8 open-ended questions covering five broad themes: (1) personal connections with fisheries and fisheries stakeholders, (2) issues affecting fisheries in general and the snook fishery specifically, (3) views toward place-based management, presented in this case as localized management, (4) perceived ability to influence management, and (5) sources of information about fisheries. Interview guide creation was informed in part by previous surveys of fisheries stakeholders in Florida (unpublished data, Sutt et al. 2014), and questions were first pilot tested with a group of 7 individuals, including 2 fisheries scientists, 2 social scientists, and 3 recreational anglers.

In total, interviews lasted between 15-65 minutes. Interviews were conducted by the author in all cases. Interviews were continued until responses had become "saturated," or in this case until three consecutive interviews had passed where no new information was gained (Mason 2010). When possible, interview audio was recorded. One individual declined recording, and in 4 additional cases conversations were not

recorded because potential participants seemed ill at ease or initially distrustful. In these cases, the interviewer took detailed notes. In addition, a recorder malfunction led to another interview logged in writing. Recorded interviews were later transcribed for analysis. Interview results were analyzed using the NVivo software version 10 (QSR International). Data analysis was based in Grounded Theory (Strauss and Corbin 1990), an inductive analysis approach in which the findings are said to be grounded in the data rather than in the application of an existing theory. Responses in this case were analyzed by the interviewer using open coding followed by focused coding, and were then grouped thematically to look for patterns in the data, in accordance with Esterberg (2002). Coding was done by the interviewer, and was repeated 3 months later to check for consistency (Esterberg 2002).

Results

A total of 28 individuals were invited to participate in the study; one individual (a bait and tackle shop owner) declined participation, while 3 charter captains agreed to participate but were unable to coordinate a time for interviewing. Total respondent sample size was therefore 24 (Table 2-1). The respondents included charter captains/guides (10), bait and tackle shop stakeholders (7), 4 natural resource professionals who were involved with fisheries management and education, and 3 recreational anglers (one of whom was also a law enforcement agent for the state fisheries management agency but who responded to the interviews based on his experiences as a recreational angler). Stakeholder groups will be abbreviated as follows: CG (charter captain/guide), BT (bait/tackle shop), RA (recreational angler), and EG (education/ government). Each individual was assigned a code for analysis and reporting (Table 2-1). The majority of respondents (88%) were male; 54% had multiple

connections to fisheries, as depicted in Table 2-1. There were 3 broad themes that resulted from analysis, which are described below.

Issues Affecting Local Fisheries

The most commonly cited issue affecting local fisheries in general (54%) and snook specifically (25%) was water quality, with many sharing the view that "deteriorating water quality has the most profound effect on our fishery" (CG6). Respondents were primarily concerned with red tides and harmful algal blooms, with one respondent noting that in his experience bad fishing years "directly coincide with bad red tides" (CG3). In addition, respondents noted concerns related to the alteration of freshwater flows, specifically with regard to the Caloosahatchee River and estuary[1]. As one respondent noted:

EG2: The timing and delivery and water quality of water that flows to the estuaries is highly altered and that really effects the species that depend on those upper estuarine reaches.

The next most commonly cited issue was concern about habitat loss and habitat degradation (46%), with one respondent stating "habitat, that's the biggest issue anywhere, it's habitat loss" (CG4). Concerns about habitat included issues with coastal development in general as well as concerns about the loss of specific habitats, such as "declines in seagrass, mangroves, and oysters" (EG1).

Goliath grouper[2], *Epinephalus itajara*, were also cited as an issue of concern affecting local fisheries (33%). In the interviews, respondents were concerned that

[1]In 1984 the Caloosahatchee River was artificially extended eastward to connect with Lake Okeechobee; later, a combination of locks and dams were constructed to regulate water flow and discharge from the lake, with regular releases of freshwater into the river to maintain lake water levels (Doering et al. 1999).

[2] Goliath grouper have been closed to harvest since 1990; since then, populations have increased, and many stakeholders believe the moratorium should be ended to allow for population control (Sutt 2014).

Goliath grouper were having a negative impact by consuming smaller fishes, or in the words of one respondent “goliath grouper…no doubt about it, they destroy fisheries, eat everything” (BT4).

Other issues affecting local fisheries were cited by a minority of individuals in the interviews. These included concerns about grouper management in general (13%), access to fishing (4%), weather-related impacts such as a recent hurricane (8%), pollution (8%), invasive lionfish[3] (4%), and economic concerns with regard to the charter industry (8%):

CG3: The economics side of it is scary you know we keep getting more and more of our prime fishing months cut out then a lot of us will go belly-up.

The most commonly cited issue affecting local snook populations specifically was the recent prolonged cold event (75%). Notably, however, two respondents (8%) felt that there were no issues affecting snook populations:

Bt4: Nothing. There are so many when you dive you can walk across them; they are not depleted at all.

Attitudes Toward Management

During discussions about fisheries issues, half of respondents (50%) cited management as a source of concern about local fisheries. Respondents were frustrated with the bureaucracy associated with the management process, with one charter captain for example feeling that he was “overloaded with paperwork[4]” (CG3), as well as with resulting regulations and policies. In addition, 38% of respondents expressed dissatisfaction with the process by which management decisions are made.

[3]The Indo-Pacific lionfish (*Pterois volitans*) has become established in Florida (Schofield 2010), with many concerned about its impacts on native species.

[4]Referencing the paperwork he is required to fill out for permits as a charter captain.

Respondents were concerned that decisions were made without taking their needs into account and that “regulators have little sympathy for the plight of the fisherman” (CG7). In addition, some respondents felt that input was not regionally balanced, with fishers in the panhandle of Florida for example having more influence than those in Southwest Florida:

CG3: Why do we make kneejerk reactions because one group of fishermen, specifically panhandle fishermen, have a very loud voice?

In addition, the majority of respondents (75%) indicated that they did not feel able to influence fisheries management (Table 2-1). Some individuals shared the perception that other more organized or well-funded groups, such as the commercial sector or conservation organizations such as Oceana, held the most power, or in other words “when you got big bucks you get an ear” (CG3). In addition, many expressed the perception that management does not care about them or listen to the public and that managers “don’t answer to anybody” (BT3), or in the words of one respondent:

BT4: They don’t listen, just sit on their computers and don’t care what we have to say.

Finally, some respondents felt that public engagement efforts by management are insincere, with the perceptions that:

RA1: I’ve been to a couple of meetings, you know, the open town hall meetings when they are looking at changing fishing regulations, and it all seems like it’s very much predetermined and they get a little bit of public input just so they can say they did and then they regulate them the way they see fit anyhow.

CG7: They already got their minds made up have to have public meetings to satisfy sunshine laws and save face with the public but they already got their minds made up.

Those three individuals (13%) that did feel able to influence management all either worked in government (EG3) or were involved with government (CG4) or research (CG5). In addition, all qualified their responses, saying:

CG6: I can only guess as to answer yes. To not guess, I would say I would have zero chance if I didn't exercise my right to participate in the process.

EG3: Yes, I think I do, but it's tough, these one-interest type of non-profits they definitely have a lot more power than the actual staff person.

CG4: Yeah I do, I mean a little bit, but you know I would hope that somebody would listen to me you know, I just think they need to ask more people, I don't think they do that, I mean, they rely too much on the scientific end of it.

Respondents also expressed concern over what they felt was improper or inadequate science (46%) and distrust of management and scientists was mentioned, though only by a minority of respondents (4%). Respondents felt that the science behind management was "totally incomplete" (CG3) and that "research is not the greatest, it's old data" (BT3). In addition, many did not trust management and scientists:

CG7: Phone surveys[5] are an archaic method of collecting data in my opinion it takes time and not everyone in a phone survey is always forthcoming- when you get a call from these guys do you want to comply with the survey and give 'em the best data, or give them ballpark numbers? What are they doing with the numbers? There are serious distrust issues.

CG3: Most captains are afraid to say anything you understand because we have seen what has happened over the years and it seems like any information we give away they use it to hurt us.

In this light, it is unsurprising that many respondents (63%) cited other fishers, and not managers or scientists, as the best source of information about fisheries in their area,

[5]Referencing the phone surveys conducted as part of NOAA's Marine Recreational Information Program, or MRIP, which collects information on recreational fishing catch and effort.

for example stating that:

BT1: Guides out on the water they see the changes on a daily basis every day and are the best.

The next most commonly cited sources were the Florida Fish and Wildlife Conservation Commission, or FWC, (29%) and their own personal experience (25%). Respondents shared difficulties in finding or accessing scientific information about fish and fisheries, with the perception that the science is unavailable and that the state “doesn’t make it easily available for anyone to find anything” (CG4). In addition, one individual discussed how anglers interpret scientific information through their own experiences:

RA1: I think what happens is your general fisherman when he or she does see an article…what they’ll do is they’ll compare that to their own personal experiences and when it doesn’t line up they immediately think that they scientific article is bogus, there’s some sort of hidden agenda or they are trying to do something to keep the fishery from being opened.

Respondents also expressed concern about the impacts of other stakeholder groups and how they were managed (33%). Some were dissatisfied with the impacts of commercial fishing and felt it should be restricted, stating for example “we need to get a handle on the commercial side of things” (RA1). Others were frustrated with conservation-oriented individuals, or “tree-huggers” (CG3), or with the impacts of other anglers in general, with the perception that:

BT5: People they’ll just fish them until they are gone, they are extinct…people just want to take everything.

One respondent shared the perception that anglers are apt to blame other groups for fisheries declines, stating that:

EG1: Anglers have a lack of acknowledgement of any personal responsibility for declines in fish stocks, blame it on other forces…always someone else’s fault.

Place-Based Management: Views Toward Localized Management

The concept of place-based management was introduced as a shift toward smaller scale, more localized fisheries management, with the example of localized fisheries regulations given. Most (75%) respondents reacted positively to the idea of a shift toward localized management (Table 2-1). Many respondents felt that localized management would have positive impacts on their fisheries, and that "it would be beneficial" (RA1). In addition, they felt it would be appropriate as in their view "every region is different" (BT1). For snook specifically, one respondent in Sarasota explained that fishing was different in his region than in the city of Fort Myers (approximately 75 miles south of Sarasota):

CG4: I think it would be a great idea there is a huge difference between snook fishing here and snook fishing in Fort Myers.

Respondents also shared the perception that the freeze had impacted snook differently in different areas in the state:

CG3: After the so-called big kill you couldn't tell the difference at least in the Naples area, I know in some shallower waters…they had kills that really messed up their fishing but that's localized I mean really localized.

RA1: The cold really affected the snook here but not so much in other parts.

Those who were not in favor of the idea (21%) shared concerns over regulations, enforcement, and expected additional bureaucracy, stating for example that:

CG6: I would see it being very difficult and costly to try to manage any fishery locally. In addition, it may bring about needless regulation.

In addition, they felt it did not align with their understanding of fish populations and movement patterns, for example because "fish migrate, has to be a huge region" (BT5).

Discussion

One of the first steps when considering a novel approach to natural resource management is to understand how it would be received by the stakeholders who interact with the resource. In the case of Florida's marine fisheries, preliminary interview results with southwest Florida fisheries stakeholders suggest that there is support for localizing management, particularly in the context of snook fisheries. This support was seen across all categories of respondents.

Those who were opposed to localizing management were concerned with the logistics as well as its impacts on fish populations. Logistics, voiced in the form of concerns about regulations and bureaucracy, could be addressed in the design of a place-based management approach, and concerns could be incorporated through a stakeholder input process that should be part of a shift to place-based management. Information and education would be able to quell other concerns, such as the consideration of fish range and movement patterns. Many fish species move less than might be expected and in actuality have relatively small home ranges with localized subpopulations. Snook in the Gulf of Mexico, for example, may inhabit a single estuary for the entirety of their lives (Muller and Taylor 2012), and snook in the Atlantic Ocean have been found to exhibit interannual spawning site fidelity, with many individuals overwintering within 40 km of their primary spawning site (Young et al. 2016). Increasing stakeholder awareness of the actual range of many of these fish species may influence their views toward localized or place-based management. In those cases where issues or species span regions, a nested, polycentric approach could help incorporate local, place-based management with larger scale governance (Ostrom 1967, Ostrom 1999, Brewer 2010).

Respondents identified a variety of issues impacting their local fisheries, many of which are locally based and therefore could be addressed using a place-based approach. Water quality concerns, for example, are place-based in nature; red tide blooms often occur on localized scales, and concerns about alteration of water flows are particular to the Caloosahatchee River and the Charlotte Harbor region. Other issues cited, such as habitat loss and degradation and the impacts of the cold kill on snook, are specific to a locality and could benefit from a place-based approach.

Interview results suggest that snook may be a useful case study species on which to focus future explorations of place-based management, as using snook as an example species was able to bring out stakeholders' place-based thoughts. Many stakeholders shared the perceptions that snook fisheries differ regionally or that snook were impacted differently by the freeze in different regions, suggesting that they are already thinking about snook in a place-based manner. In addition, snook are sensitive to many of the issues listed by stakeholders, such as habitat loss and water quality concerns, and so could serve as a focal point for discussions of how to address these issues locally.

Most interview respondents did not feel able to effectively participate in the fisheries management decision-making process and were overall dissatisfied with management. Respondents expressed concerns over the quality of fisheries data as well as the perception that scientific information was inaccessible, with most respondents citing other people or personal experience as a trusted source of information rather than fisheries professionals. Furthermore, many respondents indicated frustration with the stakeholder engagement process, feeling that their needs

and inputs are ignored and that they have no ability to influence management. Fisheries professionals were repeatedly characterized as close-minded individuals more focused on typing on computers than on listening to stakeholders, and more than one individual expressed the opinion that everyone in management should be fired. Overall, this shows dissatisfaction with the way they are engaged currently; satisfaction may be improved if stakeholders perceived ways to participate in a meaningful way and if trust of management was increased.

The success of public engagement strategies is dependent upon stakeholders' perceptions that their voices are being heard and incorporated into final decisions (Jentoft and McCay 1995), and engagement efforts viewed as insincere may only serve to frustrate stakeholders (Toman et al. 2006). Interview results suggest that stakeholders who participate in public meetings may not view their participation as meaningful or feel able to affect decisions, and may become frustrated with management as a result. Studies examining stakeholder engagement through collaborative, or co-management approaches, indicate that effective collaboration can be influenced by scale, with co-management approaches more successful at smaller scales (Cheng and Daniels 2002). In this way, a shift toward localized, place-based management may improve stakeholder engagement efforts (Jentoft 2000).

Synthesis

Place-based management is not in itself a novel concept, as any management action that affects a bounded geographical area can be said to be place-based (Olsen et al. 2011). However, such efforts traditionally focused on single resources or systems, and often the scale is still spatially large. Shifting management of Florida's marine coastal fisheries from a large-scale, species-centered approach to a more localized,

place-based regime may have benefits for addressing those issues of concern to stakeholders, and may be supported by many stakeholders. In addition, it could facilitate participatory processes, which in turn may alleviate stakeholders' concerns that their input is not heard.

Table 2-1. Interview respondents and their respective primary stakeholder group and assigned codes, other connections to fisheries, gender (F=female, M=male), whether or not the interview was recorded, whether or not they felt able to influence fisheries management, and whether or not they were in favor of localized, place-based management. A Y indicates a “yes” response, N a “no” response, and NR indicates the individual did not respond to the question because they didn’t know an answer.

Stakeholder Group	Code	Other Connections to Fisheries	Gender	Recorded?	Influence?	Place-Based?
Charter Captain/Guide	CG1	Family commercially fished	M	Y	NR	Y
	CG2		M	Y	N	N
	CG3		M	Y	N	Y
	CG4	Fishing and conservation groups, County committees	M	Y	Y	Y
	CG5	Media (articles and radio shows about fishing)	M	Y	N	Y
	CG6	Recreational fishing, helps research	M	Y	Y	N
	CG7	Media (articles about fishing)	M	Y	N	Y
	CG8		M	Y	N	N
	CG9		M	N	N	Y
	CG10		M	Y	N	Y
Bait and Tackle Shops	BT1		M	Y	N	Y
	BT2	Conservation efforts	M	Y	N	Y
	BT3		M	N	N	Y
	BT4		F	N	N	Y
	BT5	Recreational, commercial, and charter fishing	M	Y	N	N
	BT6	Recreational fishing, fishing groups	M	Y	N	Y
	BT7		F	N	N	Y
Extension/Government	EG1	Recreational fishing	M	N	NR	NR
	EG2	Recreational fishing	M	Y	NR	Y
	EG3	Recreational fishing	F	Y	Y	Y
	EG4		M	Y	NR	N
Recreational Angler	RA1	Marine law enforcement, diving, spearfishing	M	Y	N	Y
	RA2	Extension advisory board, fishing tournament	M	Y	N	Y
	RA3		M	N	NR	Y

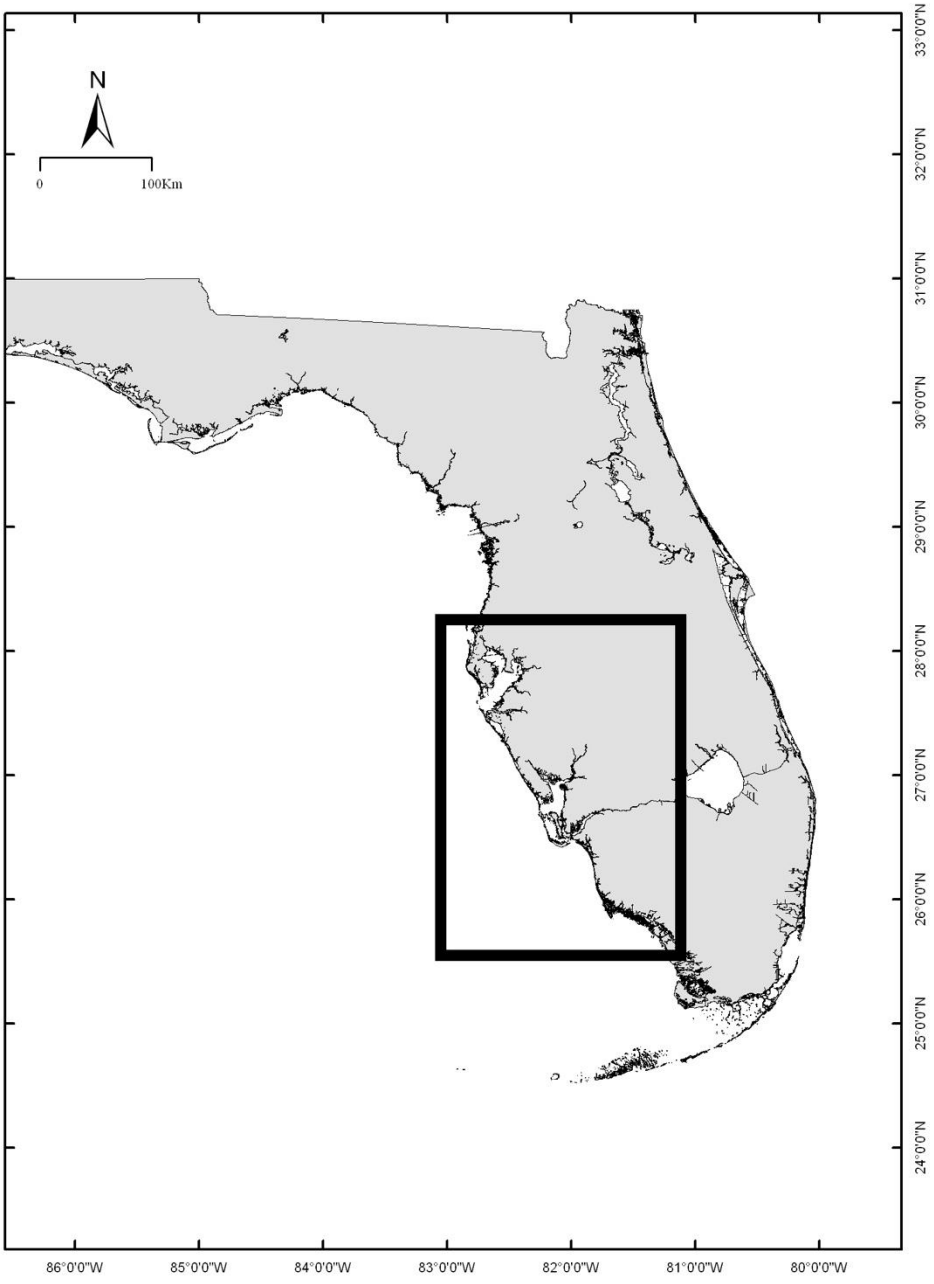

Figure 2-1. Map of Florida, with the southwest Florida study region highlighted with a black box.

CHAPTER 3
PARTICIPATORY MANAGEMENT AND STAKEHOLDER SATISFACTION

Participatory Management Background

A recurring question in fisheries management today is whether or not participatory approaches can improve management outcomes along biological, economic, social, and political measures. For the purpose of this study, participatory management is defined as any approach that includes stakeholders in the management process (therefore including other concepts, such as co-management and adaptive collaborative management). In participatory management, the degree to which stakeholders are included in the management process varies and can range from systems in which government consults with stakeholders but retains all decision-making power to those in which stakeholders design, implement, and enforce regulations with the advice and endorsement of the government (Jentoft and McCay 1995, Sen and Nielson 1996, Pomeroy and Berkes 1997). The unifying theme is that government incorporates stakeholders in some way in the decision-making process. As participatory management approaches are explored across natural resources, it is important that their success is evaluated across social, resource-based, and ecological outcomes (Wamukota et al. 2012). In this chapter, I focus on the relationship between participatory management and stakeholder attitudes. Understanding stakeholder attitudes toward management is important, as their acceptance of regulations and governance can influence compliance (Berkes 2009). In addition, adversarial interactions are likely when stakeholders are dissatisfied with the management process (Armitage et al. 2009), therefore understanding attitudes is a key component to managing conflict.

In this study I focused specifically on stakeholder perceptions of participation in the management of marine fisheries. As participatory management becomes more prevalent, it is important to understand how stakeholders perceive participatory approaches and whether or not they perceive engagement opportunities to be meaningful. Regardless of the level of power sharing between government and resource users, one component key to successful participatory management approaches is that the public perceives engagement as genuine. The acceptance and success of government cooperation with user groups depends on whether stakeholders feel that their input is listened to and that the process does not serve as simply a "symbolic gesture aimed at releasing the frustration of user groups" (Jentoft and McCay 1995, p. 228). If stakeholders do not view their participation as meaningful or the request for input as genuine, cooperative management efforts may only serve to frustrate individuals and may erode trust of agency personnel (Toman et al. 2006).

Marine fisheries in the state of Florida, United States, provide a useful context in which to examine stakeholder attitudes toward participation in the management process. The peninsular state is bordered by the Gulf of Mexico on the West and the Atlantic Ocean on the East, and is home to numerous recreational and commercial saltwater fisheries. Nearshore waters (up to 9 miles offshore in the Gulf of Mexico and 3 miles offshore in the Atlantic) are governed by the Florida Fish and Wildlife Conservation Commission (FWC) and include popular inshore fishery species such as snook (*Centropomus undecimalis*), red drum (*Sciaenops ocellatus*), and spotted seatrout (*Cynoscion nebulosus*); offshore waters fall under the federal jurisdiction of National Oceanic and Atmospheric Association (NOAA) Fisheries through the Gulf of

Mexico and the South Atlantic Fisheries Management Councils, and include popular reef fisheries such as red snapper (*Lutjanus campechanus*) and red and gag groupers (*Epinephelus morio* and *Micteroperca microlepis*). There are currently several ways that Florida's fisheries stakeholders can be engaged in the management decision-making process at both the state and Federal level, with participation in each case consisting mainly of consultation-style approaches such as public forums, surveys, and workshops, in which management obtains input and opinions from stakeholders about regulations and other management actions. However, recent interviews with stakeholders in southwest Florida suggest that som stakeholders do view these engagement opportunities as genuine and that many do not feel empowered in the management decision-making process (Chapter 2). Florida therefore offers a context in which to study stakeholder perceptions of engagement and in particular what it means for their attitudes toward management.

The Reasonable Person Model (RPM) (Kaplan and Kaplan 2000, 2009, Kaplan and Basu 2015, Monroe 2015) provides a theoretical framework through which to evaluate stakeholder perceptions of their participation in the management process. The RPM originated in the field of environmental psychology and posits that people behave in a more reasonable manner (i.e., they are more cooperative, helpful, and constructive) when their environment supports their informational needs (Kaplan and Kaplan 2000, 2005, 2006, 2009). These needs fall into three distinct yet interacting domains. The first describes the human need to build mental models to understand their environment. The second references people's need to be effective, or to feel competent and clear-headed. The third component refers to people's need to participate and make a difference,

termed meaningful action. In this study I focus on the meaningful action construct; specifically, I explore whether or not stakeholders perceive routes for meaningful action in the fisheries management process. Studies in the field of ecosystem restoration suggest that meaningful action is the biggest source of satisfaction in conservation volunteering (Miles et al. 2000), and work with Goliath grouper stakeholders in Florida shows a relationship between meaningful action and acceptance of management regulations (Sutt 2014); therefore it is hypothesized that feeling able to participate in fisheries management in a meaningful way will impact stakeholder satisfaction with management, which I consider an important social and political outcome of management.

This study aimed to explore stakeholder attitudes about and satisfaction with management in Florida through the application of the RPM. I chose a quantitative survey to accomplish this goal. My objectives in the survey were to 1) obtain baseline information on stakeholder attitudes regarding participatory management and 2) to explore whether or not there is a correlation between participation, in this case explored as whether or not they perceived opportunities for meaningful action, and stakeholder satisfaction with management.

Theoretical Framework: the Reasonable Person Model

The meaningful action domain of the RPM speaks to people's need to make a difference, to be needed, and to participate with their fellow humans in achieving goals. According to Kaplan and Kaplan (2003), the inability to do something helpful can lead to feelings of frustration and demoralization. Though this domain emphasizes action, how that action is received is equally important, therefore meaningful action also includes feeling respected, listened to, and heard (Kaplan and Kaplan 2003). In summary, the

meaningful action domain speaks both to people's need to make a difference and to have the opportunity to have an impact on the world around them as well as to their need to feel that their actions have been received and acknowledged.

The meaningful action construct incorporates ideas from two established behavioral theories: the Theory of Learned Helplessness (Seligman 1972) and Hope Theory (Snyder 1995). The Theory of Learned Helplessness proposes that when an individual experiences an outcome that is independent of his actions, he learns that he can't affect the outcome and is left feeling powerless (Dweck 1975, Maier and Seligman 1976). Conversely, Hope Theory defines hope as a positive state based on a positive outlook on future goal achievement (Snyder 1995), with hope a function both of an individual's ability to identify multiple pathways for goal achievement and their perceived capacity to use these pathways to achieve their goals (Snyder 2002). A hopeless individual therefore is someone who perceives few pathways for goal achievement and who has a negative outlook on their own ability to achieve their goals.

Creating environments that enable meaningful action is proposed as a corrective for feelings of helplessness and hopelessness (Kaplan and Kaplan 2003). Meaningful action can alleviate feelings of helplessness and hopelessness by providing people with the opportunity to participate in a meaningful way in their environment and to gain the sense that they can make a difference and that they are heard and respected (Kaplan and Kaplan 2006), thereby reducing feelings of frustration and demoralization.

Methods

This survey is part of a larger research initiative exploring the application of place-based management approaches to the management of Florida's fisheries (Chapter 2). The sample was drawn from four study areas in southwest Florida: Pinellas

County, Sarasota Bay (Sarasota and Manatee Counties combined), Charlotte Harbor (Charlotte and Lee Counties combined), and Collier County (Figure 3-1).

The survey was created using the Qualtrics software and distributed via email in June and July 2014. Prior to distribution, the survey was first pilot tested with 21 individuals, which included four fisheries scientists, six social scientists, two extension agents, and nine anglers. Pilot testing led to the addition of items differentiating state and federal management satisfaction as well as the addition of Extension/Sea Grant as sources of information about fisheries in the state and an item exploring future outlooks on public input incorporation.

A sample of 3,087 individuals (chosen to allow for a 5% margin of error and a 95% confidence interval assuming a 12% response rate) (surveymonkey.com) was randomly selected for each study area from the FWC's Recreational Saltwater Fishing License Holders Database, for a total of 12,348 anglers (from a total population of 122,691 license holders in the region). Prior to sampling, the database was first filtered to include only those individuals with valid emails (e.g., emails such as "no@no.com" and individuals without email addresses were excluded). Survey distribution included a personalized email request, and reminder emails were sent 1 week after the initial email (one reminder was chosen as few additional respondents were gained after the first reminders and therefore further reminders were deemed unwarranted) (Dillman et al. 2009). After distribution, nonresponse bias was assessed by comparing the demographics of respondents to that of the original sample (Vaske 2008). All procedures were approved by the University of Florida Institutional Review Board.

The survey questionnaire contained a total of 20 questions divided into 5 sections. The first section characterized respondents' general fishing characteristics, and included questions about their frequency of fishing, species targeted, and habitats fished. The second section focused on respondents' participation in the management process. The third section covered respondents' general views toward management and public participation in the management process. The fourth section included questions about satisfaction and perceptions of meaningful action, and the final section covered demographic information, such as age and gender.

Based on the RPM, it was hypothesized that an individual's perception of whether or not they had opportunities for meaningful action would influence their satisfaction with management. To test this, scales were created to measure meaningful action and satisfaction. To measure satisfaction with management, a 6-item scale was created which included items related to satisfaction with Florida fisheries management in general, state management, Federal management, regulations, enforcement, and the way regulations are made; response options were given as a 5 point scale ranging from very dissatisfied to very satisfied. To measure meaningful action, a 9-item scale was created which included items from Ward's Helplessness Scale (to measure learned helplessness) (Smallheer 2011) and from Beck's Hopelessness Scale (to measure hope) (Beck 1974), each adjusted slightly for relevance to fisheries and fisheries management; response options were given as a 5 point scale ranging from strongly disagree to strongly agree. Internal consistency, or reliability, for the satisfaction and meaningful action scales was tested using Cronbach's alpha. Assuming a cut-off value of 0.70 or greater (Vaske 2008), analyses found acceptable Cronbach's alpha values for

both scales (0.88 for meaningful action and 0.93 for satisfaction with management). I then calculated the Pearson's correlation coefficient to explore whether there was a relationship between perceptions of meaningful action and satisfaction with management.

It was also hypothesized that there would be differences across surveyed variables when comparing those individuals who perceive they have opportunities for meaningful action and those who do not. To test this, the responses of individuals who scored either in the highest or lowest 20% of the meaningful action scale were compared across surveyed metrics. When responses represented categorical data, they were compared with a chi-square test, and when responses represented continuous data, they were compared using a t-test.

Results

Response Rates and Demographics

In total, 826 individuals completed the survey for a response rate of 7%. Demographic comparison showed little nonresponse bias, with no differences in ethnicity; however, males were slightly overrepresented, with females comprising 28% of the sample but only 15% of the respondents. The majority of respondents were white (96%), male (84%), and between the ages of 40-70 (77%, average age of 49) (Table 3-1). The majority (97%) were also full-time residents of the state of Florida, with only 2% identifying as part-time residents and less than 1% identifying as visitors. When asked the ways in which they identify as a stakeholder in Florida's fisheries, nearly all respondents (95%) identified as recreational anglers, with about half (54%) identifying as concerned citizens. This was followed by identification as conservationists (29%), recreational divers (26%), recreational spearfishers (20%), and fishing charter operators

(13%). Fewer identified with the marine tourism industry (7%) or commercial fishing (7%), with 6% identifying as a bait and tackle shop owner, fisheries or other marine scientist, or connected to the seafood industry, and 5% and 4% identifying as resource managers or policy decision-makers.

Fishing Characteristics

When asked the frequency with which they had fished in the past 12 months, the majority (61%) of respondents reported having fished with moderate frequency (once a month to once a week), with 19% having fished more frequently (a few times a week or daily), 19% having fished less frequently (once or a few times), and 1% responding that they had not fished (Table 3-2). In addition, the majority (59%) of respondents indicated that the last time they had been fishing was in the past week, with 31% indicating they had fished last in the past month. When asked about their fishing ability, most respondents viewed themselves as either more skilled (42%) or equally skilled (44%) when compared to other anglers, with only 14% viewing themselves as less skilled.

In order to ascertain years of fishing experience (both in general and in the state of Florida), respondents were asked what year they started fishing and what year they started fishing in Florida (Table 3-2). Results showed that three quarters (74%) of respondents had been fishing for more than 30 years, with 25% having fished for more than 50 years. However, only 42% had been fishing in Florida for more than 30 years, with only 7% having fished in Florida for more than 50 years. To further explore this, a new variable (FLF) was created to look at what proportion of an individual's fishing experience had occurred before fishing in the state of Florida, such that FLF = years since first fished in Florida / years since first fished. Just less than half (46%) of respondents had started fishing in Florida the same year that they started fishing (i.e.,

years since first fished in Florida / years since first fished = 1.00, assumed to indicate that they began fishing in Florida), while the rest had started fishing elsewhere before beginning to fish in the state (i.e., years since first fished in Florida / years since first fished < 1.00).

Most respondents indicated that they typically fish either from a motorized vessel exclusively (51%) or from a combination of motorized vessel, shore (which included piers, bridges, and docks), and/or kayak/canoe (40%); only 7% fished exclusively from shore, and only 2% fished exclusively from a kayak/canoe. When asked what habitats they had fished in the past 12 months, almost all (92%) indicated having fished inshore/coastal marine waters, with 62% having fished offshore marine waters and 29% having fished in freshwater.

Respondents were asked in a free-response type question to list their top three species targeted when fishing. Responses were first coded for consistency across common names (for example, the species *Cynoscion nebulosus* was referred to as trout, seatrout, spotted seatrout, spotted trout, and speckled trout by different respondents). Unfortunately, in the case of snappers and groupers respondents did not always specify species (for example, while some individuals wrote “red snapper” or “mangrove snapper”, referencing two distinct snapper species, others simply put “snapper”); for this reason, snappers and groupers were each grouped at the lowest possible taxonomic level. In the case of snappers, this was the genus *Lutjanus*, and in the case of groupers, this was the family Serranidae.

In total, 98 different species and species groups were listed by respondents. The top 6 species listed are presented in Table 3-2; each were listed by at least 10% of

respondents. The top species listed by respondents was redfish *Sciaenops ocellatus*, followed by snook *Centropomus undecimalis*, each targeted by about half of respondents (52% and 51% respectively). This was followed by groupers (Serranidae) (listed by 34% of respondents) and the spotted seatrout *Cynoscion nebulosus* (listed by 32% of respondents). Snappers (*Lutjanus* sp.) were targeted by 28% of respondents, and 12% of respondents included Atlantic tarpon *Megalops atlanticus* among their top three species.

Stakeholder Participation in Management

Respondents were asked a series of questions to explore their experience with management as well as their attitudes toward public participation in the management decision-making process. When asked how they had participated in the fisheries management process in the past 2 years, 54% indicated that they had never participated (Table 3-3). Those who had participated had done so mostly through opinion surveys (31% of respondents) or through catch information reporting (15% of respondents), with only 3-5% of respondents having participated in regulatory or fisheries council meetings. In addition, 7% reported having participated by supporting a lobbying group, and 5% had participated through letter writing. Finally, 5% of respondents indicated that they had stopped participating in the management process.

Respondents were also asked about their interest in participating in the management process in future on a 5-point scale ranging from Very Uninterested to Very Interested. Respondents were on average somewhat interested in participating in all engagement options in future, with mean scores ranging from 3.35-3.74 (Table 3-3). The majority of respondents were either interested or very interested in participating in fishing for data collection (66%) or opinion surveys (61%), with fewer interested or very

interested in participating in educational seminars (51%), or public meetings/workshops (47%).

Respondents were also asked how knowledgeable they felt about the fisheries management process, with 4 options ranging from Not at All Knowledgeable to Very Knowledgeable. On average, respondents felt they were only a little knowledgeable about both the process by which fisheries management decisions are made and about the science behind fisheries management (mean scores of 2.02 and 2.12 out of 4.0 respectively) (Table 3-3). Only 4% and 5% of respondents felt they were very knowledgeable about the process by which fisheries management decisions are made and the science behind fisheries management respectively.

Respondents were also asked to rate the level of trust they have for different sources of information about fisheries on a 5-point scale ranging from Not at all Trustworthy to Very Trustworthy. On average, respondents had the most trust for Extension/Sea Grant agents (3.34 out of 5.0) and the least trust for Federal Councils (2.67), with a moderate level of trust for fishing magazines, other anglers, scientists, and state agency personnel (3.17 for each) and for websites (3.10) (Table 3-3). Overall, trust for fisheries professionals was low, with 8% and 10% of respondents rating fisheries scientists and state agency personnel as Not at All Trustworthy (score of 1.0) and 22% of respondents rating Federal councils as Not at All Trustworthy.

Finally, respondents were asked about their attitudes toward public participation in the management process, with response options given as a 5-point scale ranging from Strongly Disagree to Strongly Agree. Overall, 89% of respondents agreed that public input should be included in the management decision-making process (mean

score of 4.17 out of 5.0) (Table 3-3); however, only 19% agreed that public input is currently incorporated in management decision-making (mean score of 2.70), with only 13% agreeing that managers listen to public input (2.60) and only 24% agreeing that public input will be incorporated in future (2.85). In addition, only 23% agreed that they understand the process (2.90), with only 38% agreeing that there is good science behind management (2.95). Though 41% agreed that they would like to be a part of the process (3.55), only 15% agreed that there are currently opportunities for them to participate (2.88). It is therefore unsurprising that 26% agreed that they are frustrated with the management process (3.17).

Theoretical Scales

The 5-point satisfaction scale consisted of 6 items, with response options ranging from Very Dissatisfied to Very Satisfied. Responses were averaged across items for an overall satisfaction with management score. Respondents were on average dissatisfied with fisheries management in the state of Florida, though the mean was near neutral (mean score of 2.94 out of 5.0); this is reflective of the near even split between satisfied and dissatisfied individuals, with 42% of respondents overall dissatisfied with management (mean score of less than 3.0 on the satisfaction scale) and 44% overall satisfied with management (mean score of greater than 3.0 on the satisfaction scale). In addition, though most respondents scored on average somewhere near neutral, 14% of respondents were on average very dissatisfied with management (mean score of less than 2.0), and only 6% were on average very satisfied (mean score of greater than 4.0). Respondents were most satisfied with the way regulations are enforced (mean score of 3.14) and were least satisfied with the way regulations are made (2.78) and with Federal fisheries management (2.77) (Table 3-4).

Responses on the 9 item meaningful action scale ranged from Strongly Disagree to Strongly Agree and were reverse-coded when necessary and then averaged, so that a high score on the scale indicated an individual does perceive routes for meaningful action (with a low score indicating they do not perceive routes for meaningful action). On average, respondents disagreed that they had meaningful ways to participate in the management process, though again the average was close to neutral (mean score of 2.95); similar to the satisfaction scale, this was reflective of a near even split between those who agreed (42%) and disagreed (40%) that they had routes for meaningful action (mean scores of greater than or less than 3.0 on the meaningful action scale). Most respondents scored near neutral on average, however, with only 3% on average strongly disagreeing (mean score below 2.0) and only 6% on average strongly agreeing (mean score above 4.0). Respondents agreed on average with the item “no matter how much energy I put into providing input, I feel I have no control over the outcome of a management decision” (mean score of 3.26) and disagreed that they are successful when they try to engage with management (2.84), that they are able to influence fisheries management decisions (2.59), and that when they look ahead to the future of fisheries management they expect to be happier (2.86). However, they also disagreed that they can’t make things better so they may as well not try (2.67) and agreed that they “look forward to the future of fisheries management with hope and optimism” (3.17) (Table 3-4).

Relationship Between Meaningful Action and Satisfaction

Results show a significant, moderate, positive correlation between perceptions of meaningful action and satisfaction with management ($n=816$, $r=0.58$, $p<0.001$) (Figure 3-2).

Comparison Across Groups

A total of 164 individuals from the low end of the meaningful action scale (i.e., those who perceived the least meaningful action, labeled LMA for reporting) and 164 individuals from the high end of the meaningful action scale (i.e., those individuals who perceived the most meaningful action, labeled HMA for reporting) were then compared to look for significant differences across survey variables (Tables 3-5, 3-6). There were no significant differences in gender, age, ethnicity, or Florida residency between LMA and HMA respondents, though a significantly greater proportion HMA individuals identified as conservationists (44% versus 28%) ($X^2(1, N=328)=9.69$, $p=0.002$) and fisheries/marine scientists (11% versus 4%) ($X^2(1, N=328)=6.47$, $p=0.011$).

While there were no significant differences in fishing frequency or skill, there were differences in fishing characteristics between LMA and HMA individuals in the survey. For example, LMA respondents were significantly more likely to list grouper as a top three target species (54% versus 30%) ($X^2(1, N=328)=19.07$, $p<0.001$), while HMA respondents (i.e., perceived the most meaningful action) were significantly more likely to list spotted seatrout (38% versus 21%) ($X^2(1, N=328)=10.671$, $p=0.001$). There was also a small but significant difference in the number of years spent fishing in Florida, and correspondingly in the percentage of years fishing in Florida: LMA individuals had fished in Florida for an average of 30.49 years, with an FLF average of 0.79, whereas HMA individuals had fished in Florida for an average of 25.84 years, with an FLF average of 0.67 ($t(327)=2.65$, $p=0.009$ and $t(327)=3.76$, $p<0.001$). HMA respondents were also more likely to fish from shore or from a combination of methods, whereas LMA respondents were more likely to fish from a motorized vessel exclusively ($X^2(1, N=328)=30.97$, $p<0.001$). In addition, LMA individuals were more likely to fish offshore

(76% versus 56%) (X^2(1, N=328)=14.70, p=0.001), whereas HMA individuals were more likely to fish inshore coastal/marine (96% versus 85%) (X^2(1, N=328)=4.32, p<0.038) and freshwater (X^2(1, N=328)=12.17, p<0.001) habitats.

The two groups also differed significantly in their experience with and attitudes toward the fisheries management process. While almost half of respondents in both groups had never participated in the management process (45% for each), LMA respondents were significantly more likely to have participated by supporting a lobbying group (20% versus 4%) (X^2(1, N=328)=19.25, p<0.001) and were significantly more likely to have stopped participating (9% versus 2%) (X^2(1, N=328)=7.04, p<0.008). In addition, LMA and HMA differed significantly in whether or not they agreed that there are opportunities for them to participate in the management process (mean scores of 2.52 versus 3.22) (t(327)=6.90, p<0.001). However, there were no significant differences in how interested respondents in each group were in participating in management in the future through opinion surveys, fishing for data collection, public meetings, or educational seminars, and respondents in both groups agreed that public input should be included in the fisheries management process (mean scores of 4.41 and 4.17) and that they would like to be a part of the process (mean scores of 3.90 and 3.60).

Though both groups agreed that public input should be included in the management process (mean scores of 4.41 and 4.17, t(327)=1.63, p=0.104), they significantly disagreed along other measures (Table 3-6). For example, LMA disagreed on average that they understand the process (mean score of 2.58), that managers listen to public input (1.88), that public input is or will be incorporated into management

decisions (1.88 and 1.99), and that there is good science behind management (1.89), whereas HMA agreed on average (mean scores of 3.28-3.71) ($t(327)=6.17$-16.73, $p<0.001$). In addition, LMA agreed that they are frustrated with management, whereas HMA disagreed (mean scores of 3.93 versus 2.58) ($t(327)=9.68$, $p<0.001$).

Notably, LMA respondents also had lower levels of trust for fisheries professionals and higher levels of trust for other anglers, differing significantly from HMA respondents in their ratings of the trustworthiness of scientists (mean score of 2.46 versus 3.85) ($t(327)=9.28$, $p<0.001$) , the state agency (mean score of 2.27 versus 3.79) ($t(327)=12.21$, $p<0.001$), Federal councils (mean score of 1.71 versus 3.32) ($t(327)=12.93$, $p<0.001$), extension/Sea Grant agents (mean score of 2.87 versus 3.79) ($t(327)=6.76$, $p<0.001$), and other anglers (3.41 versus 3.02) ($t(327)=3.58$, $p<0.001$), but with no significant differences in their ratings of the trustworthiness of fishing magazines and websites.

As expected from the correlation results, there was also a significant difference across satisfaction items between LMA and HMA respondents, with HMA respondents also significantly more satisfied with management than LMA respondents (Table 3-4).

Discussion

Stakeholder satisfaction with decision-making can influence their acceptance of decisions, their compliance with regulations, and their relationships with decision-makers (Lawrence et al. 1997). Participative management approaches can increase satisfaction, and an important factor influencing satisfaction is having the opportunity to be heard (Lawrence and Deagan 2001) and having the opportunity to participate in meaningful ways. In this study, application of the RPM to fisheries management in Florida showed that whether or not an individual feels that he/she can participate in the

management process in a meaningful way significantly correlations with their satisfaction with management. Those individuals who perceived routes for meaningful participation in the management process were also more satisfied with management, whereas those who did not feel that they could participate in a meaningful way had low satisfaction with management.

Overall, almost half of survey respondents did not perceive routes for meaningful action in the fisheries management decision-making process, though many of these individuals were overall near neutral. Feeling listened to and heard is an important component of the meaningful action domain (Kaplan and Kaplan 2003); a minority of respondents in the survey agreed that managers listen to public input or that public input is or will be incorporated into management decisions, indicating that they do not feel listened to or heard by managers. In addition, respondents exhibited elements of helplessness and hopelessness, disagreeing that they are successful when they try to engage management or feel able to influence management, with a number of respondents indicating that though they had participated in management in the past they had stopped participating. However, respondents also disagreed that they may as well not try to make things better and agreed that they look forward to the future with hope and optimism, suggesting that on average they are not entirely without hope.

Satisfaction with management was relatively low among respondents, with the lowest satisfaction seen with Federal fisheries management in Florida. In addition, trust of fisheries professionals was moderate, and no higher than trust for other anglers or for fishing magazines. Research has shown that engagement that is not perceived as genuine can erode trust (Toman et al. 2006); this is reflected in the survey results,

which show that those who scored lowest on the meaningful action scale also have lower levels of trust for fisheries professionals. The relationship between satisfaction and meaningful action suggests that providing opportunities for genuine meaningful action will increase stakeholder satisfaction with management; in addition, collaborative, co-management approaches have the ability to improve trust relations between resource users and management (DeVos and Tatenhove 2011).

More than half of respondents in the survey had never participated in the management process; of those who had participated, most had done so through opinion surveys, with relatively few attending regulatory or fisheries council meetings. Though on average respondents agreed that they would like to be included in the management process and expressed interest in participating in management in future, they disagreed that they had opportunities to participate. In short, respondents want to participate but don't currently see ways to do so. In this light, management should make efforts to better advertise current opportunities for stakeholders to participate in the management process. In addition, management should experiment with novel ways to engage stakeholders. Respondents were most interested in participating in fishing for data collection, for example, indicating the opportunity for citizen science engagement efforts.

Results also show that respondents overall do not feel knowledgeable about the fisheries management process. Responses indicated low levels of knowledge about the process and science behind fisheries management, and on average respondents disagreed that they understand the fisheries management process. This suggests the need for educational outreach with regard to fisheries science and management.

Management should capitalize in this case on the most trusted source of information about fisheries (according to the survey): Sea Grant and Extension agents.

Results suggest that there is more frustration associated with Federal fisheries management than with state fisheries management in Florida. Those who scored lowest on the meaningful action scale were also more likely to target groupers (a largely offshore fishery) and to fish offshore, meaning they are more likely to fish in waters and for species that fall under Federal jurisdiction; conversely, those who scored high on the meaningful action scale were more likely to fish for spotted sea trout (an inshore, state water species) and to fish inshore marine and freshwater habitats. In addition, on average respondents were slightly more satisfied with state management than Federal (mean score of 3.00 versus 2.77), and had more trust for state agency personnel than for Federal councils (mean score of 3.17 versus 2.67). This greater trust for state management than Federal is reflected in current discussions of red snapper management in the Gulf of Mexico, in which many are pushing for management to be turned over to the states even in Federal waters. It is beyond the scope of this survey to identify the reason behind this preference for state over Federal management in the state of Florida, and it is possible that these attitudes are reflective of deeper socio-political and institutional issues (Jentoft 2006).

Florida is home to many immigrants, both from other states and other nations, and in fact is the state with the second lowest native-born population (only 36% of Floridians were born in Florida (Aisch et al. 2014)). Much of the state's population consists of retirees, though many move to Florida at other stages, and many of these transplants come to Florida to fish. Results show that those with low meaningful action

and satisfaction scores were also more likely to have started fishing in Florida, whereas those with higher scores were more likely to have started fishing outside of the state. There are many potential explanations for this difference. For example, it is possible that those individuals who started fishing elsewhere have a different baseline for experiences of meaningful action and participation in the management process, and may see participation in Florida's management as more meaningful than their engagement elsewhere. It is also possible that historical management actions influence the perceptions of those who have only fished in the state. More research would be needed in future to better understand the explanation behind these differences.

The majority of respondents identified as recreational anglers, which is unsurprising as the sample was pulled from the recreational fishing license holders' database. While this may be seen to bias results toward applicability to the recreational sector, it is reasonable to assume that a similar relationship between perceived meaningful action and satisfaction would be seen in other sectors, and results do suggest that other sectors show similar trends in their attitudes toward management. For example, those respondents who identified as commercial fishers in the survey (N=60) had similar scores for the meaningful action and satisfaction scales (2.94 and 2.64 respectively), and also on average agreed that public input should be included in the management process (4.25) and disagreed that there are currently opportunities for them to participate (2.88) and that management listens to public input (2.58).

While analysis showed little nonresponse bias along demographic variables, there was a slight overrepresentation of male respondents. Comparison between male and female responses within the survey does show that while both groups are near

neutral with regard to their perceptions of meaningful action (scores of 2.93 and 3.07), females in the survey were on average more satisfied with management than males (mean score of 3.21 versus 2.89 on the satisfaction scale). In addition, results suggest that females may differ in their views regarding the trustworthiness of different sources of information about fisheries, with females indicating greater trust of state agencies (mean of 3.29 versus 3.03) and Federal councils (mean of 2.86 versus 2.52) and males indicating greater trust of fishing magazines (3.12 versus 2.85).

Respondents were for the most part avid fishermen, which is consistent with the literature that shows that avid fishermen tend to be the ones to engage with science and management (Anderson and Thompson 1991, Prentice et al. 1993, Connelly and Brown 1996, Bray and Schramm 2001, Walker and Schramm 2004). However, there was no difference along avidity measures between those who perceived meaningful action and those who did not, suggesting that satisfaction and attitudes toward management are not related to experience or avidity.

Some authors suggest that participatory management is more successful at smaller, more local scales (Cheng and Daniels 2002) and that communication may be better attained through interactive, locally scaled efforts (Toman et al. 2006). Therefore, a promising step in this research would be to see if a locally scaled engagement effort can improve perceptions of meaningful action.

Synthesis

Participatory management approaches have the potential to improve management outcomes (Sirianni and Freidland 1997, Grafton 2005, Sirianni 2009); however, it is important to the success of participatory management that engagement opportunities are viewed as genuine. This survey demonstrates the relationship

between meaningful action and satisfaction with management. The finding that fewer than half of respondents perceived routes for meaningful action in the fisheries management process in Florida and were satisfied with management in the state indicates a need for management to evaluate its participatory processes.

Historically, efforts to improve stakeholder satisfaction have typically focused on changes in regulations or on improving fish stocks; results of this study suggest that changing perceptions about stakeholder engagement would also improve levels of satisfaction. Creating new opportunities for participation in the management process also has the potential to improve stakeholder trust of fisheries professionals and to reduce stakeholder frustration with fisheries management process. According to the RPM, individuals who do not perceive routes for meaningful action, or in other words who are helpless and hopeless, are more likely to be frustrated and less able to interact in a cooperative, constructive manner (Kaplan and Kaplan 2003, 2006). Therefore, improving perceptions of meaningful action by creating real, genuine, meaningful opportunities for sharing knowledge and engaging (and advertising them widely) would likely improve management interactions with stakeholders in addition to improving overall satisfaction.

Table 3-1. Demographics of survey respondents, with N=number of respondents.

	N (%)
Age	
18-20	15 (2%)
21-30	61 (8%)
31-40	109 (14%)
41-50	182 (23%)
51-60	267 (33%)
61-70	170 (21%)
>70	2 (0%)
Gender	
Male	691 (84%)
Female	125 (15%)
Prefer not to say	3 (0%)
Ethnicity	
White	798 (96%)
Hispanic	11 (1%)
Asian	4 (1%)
Black	7 (1%)
Other	6 (1%)
Florida residency status	
Part-time resident	18 (2%)
Full-time resident	801 (97%)
Visitor	1 (0.01%)
Other	5 (1%)
Connections to fisheries?[a]	
Recreational Angler	784 (95%)
Concerned citizen	454 (55%)
Conservationist	247 (30%)
Recreational diver	221 (27%)
Recreational spearfisher	165 (20%)
Fishing charter	110 (13%)
Commercial fisher	54 (7%)
Marine tourism industry	58 (7%)
Bait/Tackle Shop Owner	48 (6%)
Fisheries/Marine Scientist	52 (6%)
Seafood industry	47 (6%)
Resource manager	40 (5%)
Policy decision-maker	33 (4%)
Other	48 (6%)

[a] Indicates a multiple response/check all that apply question

Table 3-2. General fishing characteristics of survey respondents, with N=number of survey respondents. Fish species targeted by fewer than 10% of respondents are not reported.

	N (%)
Frequency of Fishing in Past 12 months	
Never	5 (1%)
Infrequent (once-a few times)	154 (19%)
Moderate (once a month-once a week)	507 (61%)
Frequent (a few times a week-daily)	159 (19%)
Last time fishing	
In the past week	493 (60%)
In the past month	249 (30%)
In the past 6 months	62 (8%)
In the past year	16 (2%)
A year ago or more	3 (0%)
How do you compare your fishing ability to that of other anglers?	
More skilled	348 (42%)
Equally skilled	365 (44%)
Less skilled	113 (14%)
Years fishing	
10 years or fewer	33 (4%)
11-20 years	66 (8%)
21-30 years	116 (14%)
31-40 years	173 (21%)
41-50 years	231 (28%)
> 50 years	207 (25%)
Years fishing in Florida	
10 years or fewer	188 (23%)
11-20 years	174 (21%)
21-30 years	172 (21%)
31-40 years	160 (19%)
41-50 years	131 (16%)
> 50 years	58 (7%)
FLF	
0-25%	132 (16%)
26-50%	107 (13%)
51-75%	124 (15%)
76-99%	83 (10%)
100%	347 (46%)

Table 3-3. Continued

	N (%)
Typically fish…	
From shore/pier/bridge/dock	58 (7%)
From a kayak/canoe	16 (2%)
From a motorized vessel	421 (51%)
From a combination of the above	330 (40%)
Habitats fished in the past 12 months[a]	
Inshore coastal/marine	750 (92%)
Offshore marine	513 (63%)
Freshwater	241 (29%)
Target Species (Top 6 Listed)[a]	
Redfish *(Sciaenops ocellatus)*	483 (52%)
Snook *(Centropomus undecimalis)*	470 (51%)
Grouper *(sp*. unspecified)	314 (34%)
Spotted Seatrout *(Cynoscion nebulosus)*	298 (32%)
Snapper *(sp*. unspecified)	260 (28%)
Tarpon *(Megalops atlanticus)*	112 (12%)

[a] Indicates a multiple response/check all that apply question

Table 3-3. Respondent participation in and attitudes toward participation in the management process, with N=number of respondents.

	N (%)	Mean (Standard Deviation)
In the past 2 years, how participated in management?[a]		
Opinion surveys	255 (31%)	
Catch information reporting	125 (15%)	
Regulatory meetings	40 (5%)	
Supporting a lobbying group	61 (7%)	
Fisheries council meetings	27 (3%)	
Letter writing	40 (5%)	
Other	20 (2%)	
I used to participate but stopped	37 (5%)	
I have never participated	444 (54%)	
Level of interest in participating in the following (1-5):		
Opinion surveys		3.65 (0.98)
Educational seminars		3.42 (1.01)
Public meetings/workshops		3.35 (1.01)
Fishing for data collection		3.74 (1.04)
Level of agreement with the following (1-5):		
I understand the process		2.90 (0.99)
Public input should be included		4.17 (0.83)
I would like to be a part of the process		3.55 (0.92)
There are opportunities for me to participate		2.88 (0.85)
Managers listen to public input		2.69 (0.95)
Public input is currently incorporated		2.70 (0.97)
Public input will be incorporated in the future		2.85 (0.98)
There is good science behind management		2.95 (1.10)
I am frustrated with the process		3.16 (1.10)
How knowledgeable do you feel about (1-4):		
The process behind fisheries management		2.02 (0.82)
The science behind fisheries management		2.12 (0.85)

Table 3-3. Continued

	N (%)	Mean (Standard Deviation)
Trust for following sources of fisheries information (1-5):		
Fishing magazines		3.17 (0.93)
Websites		3.10 (0.95)
Other anglers		3.17 (1.00)
Scientists		3.17 (1.10)
State agency personnel		3.17 (1.10)
Federal councils		2.67 (1.20)
Extension/Sea Grant agents		3.34 (1.00)

[a] Indicates a multiple response/check all that apply question

Table 3-4. Theoretical Scale responses for all respondents and for the low and high meaningful action subsets, with LMA signifying the low meaningful action group and HMA signifying the high meaningful action group, presented as means and standard deviations (SD).

	Total Mean (SD)	LMA (SD)	HMA (SD)
In Florida, how satisfied are you with:			
Current fisheries regulations	2.96 (1.09)	1.98 (0.93)	3.51 (0.87)
Fisheries management agencies	3.03 (1.07)	2.03 (0.94)	3.59 (0.85)
The way regulations are made	2.78 (1.09)	1.79 (0.84)	3.33 (0.93)
The way regulations are enforced	3.14 (1.02)	2.48 (1.11)	3.60 (0.87)
Federal fisheries management	2.77 (1.08)	1.73 (0.92)	3.36 (0.87)
State fisheries management	3.00 (1.04)	2.10 (1.05)	3.55 (0.90)
Level of agreement:			
I am successful when I try to engage with fisheries management	2.84 (0.60)	3.72 (0.82)	2.88 (0.55)
I am able to influence fisheries management decisions	2.59 (0.77)	4.16 (0.80)	3.00 (0.64)
No matter how much energy I put into providing input, I feel I have no control over the outcome of a management decision	3.26 (0.87)	4.09 (0.97)	2.62 (0.77)
No matter how hard I try, things never seem to work out the way I want them to	2.95 (0.79)	3.62 (0.93)	2.33 (0.80)
I can't make things better so I may as well not try	2.67 (0.97)	3.48 (1.13)	1.72 (0.65)
I don't expect to get what I want in future management decisions	3.10 (0.90)	4.12 (0.81)	2.15 (0.70)
The future of Florida's fisheries seems dark to me	2.91 (1.01)	3.96 (0.91)	1.84 (0.61)
When I look ahead to the future, I expect I will be happier with fisheries	2.86 (0.85)	4.04 (0.80)	2.48 (0.74)
I look to the future of fisheries management with hope and optimism	3.17 (0.97)	3.88 (1.03)	2.05 (0.61)

Table 3-5. Demographics and fishing characteristics comparisons across groups, with LMA signifying the low meaningful action group and HMA signifying the high meaningful action group, with N=number of responses.

	LMA N (%)	HMA N (%)	T-statistic	Chisq Statistic	p-value
N	164	164			
Connections to fisheries					
Conservationist	45 (28%)	72 (44%)		9.69	0.002
Fisheries/Marine Scientist	6 (4%)	18 (11%)		6.47	0.011
Target Species					
Grouper *(sp*. unspecified)	88 (54%)	49 (30%)		19.07	<0.001
Spotted Seatrout *(Cynoscion nebulosus)*	35 (21%)	62 (38%)		10.67	0.001
Years fishing in Florida			2.65		0.009
<10 years	14 (9%)	34 (21%)			
11-20 years	33 (20%)	37 (23%)			
21-30 years	33 (20%)	28 (17%)			
31-40 years	36 (22%)	28 (17%)			
41-50 years	35 (21%)	23 (14%)			
51-60 years	12 (7%)	13 (8%)			
FLF			3.76		<0.001
0-25%	8 (5%)	29 (18%)			
26-50%	23 (14%)	23 (14%)			
51-75%	26 (16%)	27 (17%)			
76-99%	18 (11%)	22 (14%)			
100%	88 (54%)	59 (37%)			
Typically fish…				30.97	<0.001
From shore/pier/bridge/dock	6 (4%)	14 (8%)			
From a kayak/canoe	0 (0%)	0 (0%)			
From a motorized vessel	113 (69%)	63 (39%)			
From a combination of the above	44 (27%)	86 (53%)			
Habitats fished in the past 12 months					
Inshore coastal/marine	139 (85%)	157 (96%)		4.32	0.038
Offshore marine	124 (76%)	91 (56%)		14.70	0.001
Freshwater	35 (21%)	64 (39%)		12.17	<0.001

Table 3-6. Management attitudes comparison between groups with LMA signifying the low meaningful action group and HMA signifying the high meaningful action group, with SD=standard deviation.

	LMA Mean (SD)	HMA Mean (SD)	T-statistic	p-value
In Florida, how satisfied are you with:				
Current fisheries regulations	1.98 (0.93)	3.51 (0.87)	13.69	<0.001
Fisheries management agencies	2.03 (0.94)	3.59 (0.86)	14.52	<0.001
The way regulations are made	1.79 (0.84)	3.33 (0.93)	14.05	<0.001
The way regulations are enforced	2.47 (1.11)	3.60 (0.87)	10.06	<0.001
Federal fisheries management	1.73 (0.92)	3.36 (0.87)	14.69	<0.001
State fisheries management	2.10 (1.05)	3.54 (0.90)	13.32	<0.001
Level of trust for the following sources of fisheries information:				
Fishing Magazines	3.14 (1.00)	3.23 (0.91)	0.58	0.560
Websites	2.96 (0.99)	3.16 (0.93)	0.70	0.490
Anglers	3.41 (1.10)	3.02 (1.00)	3.58	<0.001
Scientists	2.46 (1.10)	3.85 (0.81)	9.28	<0.001
State Agency	2.27 (1.10)	3.79 (0.92)	12.21	<0.001
Federal Council	1.71 (0.96)	3.32 (1.00)	12.93	<0.001
Extension/SG	2.87 (1.10)	3.79 (0.89)	6.76	<0.001
Level of agreement with the following statements:				
I understand process	2.58 (1.20)	3.29 (0.95)	6.17	<0.001
Public input should be included	4.41 (0.83)	4.17 (0.79)	1.63	0.104
I would like to be a part	3.90 (0.92)	3.60 (0.92)	2.66	0.008
There are opportunities for me to participate	2.52 (1.00)	3.22 (0.78)	6.90	<0.001
Managers listen to public input	1.88 (0.92)	3.31 (0.75)	14.02	<0.001
Public input currently incorporated	1.88 (0.88)	3.28 (0.85)	13.31	<0.001
Public input will be incorporated in future	1.99 (0.95)	3.48 (0.80)	15.43	<0.001
There is good science behind	1.89 (0.95)	3.71 (0.90)	16.73	<0.001
I am frustrated	3.93 (1.40)	2.58 (0.97)	9.68	<0.001

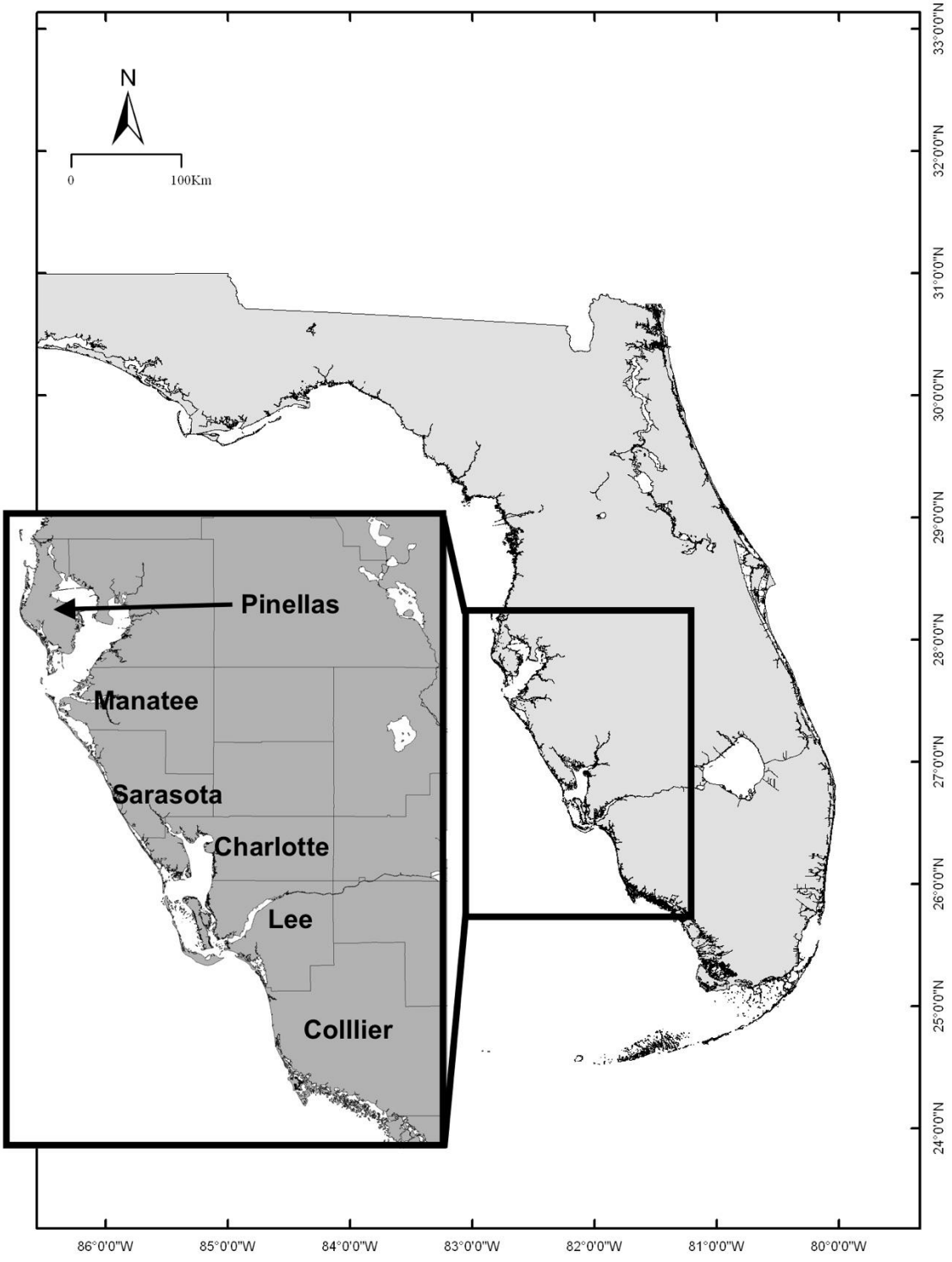

Figure 3-1. Map of Florida, with southwest region highlighted, showing the study sites Pinellas County, Manatee and Sarasota Counties, Charlotte and Lee Counties, and Collier County.

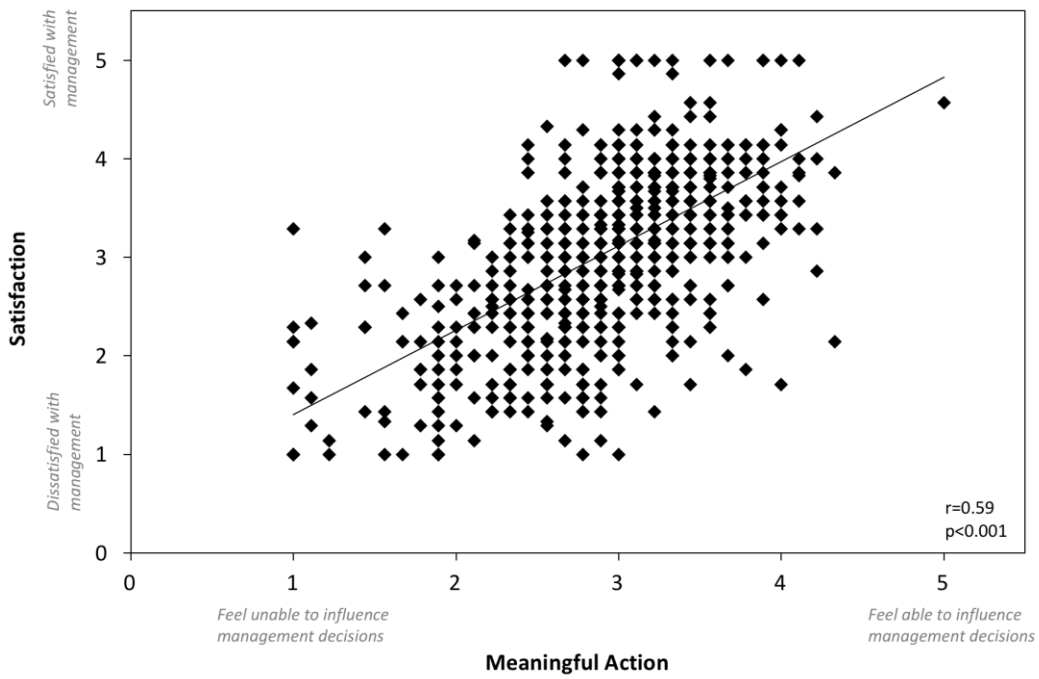

Figure 3-2. Correlation between meaningful action and satisfaction scores across individuals in the survey.

CHAPTER 4
MOTIVATIONS AND BARRIERS TO PARTICIPATION IN A VOLUNTEER ANGLER DATA PROGRAM

Introduction to Volunteer Angler Data Collection Programs

Accurately capturing recreational fisheries data is vital to sustainably managing fisheries (Post et al. 2002, Cooke and Cowx 2004). However, recreational anglers are such a diverse and diffuse group that these data can be difficult to collect. Traditional methods include angler surveys, such as creel intercepts or the Marine Recreational Information Program interviews, which query anglers on recent fishing efforts. These approaches have been relatively successful in capturing recreational harvest but are time and labor intensive (Cooke et al. 2001), and may become more so as the recreational sector grows in the future. An alternate approach that is rising in popularity is citizen science that actively involves anglers in the data collection and reporting process; these volunteer angler data (VAD) programs will be the focus of this paper.

Volunteer angler data programs have been implemented in a variety of formats, from paper-based catch cards, logbooks and diaries to the more technologically advanced online databases and mobile phone applications. The programs are similar in that all reference some system in which anglers voluntarily collect and report data on their individual fishing experience. Virtually all VAD programs ask anglers for some quantification of catch and effort (typically in hours fished); beyond this, the data collected are dependent upon program objective and the preference of program managers. Target objective also influences the scope of the VAD program, with regard both to recorded species and geographic coverage. While some programs are clearly bounded (see for example the New York City Angler Diary Program or the New

Hampshire Striped Bass Volunteer Angler Survey), others take a more generalist approach (as in the Angler Action Program, which spans species and states).

Some of the biggest difficulties in VAD programs lie in recruiting and then retaining participants (Cooke et al. 2001). Participation rates in VAD are typically low, with a small proportion of anglers contributing data (Cooke et al. 2001). Recruitment of anglers requires a considerable amount of time and effort, and often-high dropout rates necessitate the constant recruitment of new participants (Younk and Cooke 1992). Prentice et al. (1993) for example noted a rapid decline in reports as soon as the Texas Parks and Wildlife Department (TPWD) halted recruitment efforts, despite questionnaire responses indicating that 83.5% of participants had an interest in continuing with their diary program. Diary return rates among VAD participants often fall below 50%, suggesting that more than half of volunteers drop-out before reporting any trips (Weiss-Glanz and Stanley 1984, Younk and Cooke 1992, Chambers 1993, Prentice et al. 1993, Tarrant et al. 1993, Connelly and Brown 1996, Bray and Schramm 2001, Walker and Schramm 2004). Therefore, critical questions in VAD program implementation are how to effectively recruit and retain participants.

Little is known about what motivates anglers to participate in VAD programs, and the underlying barriers to participation remain relatively unexplored. Some studies have found that occasional reminders and solicitation from staff can increase VAD participation rates (Anderson and Thompson 1991, Walker and Schramm 2004); in a review of angler diaries in Ontario, Canada, Cooke et al. (2001) found that the clearest factor associated with diary program completion was frequency of contact with participants. However, other studies report no effect of reminders and follow-up mailings

(Younk and Cooke 1992, Connelly and Brown 1996). Anglers may decline participation due to confidentiality concerns (Younk and Cooke 1992) or repeated survey exposure as in the case of daily catch cards (Walker and Schramm 2004), and drop-outs due to personal/health reasons and concerns over time involved in diary recording have been reported (Connelly and Brown 1996); beyond this, however, little has been documented regarding why anglers do or don't participate in VAD programs. Those programs that have evaluated participant motivations found concerns about conservation and a desire to help management listed as important factors motivating volunteers (Anderson and Thompson 1991, Prentice et al. 1993). Understanding why some anglers decline participation as well as the factors motivating others to take part in VAD programs may help with future recruitment efforts and aid in increasing and maintaining participation rates.

This study aimed to explore motivations and barriers to participation in a VAD program using a quantitative survey. Concerns about participation rates are not unique to VAD programs, and recruiting and maintaining participants is a frequently cited difficulty across citizen science projects. Therefore the first step in this research was to review the citizen science literature and synthesize motivations and barriers identified across disciplines. I then apply these findings in the creation of a survey questionnaire, which was used to determine the most significant motivations and barriers to participation in VAD programs.

Motivations Literature Review

Numerous models have been applied to citizen science and other volunteer efforts to understand motivations for participation. Klandermans' (2003) model for social movement participation is one example framework that has been applied (with

modification) to both volunteer Linux contributors as well as to astronomy-based citizen science participants. The original model describes three classes of motivations for participation in social movements: collective motives, or those based on evaluation of movement goals, social motives, or those based on expected reactions of significant others such as family and friends (referred to as “subjective-norm” motives in subsequent studies), and reward motives, or those related to expected benefits such as money and/or making new friends. In a study of Linux volunteer programmers, Hertel et al. (2003) added an identification process category to capture motivations related to how closely an individual identifies with active subgroups of a social movement-in this case, other Linux contributors. Through surveys based on Klandermans’ model (with the addition of other items), the authors identified seven factors that correlated positively with Linux participation: 1) general identification as a Linux user, 2) specific identification as a Linux developer or within the subsystem, 3) pragmatic motives related to improvement of one’s own software and/or career advantages, 4) norm-oriented motives related to reactions of relevant others, 5) social and/or political motives related to supporting independent software and networking within the Linux community, 6) hedonistic motives such as pure enjoyment of programming, and 7) motivational obstacles related to time losses during Linux-related activities. Results indicated that specific identification with a subgroup (2) and time loss tolerance (7) most strongly predicted the number of hours per week a volunteer engaged with the system, and that pragmatic interest in personal advantages (3) showed significant effects on willingness to participate in the future.

Nov et al. (2011, 2014) also utilized an extended Klandermans' model to identify participant motivations, in this case in the context of the citizen science astronomy projects Seti@home and Stardust@home. The authors included a fifth factor in their model: intrinsic motivation, operationalized as the enjoyment associated with participation in the project. In addition, they split reward motives into two categories: community reputation benefits and social interaction benefits. The authors found that collective motives rated highest among respondents, followed by intrinsic motives. Identification and norm-oriented motives were of secondary importance, and reward motives did not play an important role in motivating participation (Nov et al. 2011). Intrinsic motives were most strongly related to respondents' intention to increase participation, though all motives correlated positively with intention. In a subsequent study comparing Stardust@home volunteers to participants in the Citizen Weather Observer Program (CWOP) and the Berkeley Open Infrastructure for Network Computing (BOINC), the authors again found that collective motives rated highest, followed by intrinsic motives, with norm-oriented motives and reputation motives of secondary importance (Nov et al. 2014). Interestingly, the authors found a positive relationship between Stardust@home volunteer contribution quality (measured using the project's Sensitivity function, which identifies how well volunteers correctly identify interstellar tracks) and reputation and collective motives but a negative relationship with intrinsic motivation. In summary, applications of Klanderman's model for social movement participation to online volunteer efforts show that subgroup identification, tolerance to time loss, pragmatic interests in personal advantages, collective motives, and intrinsic motives may all play important roles in motivating volunteer participation.

Hertel and colleagues also applied the Valence/Instrumentality/Self-Efficacy/Trust (VIST) model to explore volunteer Linux programmer motivations (Hertel et al. 2003). The model, developed by Hertel et al. in 2002, describes four components to motivation of individuals to participate in a team: valence, or the subjective evaluation of team goals, instrumentality, or the perceived importance and/or indispensability of one's own contributions to the group outcome, self-efficacy, or perceived capability of showing the required activities for the team tasks and/or the perceived contingency that one's own high efforts lead to high performance (adapted from Bandura 1977), and trust, or the expectancy that efforts will be reciprocated and not exploited by other team members (interpersonal trust) and that the electronic system works reliably (trust in the system). The model was tested among Linux subsystem teams. The authors found significant correlations between participation and the first three components, but trust was found to be relatively unimportant. Instrumentality and valence were strongly predictive for measured motivational criteria such as time investment and willingness to participate in the future, while self-efficacy more strongly predicted output criteria.

The Volunteer Functions Index, VFI, is another tool that has been used to assess volunteer motivations. The index, developed by Clary et al. (1998), identifies six personal and social functions served by volunteering that may motivate participation: values (i.e., an individual volunteers in order to express or act upon important personal values), understanding (i.e., seeking to learn more about the world or to exercise skills that are often unused), enhancement (in that one can grow and develop psychologically through volunteer activities), social (in which an individual volunteers in order to strengthen his or her social relationships), career (or volunteering with the goal of

gaining career related experience), and protective (i.e., an individual uses volunteering to reduce negative feelings like guilt or to address personal problems). Clary et al. (1999) report that values, understanding, and enhancement are most often important functions, while career, social and protective motivations are less important, though this can vary across groups and across projects. In a study of Wikipedia contributors, for example, Nov (2011) found that fun and ideology (factors not on Clary's list but added by the authors) were the most important motivations, whereas career, social, and protective motives are not strong motivators for contribution to the site. Though ideology was listed as the second highest motivating factor, it was not significantly correlated with contribution levels. In addition, Bradford and Israel (2004) utilized the VFI to identify motivations for participation in a citizen science project involving sea turtle nest monitoring. Respondents indicated that helping and protecting sea turtles was the most important factor motivating volunteering, with showing compassion and concern for other people listed as the second most important. Career development was overall unimportant to volunteers, though it was important to a subset of young volunteers. The authors concluded, however, that the model was not a perfect fit for structuring motivations in this context. Jacobson et al. (2012) also utilized a modified version of the VFI to look at motivations of volunteers at a natural resource agency; they found that helping the environment was the strongest motivator, with furthering career goals the weakest.

The collective effort model (Karau and Williams 1993) also has guided studies of volunteer contributions. The model describes conditions under which individuals will refrain from "socially loafing" (i.e., working less hard to achieve a goal because they

working jointly with others than when they are working by themselves), including both believing that their individual efforts are important to group performance and that their contributions to the group are identifiable as well as liking the group they are working with. Beenen et al. (2004) used this model to test motivations to contribute to MovieLens, an online movie rating system. The authors found that stressing the uniqueness of an individual's contributions to the site encouraged them to contribute more, but that stressing the benefits that they or others would receive as a result of participation actually depressed the number of contributions. However, further studies showed that MovieLens contributors were 7.4% more likely to rate a movie when the page attributes indicated the value of rating to people who like movie genres that the individual also liked than when they indicated value to people who liked genres that the individual did not like, suggesting that highlighting the value of contributions to others that an individual volunteer identifies with can increase motivation (Rashid et al. 2006).

In addition, Beenen et al. (2004) tested the application of goal-setting theory in increasing MovieLens participant contributions. Goal-setting theory states that setting specific, high challenge goals stimulates higher task performance (Locke and Latham 2002). The authors found that setting specific goals led to higher contribution rates than more general goals (i.e., "do your best"). However, the relationship was shown to be curvilinear, with contributions dropping at the highest goals.

The model of helping behaviors, developed by Schwartz and Howard in 1982, has also been applied to citizen science participation. The model states that helping behaviors result from the satisfaction of four precursor conditions: attention, in which an individual recognizes a need in others, an impetus to respond, which can result from the

combination of feelings of social obligation and/or responsibility and the self-perceived ability to respond, evaluation, or weighing of obligation and capability against social and tangible costs, and finally defense mechanisms, which come into play when an individual opts out of helping and serve to justify such actions. Crowston and Fagnot (2008) suggest that the first three stages all play important roles in citizen science volunteerism. Reed et al. (2013) created a survey based on Crowston and Fagnot (2008) and applied the questionnaire to registered Zooniverse citizen science participants. The authors then conducted an exploratory factor analysis of results, which suggested a three-factor solution representing motives related to social engagement (awareness of and interaction with other members of the Zooniverse community), interaction with the website (a sense of awareness, facility, and enjoyment from using the various features of the projects), and helping (how participants experience positive feelings from helping/volunteering to participate).

Using preliminary qualitative interviews and open-ended forum discussions, Raddick et al. (2010, 2013) created their own model to study the motivations of Galaxy Zoo citizen science participants. After analyzing free responses from forum posts and interviews, the authors settled on a list of 12 motivating components, each with its own descriptive sentence: contribute (“I am excited to contribute to original scientific research”), learning (“I find the site and forums helpful in learning about astronomy”), discovery (“I can look at galaxies that few people have seen before”), community (“I can meet other people with similar interests”), teaching (“I find it a useful resource for teaching other people”), beauty (“I enjoy looking at the beautiful galaxy images”), fun (“I had a lot of fun categorizing the variables”), vastness (“I am amazed by the vast scale of

the universe"), helping ("I am happy to help"), zoo ("I am interested in the project"), astronomy ("I am interested in astronomy"), and science ("I am interested in science"). A subsequent survey of Galaxy Zoo volunteers found that overall volunteers had a variety of reasons for participating in the project, though community, teaching, and learning were less important motivators. In general, women ranked motivational factors more highly than men, but ranked beauty even more highly, while men ranked science significantly more highly than women. Forty percent of respondents indicated that contribute was their primary motivation for participation; no other motivation captured more than 13% of responses. The authors concluded that participation in Galaxy Zoo for the most part was not related to specific features of the project but to making a contribution to science in general.

Batson's four motives for community involvement (Batson et al. 2002) were utilized by Rotman et al. (2012) to examine Biotracker citizen science volunteers. Types of motivation for social participation toward common goals are: egoism (when the ultimate goal is to increase one's own welfare), altruism (when the goal is to increase the welfare of another individual or group of individuals), collectivism (when the goal is to increase the welfare of a specific group that one belongs too), and principlism (when the goal is upholding one or more principles dear to one's heart, such as justice or equality). Among Biotracker survey respondents, the average rating of each category of motivations was similar. However, follow up qualitative interviews revealed that the motivations were not equally salient and that motivations varied across time.

Finally, Eveleigh et al. (2014) used Amabile's Work Preference Inventory (WPI) (Amabile et al. 1994) to study motivations of Old Weather citizen science participants.

The WPI divides motivators broadly into intrinsic (i.e., those that stem from the task itself, such as curiosity, enjoyment, and interest) and extrinsic (i.e., those that relate to the outcomes of an activity, such as status gained from social interactions, group norms, and rewards) factors. A survey of Old Weather contributors found that a higher intrinsic motivation was associated with both a greater number of contributions as well as a greater depth of participation, while higher extrinsic motivation was only associated with a greater number of contributions. The authors concluded that intrinsically motivated volunteers are more likely to contribute in depth whereas extrinsically motivated volunteers engage in a more casual way.

Motivations Synthesis

The literature review showed a number of different motivations for citizen science participation, based in part on the application of different behavior models. In order to synthesize findings, the most significant factors from each study were grouped based upon their similarity to each other. Grouping was conducted using open coding (Esterberg 2000) by first writing the most important findings from each study onto individual slips of paper, then by grouping factors into piles based upon perceived similarities.

Project Goals. Many of the reviewed studies found the identification of individuals with the overall goals of a volunteer project to be important in motivating participation (Table 4-1). For example participants in two astronomy-related citizen science efforts rated collective motives (i.e., those related on an individual's evaluation of the project goals) highest (Nov et al. 2011), with collective motives positively related to contribution quality (Nov et al. 2014). Likewise, Hertel et al. (2003) found valence (i.e., subjective evaluation of team goals) to be important in motivating Linux volunteers

and found it predictive of criteria such as time investment and willingness to engage in future. In surveying volunteers in a sea turtle nest monitoring citizen science effort, Bradford and Israel (2004) found that helping sea turtles was the most important factor motivating participants. In addition, Clary et al. (1998) found values to be an important motivator for volunteerism, and Nov et al. (2011) found ideology to be important in motivating Wikepedia contributors. Finally, Raddick et al. (2013) noted the importance of the "contribute" motive, i.e., contributing to original scientific research, in motivating participation, as well as the importance of an interest in science and astronomy.

Other Participants. The reviewed studies also found identification with other project participants an important factor in motivating volunteers. For example, Hertel et al. (2003) found that identification with a subset of Linux developers or contributors was a strong predictor of number of hours invested per week by volunteers. Likewise, Rashid et al. (2006) noted the importance of highlighting the benefits of contributions to individuals' with which MovieLens subjects identified. Finally, Rotman et al. (2012) found collectivism (i.e., increasing the welfare of a specific group that one belongs to) a factor in motivating Biotracker volunteers.

Individual Benefits. Some researchers highlighted the importance of perceived individual benefits in motivating volunteer participation. For example, Bradford and Israel (2004) found career development was a motivator for young volunteers in the sea turtle nesting project, and according to Clary et al. (1999), enhancement (growing and developing through volunteer activities) is one of the most commonly reported volunteer motivations. Hertel et al. (2003) found pragmatic motives (i.e., those related to the improvement of one's own software and/or career advantages) showed significant

effects on Linux contributor's willingness to participate in future. Furthermore, Nov et al. (2014) found a positive relationship with the reward motive "reputation" and contribution quality of Stardust@home participants (though reward motives did not seem to play a major role in motivating participation overall) (Nov et al. 2011). Rotman et al. (2014) found egoism (i.e., when the ultimate goal is to increase one's own welfare) related reasons as the initial and most substantial motivation for Biotracker participation. Finally, both Bradford and Israel (2004) and Clary et al. (1999) highlight the importance of learning/increased understanding in motivating participation.

Intrinsic Satisfaction. The studies also showed that intrinsic satisfaction, i.e., enjoyment associated with participation, plays a role in motivating volunteers. For example, Nov et al. (2011) found intrinsic motives most strongly related to Stardust@home and Seti@home participants' intentions to contribute more in future. Likewise, Eveleigh et al. (2004) found higher intrinsic motivation was associated with a greater number of contributions and a greater depth of participation in the Old Weather citizen science project. With regards to Wikipedia contributors, "fun" was found to be the top motive for participation (Nov 2011), and surveys of MovieLens raters found that many participants contribute "because it is fun" (Beenen et al. 2004).

Individual Contributions. Research also shows the importance of the perception of one's own contributions in motivating volunteer participation and contributions. In their study of Linux subsystem team contributors, Hertel et al. (2003) found that instrumentality (the individual's perception of the importance and/or indispensability of his or her contributions to the group outcome) predicted motivational criteria such as time investment and willingness to participate in future, and self-efficacy

(or the individual's capability of showing the required activities for the task and his or her perceived contingency that one's own high efforts led to high performance) predicted output criteria. Furthermore, Beenen et al. (2004) showed that stressing the uniqueness of an individual's contributions increased the number of MovieLens ratings an individual volunteered.

Altruism. Motivation literature also indicates that altruism, or conducting an action with the goal of increasing the welfare of another individual or group of individuals, plays a role in voluntary contributions. For example, Rotman et al. (2012) found that altruism motivated long-term engagement in the Biotracker citizen science project. In addition, sea turtle nest monitoring volunteers indicated that showing compassion and concern for others was their second highest motivation for volunteering (Bradford and Israel 2004), and Hertel et al. (2003) found tolerance to time loss an important predictor of individual willingness to participate in future and time invested in contributing to Linux.

Subjective Norms. The literature is somewhat conflicted with regards to the ability of subjective norms to motivate volunteer contributions. On the one hand, though subjective norms were found to be of secondary importance in a survey of Seti@home and Stardust@home volunteers, they were strongly related to intention to increase future contributions (Nov et al. 2011, Nov et al. 2014). In addition, though Hertel et al. (2003) found norm-oriented motives to correlate positively with time invested in Linux and willingness of participants to engage in future, it was not an important predictor relative to other measures studied.

Other Motivations. Studies have found other factors involved in motivating citizen science and volunteer participation. For example, Beenen et al. (2004) found that setting specific goals led to higher contribution rates in participants when compared to non-specific goals, and concluded that goal-setting motivates contributions. Reed et al. (2013) found social engagement, or an awareness of and interaction with other members of the community, to be a factor in motivating Zooniverse contributors.

Motivations over Course of Participation

Studies not only suggest that volunteer participants may have a number of different motivations, but that these factors may differ through the course of participation. According to Crowston and Fagnot (2008), participants may initially get involved with a project to satisfy their own curiosity, but sustained contribution is driven by agreement with project ideology and the intrinsic motivation of the task while meta-contribution is driven by feelings of group membership that lead to a sense of social obligation. Rotman et al. (2012) found that Biotracker volunteers presented a range of egoism-related reasons as the initial and most substantial motivation for engagement with the project, but that while other motivations (collectivism and altruism) were missing from the initial decision to participate they surfaced later, affecting long-term engagement. While understanding initial motivations to participate may aid in recruiting volunteers, understanding what motivates participants to continue participating may aid in retaining volunteers.

Methods

Case Study: the Angler Action Program

The Angler Action Program (AAP) was chosen as a case study for this project. The AAP is a VAD program begun in 2010 by the Snook and Gamefish Foundation, a

501(C)(3) publically supported conservation group in the state of Florida (Dixon 2016). Data entry options include a website (accessible at www.angleraction.org) and 2 phone applications, or apps (“iAngler” and “iAngler lite”), which are available for all smartphones. Participants are asked to submit data on their trip (the state, country, and date of trip, number of anglers, hours fished, method of fishing, any affiliations they may have, and whether they fished in saltwater or freshwater) and catch (fish family and species, time fishing for that species, number of fish caught/kept/released, and number of fish under/in/over the slot limit), and are given the option to add information on trip location (latitude and longitude) and details about fish caught (length, weight, and hooking locations of fish as well as condition of released fish). In addition, participants are given the option of adding photos to each trip report and sharing their trip summaries or photos on social media (Facebook and Twitter in this case).

Data from the AAP have already been used in management: discard information was incorporated into the 2013 stock assessment for common snook (Muller and Taylor 2013). Recently, Angler Action Program data were evaluated by comparison to data collected through the MRIP program (Jiorle et al. in review). Results showed high spatial variability in the AAP data; however, when stratified by county, comparisons across three species (common snook, spotted sea trout, and red drum) showed catch rates to be similar between the AAP and MRIP datasets.

Survey Questionnaire

A survey questionnaire was created by synthesizing the results found in the literature review into a series of questions specific to the Angler Action Program. First, questions relevant to each factor were compiled from the reviewed citizen science surveys and culled to avoid repetition. They were then adjusted slightly when

appropriate or necessary for relevance to fisheries and the AAP. The first draft of the survey questionnaire contained a total of 28 questions. The questionnaire was pilot tested with a sample of 21 individuals, which included five fisheries scientists, five social scientists, 1 recreational angler, and 10 participants in the AAP. Following piloting, 3 items were removed from the motivations scale due to noted repetition, and 2 items were added regarding participation in the AAP (specifically, what platform is used).

The final survey included 30 questions divided into 5 main sections. The first section characterized respondents' general fishing habits and included questions about their frequency of fishing and habitats fished. The second section focused on respondents' participation in the Angler Action Program. The third included questions about respondent motivations and barrier to participation in the AAP. The fourth section covered demographic information, such as age and gender. Finally, since attitudes toward management or conservation may influence participation, a satisfaction with management scale (Chapter 3) and the New Ecological Paradigm Scale (NEP) (Dunlap et al. 2009) were included in a fifth and final section.

Survey Distribution

The survey was created using the Qualtrics software and distributed to all 7,019 registered AAP users (i.e., individuals who had created an AAP username and login and were therefore in the AAP database) in March 2016. Survey distribution included personalized emails, which included a link to the online survey, and reminder emails were sent 1 week after the initial email (Dillman et al. 2009). All procedures were approved by the University of Florida Institutional Review Board.

Survey Analysis

Statistical comparisons were made using a chi-square test when comparing categorical data or a t-test when comparing continuous data. Free response questions were interpreted in accordance with Grounded Theory (Strauss and Corbin 1990); responses were first analyzed using open coding and were then grouped thematically to look for patterns in the data (Esterberg 2002). Coding and grouping was done first by the primary researcher, and was then repeated by a recreational angler to check for consistency. Coders then compared their groups and discussed any discrepancies that occurred in their groupings, with coders deciding together how to resolve disagreements.

Results

A total of 614 people completed the AAP survey, for a response rate of 9%. Of those who responded, 132 (21%) considered themselves to be AAP participants (i.e., they reported that they were either currently participating or had participated in the past). Surprisingly, 79% (n=480) of respondents indicated that they had never participated in the AAP. I will first focus on those individuals that had participated in the AAP in order to characterize AAP respondents; I will later compare participants to nonparticipants (i.e., those individuals who reported that they had never participated in the AAP).

Characterizing Participants

The majority of AAP respondents were male (92%), with a mean age of 50 (Table 4-2). The majority (73%) were full-time Florida residents, with 20% identifying as visitors to the state and only 6% identifying as part-time Florida residents. Most (91%) self-identified as recreational anglers, with 69% identifying as “concerned citizens” and

52% identifying as “conservationists” (Table 4-3). There was also representation from the fishing charter sector (19%), fisheries/marine scientists (13%), and recreational divers (22%), and less representation by bait/tackle shop owners (6%), commercial fishers (6%), resource managers (5%), the marine tourism (7%) and seafood (6%) industries, and policy decision makers (4%). Most AAP respondents (88%) reported having had some college or more, with 20% having obtained a graduate degree or beyond (Table 4-2).

The majority of AAP respondents (74%) fished at least a few times in the past 12 months, with 26% fishing a few times a week and 8% fishing daily (Table 4-4). When asked to select all the ways that they typically fish, most reported fishing either from a motorized vessel exclusively (48%) or from a combination of ways (38%), with 8% fishing from shore, 1% fishing from a pier/bridge/dock, and 5% fishing from a kayak/canoe exclusively. The majority (87%) fished inshore/coastal marine waters, with 49% fishing in offshore marine waters and 43% fishing in freshwater habitats.

Overall, AAP participants in the survey were slightly eco-centric, with a mean score of 3.5 (out of 5) on the NEP scale (Table 4-5). In addition, they were on average slightly satisfied (but near neutral) with regard to satisfied with fisheries management in the state of Florida, with a mean score of 3.08 (out of 5.0) on the satisfaction scale (Table 4-5).

Comparison of Participants and Nonparticipants

Demographics, fishing characteristics, and scores on the NEP and satisfaction scales were compared between participants in the AAP and nonparticipants (Tables 4-2, 4-3, 4-4, and 4-5). Chi-square analysis found significant differences in self-identified residency status in Florida between participants and nonparticipants (X^2(2,

N=613)=11.87, p=0.003), with nonparticipants more likely to be part-time residents or visitors to the state and participants more likely to be full-time residents. In addition, there was a significant difference in education between participants and nonparticipants (X^2(2, N=613)=15.63, p=0.048), with participants more likely to have obtained a Bachelor's degree and nonparticipants more likely to have had only some college or obtained a technical or associate's degree. Participants were also more likely than nonparticipants to identify as a conservationist (X^2(2, N=613)=17.14, p=<0.001), a fisheries/marine/or other aquatic scientist (X^2(2, N=613)=5.77, p=0.016), and a concerned citizen (X^2(2, N=613)=10.51, p=0.001).

Participation in the AAP

More than half (56%) of AAP participants in the survey had begun participating in the AAP in 2014 or 2015, with 37% starting prior to 2014 and 7% starting in 2016 (Table 4-7). Most participants had either not started logging trips yet (43%) or had stopped logging trips (39%), with only 18% of participants (n=26) indicating they were currently logging data into the program.

An important question in VAD programs is whether or not anglers are reporting all or a portion of their fishing trips, and in particular whether they are reporting trips when they catch no fish, as both would have important impacts on the quality of the data obtained from such programs. The survey found that of those 18% currently logging data in the AAP, about half (52%) self-reported logging almost all or all of their fishing trips, and about half (56%) reported always logging their trips when they catch no fish.

The survey also sought to identify which data entry options were preferable to AAP participants. Among those 18% currently entering data, more than half (54%)

report using the AAP website to log trips, while 38% report using the iAngler phone application and 25% report using the iAngler-lite phone application.

Motivations to Participate

The survey asked respondents to rate how important different items were to motivating their participation in the AAP, with response options given on a 5-point scale ranging from Not at All Important to Very Important or as a 5-point agreement scale ranging from Strongly Disagree to Strongly Agree. Mean responses across all AAP participants are summarized in Table 4-6. On average, “improving the quality of fisheries data” was the most important factor motivating participation in the AAP (mean score of 4.65). This was followed by “improving fisheries for the enjoyment of all” (mean score of 4.42), “benefiting scientists” (4.22), “contributing to original research” (4.22), and “improving fishing for other anglers like me” (4.01).

Project Goals. Motivations related to project goals were overall relatively important to AAP participants, with mean scores ranging from 3.91-4.64 on the motivation scale (Table 4-7) and 3.92-3.99 on the agreement scale.

Other Participants. Identification with other project participants was also important to AAP respondents. ‘Improving fishing for other anglers like me’ received an average score of 4.01, and overall respondents agreed that they identify with other participants in the AAP (mean score of 3.68 on the agreement scale).

Individual Benefits. There were mixed results with regard to the importance of individual benefits in motivating AAP participants. Some benefits, such as improving their own fishing experiences, learning more about fisheries science and their own fishing, the opportunity to gain a new perspective on things, and feeling good about their contribution were all rated as relatively important motivators (mean score of 3.54-3.99

on the motivation scale). However, the chance to earn a reward or win a prize, appreciation by others in the community, enhancing their status in the fishing community, or career related items (helping them in their chosen profession and making new contacts that might help their career) were all rated as relatively unimportant (mean scores of 1.97-2.15), and respondents overall disagreed with the statement 'participating makes me feel important' (mean score of 2.75 on the agreement scale).

Intrinsic Satisfaction. Overall, respondents agreed that they derive some degree of intrinsic satisfaction from their participation in the AAP, agreeing that participating is fun (mean score of 3.88) and that they enjoy participating in the program (mean score of 3.79).

Individual Contributions. Respondents on average feel able to participate effectively in the AAP, with mean scores of 3.55-3.72 on items regarding the ease with which they navigate aspects of the AAP. In addition, they agree on average that they are able to make unique contributions to the program (mean score of 3.73), highlighting the potential importance of salience of uniqueness.

Altruism. Altruistic motives were important to AAP participants in the survey. Improving fisheries for the enjoyment of all was rated on average as relatively important (mean score of 4.41 on the motivations scale), and showing concern and compassion for others and making the world a better place were also rated as important (mean scores of 3.32 and 3.66).

Subjective Norms. Subjective norms were not important motivators for AAP participants in the survey. The attitudes of friends and family were rated as relatively unimportant (mean score of 2.29 on the motivations scale), and respondents disagreed

on average that other anglers like them are generally aware of the AAP (mean score of 2.79 on the agreement scale).

Community. Community played a somewhat important role in motivating AAP participants. Feeling part of the community of volunteer anglers was rated as relatively important, and received a mean score of 3.77 on the motivations scale.

Trust. Trust may also be relatively important to motivating AAP participation. Overall, respondents agreed on average that they trust their fellow volunteers (mean score of 3.65 on the agreement scale).

Change in Motivations over Course of Participation

To explore whether motivations change over the course of participation, Angler Action Program participants were asked two open-ended questions: first, “what would you say was the most important factor motivating you to start participating in the Angler Action Program?”, followed by “what are/were the most important factors motivating you to continue to participate in the Angler Action Program?” Contributing to Science was the most frequently mentioned motivation to start participating in the AAP and was listed by 37% of those who responded to the question (Table 4-8). This was followed by Conservation (22%), using the program as a Personal Log (9%), Improving Fisheries (7%), and Influencing Regulations (5%). Fishing, Helping the Program, and Personal Contact were all listed by 4% of respondents as the primary motivation for their participation. Finding the program Easy to Use was cited by 2% of participants, and Fishing Tournaments, Having Fun, the chance for a Reward, finding the Time, and Randomly Finding the Program were all listed by 1% of respondents.

Overall, Contributing to Science was also the most frequently cited motivation to continue participating, followed closely by Conservation (constituting 28% and 27% of

responses respectively) (Table 4-9). This was followed by influencing Regulations, which came up in 14% of responses. Of those who responded to the question, 7% cited use as a Personal Log as a motivation to continue participating and 6% indicated they participate because they love to go Fishing. In addition, 4% of responses cited the chance to Improve My Fishing, to Learn, and to Improve the Fishery, while 3% mentioned the Ease of Use of the software, Helping, and Remembering as motivations to continue. Finally, Fun, Rewards, and Time were all mentioned in 1% of responses.

Barriers to Participation

Those individuals in the survey who indicated that they had never participated in the AAP were directed to a series of open-ended questions about barriers. The first question asked “has anything prevented you from participating in the Angler Action Program?” The most commonly cited barrier to participation in the AAP was lack of knowledge about the program-70% of those not participating listed this as a barrier, for example stating that they were “not familiar with the program” (Table 4-10). The second most frequently listed barrier (14%) was not fishing Florida saltwaters, either because they were not a Florida resident (11%), fished freshwater (1%), or were not fishing at all at present (3%). The next most frequent barrier was time (5%), followed by forgetfulness (4%), difficulties with the software (3%), and frustration with management in general (3%). Concerns about use of the data, the perception that because they caught no fish they should not log, and laziness were each listed as barriers by 1% of respondents.

The next question asked those who had never participated “is there anything that might improve your chances of participating in the future?” The most frequently cited response was “more information” (62%), with a number of people indicating that they

would be happy to participate if they knew more about the program (Table 4-11). This was followed by “more time to fish” (6%), making the program easier to use (5%), a move by the individual to Florida (4%), and the establishment of the AAP in their area of residence (4%). In addition, 4% said reminders would help them participate, and another 4% responded saying they were spurred to participate by the survey itself and intended to begin participating immediately. Another 3% said they would participate if asked, responding for example by saying “just ask me.” In addition, 3% of respondents said they would participate if they saw improvements in fisheries management, while 2% asked for incentives such as “free stuff” for participating. Becoming a better fisher, a greater personal interaction with the program through hands on meetings, and reassurance that their information will be protected were all mentioned by 1% of respondents (Table 4-11).

In addition, those individuals who indicated that they had stopped participating in the AAP were asked if anything had made it difficult for them to participate; results are summarized in Table 4-12. Responses indicate that fishing less was the biggest barrier to continuing to participate, followed by finding the time to enter data, difficulties in using the program (most often with reference to the phone application), and forgetting about the program.

Discussion

Motivations related to project goals were among the most important to AAP participants, with “improving the quality of fisheries data” on average rated as the most important motivator for participants. Benefiting scientists, contributing to original research, and advancing the goals of the AAP were also important motivators. In addition, Contribute to Science was the most frequently listed motivator to begin and to

continue participating in the AAP. This supports findings that agreement with a project's goals can be an important motivator (Nov et al. 2011, 2014, Hertel et al. 2003, Bradford and Israel 2002) as well as findings that helping the Texas Parks and Wildlife Department was the primary motivation for 75% of participants in a Texas logbook program (Prentice et al. 1993). This suggests that recruitment efforts aimed at highlighting the ability of AAP data to improve the quality of fisheries data and to benefit science and research would be beneficial to attracting and retaining participants.

In general, altruistic and collectivist motivations were more important than egoistic motivations for AAP volunteers, with altruistic motives more important than collective. "Improving fishing for the enjoyment of all," for example, was rated as more important than "improving fishing for other anglers like me," which in turn was rated more highly than "improving my own fishing experiences." Individual benefits that were important to participants included learning more about fisheries science and their own fishing, the opportunity to gain a new perspective on things, and feeling good about their contribution. Reward motives and career-related motives were not important, and while feeling good about their contribution was rated as important participants did not agree that participating in the program makes them feel important.

Subjective norms were not important to motivating AAP participation, with most participants disagreeing that others were aware of the program; in addition, the attitudes of friends and family were rated as relatively unimportant motivators. Subjective norms have been shown to be powerful predictors of behavior in other contexts, such as the use of barotrauma mitigation devices (Chapter 6), and campaigns targeting norms have been effective in producing desired behaviors (Schultz et al. 2007). It is not surprising

that subjective norms do not play a significant role in motivating AAP participation, however, given that participants are under the impression that other anglers are unaware of the program. It is possible that if awareness of the AAP increases in future, subjective norms may begin to play a larger role in motivating participation.

On average participants scored as only slightly eco-centric on the NEP scale, similar to respondents in a recent survey about Goliath grouper fisheries (Lorenzen et al. 2013). While this could suggest that conservation-mindedness is not important in motivating participation, about half of respondents self-identified as conservationists, and Conservation was the second most frequently cited motivation to begin and to continue participating in the AAP. Notably, there was no relationship between whether or not someone identified as a conservationist and their score on the NEP scale, with those individuals who identified as conservationists scoring 3.6 on average and those who did not scoring 3.5 on average. This demonstrates that though respondents don't score as highly eco-centric, they identify as conservationists with regard to fisheries and view conservation as important to them and to motivating their participation in the AAP.

The near neutral score on the satisfaction scale indicates that dissatisfaction with management is not an important motivator for AAP participants. However, influencing regulations was cited by 4% and 14% of respondents respectively when asked their motivations to begin and to continue participating in the AAP, suggesting that while most respondents are on average satisfied with management the opportunity to affect change in management is still an important motivator for some. This demonstrates the importance of creating feedback for participants that demonstrates that their contributions have influenced management.

No significant differences were seen in motivations over time of involvement in the AAP, with Contribute to Science and Conservation the most frequently cited motivations to begin and to continue participating in the program. This conflicts with reports that egoism-related motivations initiated participation whereas collectivistic and altruistic motivations sustained participation (Rotman et al. 2014). However, results in this study are self-reported, and it is possible that respondents were unable to remember the motivation that initiated their participation in the program. In future, a survey given at the start of participation and then repeated later in time may yield different results.

The biggest barrier to participation in the AAP was lack of knowledge about the program, and overall participants felt that other anglers are unaware of the AAP. In addition, nonparticipants indicated that more information would increase their likelihood of participation in the future. In this light, campaigns to advertise the AAP would likely be effective in increasing participation.

While some barriers cited by respondents cannot be attended to (for example, finding the time to fish or improved weather conditions), others can be addressed, such as “making the program easier to use.” An understanding of user difficulties would be needed, as some participants believe it to be easy to use while others cite difficulties in use as a barrier, indicating that efforts to make data entry easier and more efficient may improve participation in future. In addition, “forgetting” was listed as a barrier to participation, indicating that reminders sent by program staff may increase data entry.

Results suggest that the proportion of participants who are frequently entering data is low, with only 6 (5%) AAP participants out of 134 in the survey reporting that

they are currently entering data and that they log almost all or all of their fishing trips. Similarly, Eveleigh et al. (2014) found that the majority of citizen science participants operate as “dabblers”, or infrequent participants, and that the majority of contributions are made by a small proportion of participants. This shows the importance of understanding motivations to increase participation, particularly if the goal of the project is to obtain a high degree of participation from a high number of participants. In future, comparisons across participant types would help to distinguish whether they are motivated by different factors. In addition, research could be done to test whether it is possible to shift dabblers to more in-depth participation, or to target recruitment at participants likely to participate in an in-depth manner.

The literature contains multiple instances where bias in participants has been documented in VAD programs. For example, VAD participants are often older (Connelly and Brown 2001, Walker and Schramm 2004) and more educated (Connelly and Brown 2001), with a higher tendency to be married, Caucasian, and employed full time and with a higher median family income (Bray and Schramm 2001). In addition, participants overall report greater catch (Walker and Schramm 2006) and harvest (Anderson and Thompson 1991) rates, with a higher frequency of fishing (Prentice et al. 1993, Connelly and Brown 1996, Bray and Schramm 2001, Walker and Schramm 2004), more angling experience (Prentice et al. 1993), and a greater tendency to fish from power boats and target sportfish (Bray and Schramm 2001) when compared to the average angling population. This bias lead Bray and Schramm (2001) to conclude that angler diaries provide estimates that are more representative of avid anglers than of the angling population as a whole. The results of this survey show that AAP participants also differ

from nonparticipants, with differences across demographic variables as well as fishing characteristics. It is possible that differences are even greater than seen in the survey, in that nonparticipants who completed the survey may themselves differ somewhat from nonrespondents. Previous surveys, for example, have found that males tend to be more represented in surveys than in the sample populations (Chapters 3, 4), and results suggest that males are overrepresented in this survey, with the AAP database containing approximately 88% males but males comprising 94% of survey respondents. This bias in participation may affect the generalizability of the data obtained from the AAP participants.

Synthesis

Results of this survey suggest that motivations related to project goals and altruism are important factors motivating participation in VAD programs, and that subjective norms and individual benefits in the form of rewards are not important motivators. Other studies of VAD programs have found that occasional reminders and solicitation from program staff can increase VAD participation rates (Anderson and Thompson 1991, Walker and Schramm 2004), and a review of angler diaries in Ontario, Canada, Cooke et al. (2001) found that the clearest factor associated with diary program success was frequency of contact with participants. Given the results of this study, I suggest that regular reports to VAD participants on the progress of the program and the use of the data could improve participation rates by demonstrating that contributions are improving the quality of fisheries data, contributing to science, and benefiting scientists, and would also serve as reminders to contribute data. Addressing barriers such as difficulties and time-intensiveness of use of the program may also improve VAD program participation rates.

Table 4-1. Synthesis of motivations from the literature, with a description of each.

Motivation	Description
Motivations Related to Project Goals	
Collectivism	Motives related to an individual's evaluation of project goals
Ideology	Project alignment with personal ideology
Helping Sea Turtles	Helping sea turtles
Valence	Evaluation of team goals
Values	Project alignment with personal values
Contribute	Excitement to contribute to original scientific research
Astronomy/Science	Interest in science and astronomy specifically
Motivations Related to Others Like Me	
Subgroup identity	Identification with a subset of Linux developers or contributors
Subgroup benefits	Highlighting benefits of contributions to individuals' with which subjects identified
Collectivism	Increasing welfare of a specific group that one belongs to
Motivations Related to Individual Benefits	
Career	Career development
Enhancement	Growing and developing through volunteer activities
Pragmatic	Improvement of one's own software and/or career advantages
Reputation	Improving one's reputation in the community
Egoism	Increasing one's own welfare
Learning	Increasing understanding
Motivations Related to Intrinsic Satisfaction	
Intrinsic Satisfaction	Deriving enjoyment from participation
Fun	Having fun participating
Motivations Related to Self-Efficacy	
Instrumentality	Perception of importance/indispensability of individual's contributions
Self-Efficacy	Capability of showing required activities
Salience of Uniqueness	Stressing uniqueness of individual contribution

Table 4-1. Continued

Motivation	Description
Motivations Related to Altruism	
Altruism	Acting to increase the welfare of another individual or group of individuals
Compassion	Showing compassion and concern for others
Motivations Related to Subjective Norms	
Subjective Norms	Conforming to norms of others
Norm-Oriented	Conforming to subjective norms
Other Motivations	
Time Loss Tolerance	Tolerance for time cost associated with participation
Goal-setting	Setting specific goals
Social engagement	Awareness of and interaction with other participants

Table 4-2. General demographic characteristics of participants and nonparticipants in the Angler Action Program, presented as N=number of respondents (% of respondents), and results of statistical comparisons across groups.

	Participants	Nonparticipants	chi-square	p-value
N	133	480		
What is your gender?			0.624	0.732
Male	122 (92%)	448 (94%)		
Female	10 (8%)	29 (6%)		
Prefer not to say	1 (1%)	2 (0%)		
In Florida, you are a:			11.873	0.003
Full time resident	97 (73%)	272 (57%)		
Part time resident	8 (6%)	35 (7%)		
Visitor	27 (20%)	168 (36%)		
What is the highest level of education you have completed?			15.630	0.048
Eighth grade or less	1 (1%)	1 (0%)		
Some high school	0 (0%)	11 (2%)		
High school graduate or GED	14 (11%)	53 (11%)		
Some college	21 (16%)	95 (20%)		
Technical degree	5 (4%)	34 (7%)		
Associate's degree	10 (8%)	49 (10%)		
Bachelor's degree	44 (33%)	115 (24%)		
Some graduate school	12 (9%)	20 (4%)		
Graduate degree or beyond	26 (20%)	101 (21%)		

Table 4-3. Self-identified stakeholder groups for participants and nonparticipants in the Angler Action Program, presented as N=number of respondents (% of respondents), and results of statistical comparisons across groups.

Stakeholder Group	Participants	Nonparticipants	chi-square	p-value
Fishing Charter	25 (19%)	66 (14%)	2.10	0.147
Bait/Tackle Shop Owner	8 (6%)	28 (6%)	0.01	0.937
Recreational Angler	119 (91%)	426 (90%)	0.06	0.814
Commercial Fisher	8 (6%)	22 (5%)	0.46	0.498
Conservationist	68 (52%)	152 (32%)	17.14	<0.001
Fisheries/Other Marine/Aquatic Scientist	17 (13%)	31 (7%)	5.77	0.016
Concerned Citizen	90 (69%)	249 (53%)	10.51	0.001
Recreational Diver	29 (22%)	91 (19%)	0.54	0.464
Resource Manager	7 (5%)	15 (3%)	1.38	0.241
Marine Tourism Industry	9 (7%)	29 (6%)	0.09	0.759
Seafood Industry	8 (6%)	25 (5%)	0.13	0.715
Policy Decision-Maker	5 (4%)	9 (2%)	1.66	0.198
Other (please specify)	6 (5%)	33 (7%)	0.98	0.323

Table 4-4. General fishing characteristics of participants and nonparticipants in the Angler Action Program, presented as N=number of respondents (% of respondents), with statistical comparisons across groups.

	Participants	Nonparticipants	chi-square	p-value
In the last 12 months, how often did you go fishing?			0.62	0.893
Never	0 (0%)	3 (1%)		
Infrequent	22 (17%)	88 (18%)		
Moderate	66 (50%)	243 (51%)		
Frequent	45 (34%)	146 (30%)		
How do you typically fish (check all that apply)?			4.27	0.370
From shore	12 (8%)	36 (7%)		
From a pier/bridge/dock	1 (1%)	4 (1%)		
From a kayak/canoe	8 (5%)	31 (6%)		
From a motorized vessel	71 (48%)	209 (39%)		
From a combination of the above	57 (38%)	250 (47%)		
Habitats				
Inshore/Coastal Marine	116 (87%)	419 (88%)	0.00	0.980
Offshore Marine	65 (49%)	224 (47%)	0.20	0.652
Freshwater	57 (43%)	217 (45%)	0.23	0.629

Table 4-5. Mean satisfaction and New Ecological Paradigm (NEP) scale scores for participants and nonparticipants in the Angler Action Program, presented as mean (standard deviation), with statistical comparisons across groups.

	Participants	Nonparticipants	t-statistic	p-value
Satisfaction Scale	3.08 (0.67)	3.20 (0.53)	1.33	0.184
NEP Scale	3.54 (0.59)	3.51 (0.64)	0.49	0.621

Table 4-6. Reporting behavior of all participants (past and present) in the AAP as well as those that identify as currently entering data, presented as N=number of respondents (% of respondents)

	All Participants	Currently Logging
N	134	26
When did you start participating in the AAP?		
2008	2 (2%)	1 (5%)
2009	1 (1%)	0 (0%)
2010	7 (8%)	2 (9%)
2011	1 (1%)	1 (5%)
2012	13 (14%)	5 (23%)
2013	10 (11%)	2 (9%)
2014	25 (27%)	5 (23%)
2015	27 (29%)	4 (18%)
2016	6 (7%)	2 (9%)
Have you logged any trips into the AAP?		
No, I haven't logged any trips yet	57 (43%)	0 (0%)
Yes, but I have stopped logging trips	52 (39%)	0 (0%)
Yes, I am currently logging trips	26 (18%)	26 (100%)
Proportion of trips logged		
A few	32 (42%)	4 (16%)
About a quarter	6 (8%)	2 (8%)
About half	9 (12%)	5 (20%)
About three quarters	6 (8%)	1 (4%)
Almost all	12 (16%)	6 (24%)
All	11 (14%)	7 (28%)
Do you log trips when you catch no fish?		
No	25 (33%)	4 (16%)
Yes, sometimes	20 (26%)	7 (28%)
Yes, always	31 (41%)	14 (56%)
What platform(s) do you use to log your trips?		
Website	37 (44%)	13 (54%)
iAngler	31 (37%)	9 (38%)
iAngler-lite	9 (11%)	6 (25%)

Table 4-7. Mean scores across participants for motivations to participate in the Action Program, scored on a scale of 1-5 for both the motivations and agreement categories.

Category	Survey Item	Motivations Scale	Agreement Scale
Project Goals			
	Improving the quality of fisheries data	4.64	
	Benefiting scientists	4.23	
	Contributing to original research	4.23	
	Advancing the goals of the AAP	3.91	
	The success of the AAP is important to me		3.92
	I identify with the goals of this project		3.99
Others Like Me			
	Improving fishing for other anglers like me	4.01	
	I identify with other participants in the AAP		3.68
Individual Benefits			
	Improving my fishing experiences	3.88	
	Learning more about fisheries science	3.99	
	Learning more about my own fishing	3.80	
	The opportunity to gain a new perspective on things	3.91	
	The chance to earn a reward or win a prize	2.13	
	Helping me in my chosen profession	2.02	
	Making new contacts that might help my career	1.97	
	Feeling good about my contribution	3.54	
	Enhancing my status in the fishing community	2.03	
	Participating makes me feel important		2.75
	Appreciation by others in my community	2.15	

Table 4-7. Continued

Category	Survey Item	Motivations Scale	Agreement Scale
Intrinsic Satisfaction			
	Participating in the program is fun		3.88
	I enjoy participating in the program		3.79
Self-Efficacy			
	I feel I can make unique contributions to this project		3.73
	I find it easy to navigate the AAP		3.55
	I find the website easy to use		3.70
	I find the mobile phone application easy to use		3.72
	It was easy for me to become skillful at entering data into the AAP		3.63
Altruism			
	Improving fisheries for the enjoyment of all	4.41	
	Showing concern and compassion for others	3.32	
	Making the world a better place	3.66	
Subjective Norms			
	The attitudes of my friends and family regarding my participation	2.29	
	Other anglers like me are generally aware of the AAP		2.79
Community			
	Feeling part of the community of volunteer anglers	3.77	
Trust			
	I trust my fellow volunteers		3.65

Table 4-8. Proportion of respondents citing each motivation to begin participating in the Angler Action Program.

Motivation	Proportion	Example Statement
Contribute to Science	0.37	Data collection for science
Conservation	0.22	Conservation
Personal Log	0.09	Having record of fishing trips
Improve Fishery	0.07	I wanted to help improve fishing
Regulation	0.05	Reduce regulations on recreational fishermen
Fishing	0.04	I like fishing
Help the Program	0.04	Learn to navigate in order to teach others
Personal Contact	0.04	Asked by a personal friend
Ease of Use	0.02	Much easier to use than before
Tournaments	0.01	I fish tournaments
Fun	0.01	Having fun
Reward	0.01	Prizes
Time	0.01	Getting the time
Random	0.01	Surfing the net and found your software

Table 4-9. Proportion of respondents citing each motivation to continue participating in the Angler Action Program.

Motivation	Proportion	Example Statement
Conservation	0.27	Conservation of Florida's natural resources
Contribute to Science	0.28	Helping to provide data for science
Regulation	0.14	Data that may spur regulation change
Personal Log	0.07	Use as fishing log
Fishing	0.06	I love to fish
Improve Fishery	0.04	Catch fish and enjoy recreational fishing
Improve My Fishing	0.04	Using data to improve personal fishing
Learning	0.04	Learning about the kinds of fish
Ease of Use	0.03	Friendliness of data input"
Helping	0.03	Wanting to help
Remembering	0.03	Just have to remember
Reward	0.01	Chance for a prize
Fun	0.01	Having fun
Time	0.01	Finding the time

Table 4-10. Barriers making it difficult for Angler Action Program participants.

Barrier	Proportion	Example Statement
Difficulties with Use	0.15	App working poorly
Fishing Less	0.30	Being busy and fishing less
Time	0.20	Time it takes to fill out the information
Forgetting	0.10	Forgetting to log trips
Weather	0.10	Rough seas every so often
Lack of Information	0.05	Not clear on goals
Laziness	0.05	My laziness
Trust	0.05	I am careful who I tell where I am catching fish

Table 4-11. Responses of nonparticipants to the question “would anything increase your chances of participation in the future?” presented as proportion of respondents who cited each.

Improve Participation	Proportion	Example Statement
More information	0.62	More information on the program
More time to fish	0.06	Fish more often
Easier to use	0.05	Easier to use app
Move to Florida	0.04	If I moved to FL
AAP in my area	0.04	A local group in Mississippi where I live
Reminders	0.04	Weekly or monthly reminder to log trips
Will do it	0.04	I will do it!
Better management	0.03	If I start to believe that the FWC will ever really start making the MUCH needed changes
Ask me	0.03	Just ask
Incentives	0.02	Free stuff for participating
Better fisher	0.01	If I considered being a better fisherman
Outreach	0.01	Good P.R.
Greater interaction	0.01	Close hands on meetings
Protect information	0.01	Steps taken to prevent any information given to AAP from getting out

Table 4-12. Barriers to participation for nonparticipants in the Angler Action Program.

Barrier	Proportion	Example Statement
Need More Information	0.70	Lack of knowledge about the program
Don't Fish Florida Saltwaters	0.14	I have never fished in Florida
Time	0.05	Lack of time
Forget	0.04	Forgot about the program
Difficulties	0.03	iAngler interface problems
Frustration with Management	0.03	Yes, frustration with the whole system
Trust	0.01	Not sure if I want where/when/how I fish publicized
Caught No Fish	0.01	Caught no fish
Lazy	0.01	Lazy

CHAPTER 5
UNDERSTANDING BAROTRAUMA MITIGATION BEHAVIOR AND PROMOTING EFFECTIVE PRACTICES: A THEORY OF PLANNED BEHAVIOR APPROACH

Barotrauma Mitigation Introduction

The reef fish complex in the Southeastern United States includes an assemblage of snapper, grouper, amberjack, and triggerfish species, in addition to other finfishes, and is a primary target for offshore fishers (Sauls and Ayala 2012). Reef fishes are economically important in the region (Adams et al. 2006, Agar and Carter 2014) and support major commercial and recreational fisheries. Reef fishes are often caught at depths of 30m or greater (SEDAR 2013, Drumhiller et al. 2014, Garner and Patterson 2015) and are therefore subject to the major stressors that arise from capture at such depths, collectively known as barotrauma. Barotrauma results from the expansion of internal gases, in particular those in the swim bladder, due to declining pressure during rapid ascent from depth (such as is experienced in angled fish). Visible symptoms related to fish barotrauma include bulging eyes, distention of the abdomen, and stomach eversion from the buccal cavity (Rummer and Bennett 2005; Campbell et al. 2010). In addition, barotrauma makes it difficult for fishes to return to depth due to increased buoyancy; these ‘floaters’ are subject to additional stress from temperature and sunlight. Furthermore, impairment of reflexes and behavioral responses may hinder anti-predatory responses (Brown et al. 2010), which along with difficulties submerging may make fish more vulnerable to predation.

Complicating issues of barotrauma are increasingly restrictive regulatory policies, which result in high levels of released fish. Reef fishes in the Southeastern U.S. are subject to intense fishing pressure and are managed through a combination of harvest

control measures, such as bag and size limits, seasonal closures, and Individual Transferable Quotas (ITQ's). These harvest control measures result in high numbers of released fish (Barthalomew and Bohnsack 2005, Hanson and Sauls 2011), and release mortality rates are significant for a number of species due in part to complications arising from barotrauma. For example, in the Gulf of Mexico red snapper (*Lutjanus campechanus*) fishery (a notably controversial fishery; Cowan et al. 2011), the percentage of dead discards relative to total number of killed red snapper has reached as high as 56.2% (Amendment 28). Therefore, reducing barotrauma-related discard mortality of reef fish is an important stock conservation priority.

There are several options available to fishers to help mitigate the effects of barotrauma. These include venting and, more recently, rapid recompression through the use of fish descending gear. In venting, a tool is used to puncture the abdomen of the fish and the swim bladder wall to reduce the volume of expanded gases; venting tools can range from specifically designed needles to filet knives. Fish descending gear mitigates barotrauma by returning a fish quickly to depth, where it can re-pressurize, and a wide variety of descending gears are available, including cages, descending hooks, and lip grips. Though there has been considerable debate in the literature regarding the efficacy of barotrauma mitigation (and in particular venting tools) in improving the survival of released fishes, with many studies showing conflicting results (Wilde 2009), recent studies of Australian snapper (*Pagrus auratus*) (Butcher et al. 2012) and red snapper in the U.S. Gulf of Mexico (Drumhiller et al. 2014, Curtis et al. 2015) show both venting tool use and rapid recompression to be equally effective and to greatly improve fish survival post-release.

Though historically the possession of a venting tool was required for Gulf of Mexico reef fisheries, this law was repealed in 2013 to allow fishers the opportunity to choose among barotrauma mitigation methods, and little is known about current levels of barotrauma mitigation use. Outreach efforts have attempted to increase use by fishers, but little is known about outreach efficacy, what motivates fishers to use such gears, or what methods fishers are using. This project addresses these informational gaps using an Internet-based survey of recreational, charter, and commercial fishers in the Southeastern state of Florida. The study aimed to provide improved estimates of barotrauma mitigation practices for use in stock assessments and in strengthening outreach and informational campaigns targeted at fishing stakeholders. The objectives of the research were 1) to gain a better understanding of fishers' experiences with barotrauma and 2) to identify use and perceptions of barotrauma mitigation devices, focusing in this case on venting tools and fish descending gear, and then 3) to determine what factors influence fisher intention to use barotrauma mitigation, using the Theory of Planned Behavior as our theoretical framework.

Theoretical Framework: Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen 1991) provides a useful framework for understanding fisher's intentions to use barotrauma mitigation devices. According to the theory, intent to perform a behavior is informed by three variables: an individual's attitude toward the behavior (i.e., the degree to which the sum of their attitudes is favorable or unfavorable evaluation or appraisal of the behavior), social norms (i.e., the social pressure to perform or not perform the behavior and the degree to which they care), and perceived behavioral control (i.e., their confidence in their ability to perform the behavior). Generally, the more favorable the attitudes and subjective norms and the

greater the perceived behavioral control, the stronger the intent of the individual to perform the behavior. Behavioral intent, in concert with perceived control, then informs whether or not a behavior is enacted.

Due to the nature of self-reported surveying, I was unable to directly measure actual behavior with regards to barotrauma mitigation method use; therefore, this study focused on intention to use such gear. Other studies demonstrate that intention accounts for significant variance in actual behavior, indicating that a focus on intention is acceptable (Azjen 1991). In this case, I examined how attitudes, subjective norms, and perceived control influence fishers' intention to use either venting tools or fish descending gear.

Methods

This survey focused on fishers in the U.S. state of Florida, which borders both the Atlantic Ocean and the Gulf of Mexico. The survey was created using the Qualtrics software and distributed via email in December 2015 and January 2016. Prior to distribution, the survey was first pilot tested with a total of 18 individuals, including 5 fisheries scientists, 10 recreational anglers, 2 commercial fishers, and 1 charter captain. Three versions of the survey were distributed to three stakeholder groups: recreational anglers, fishing charter operators, and commercial fishers. In the case of fishing charter operators and commercial fishers, the entire population of Florida charter and commercial fishing license holders who had registered their emails at the time of license application (1245 and 3939 respectively) was surveyed. The recreational angler sample was generated by pulling a subset of anglers who had self-identified as reef fishers in a previous stakeholder survey (Garlock and Lorenzen, under review), for a sample size of

2,162. Survey distribution included personalized emails, and email reminders were sent one week after initial contact in accordance with Dillman et al. (2009).

The survey questionnaire consisted of five main sections. The first section characterized respondents' general reef fishing habits and included questions about fishing frequency, gear use, species targeted, and discarding behavior. The second section focused on respondents' experiences with barotrauma and barotrauma mitigation, with questions about their awareness and use of venting tools and fish descending gear. The next section characterized their general attitudes about barotrauma mitigation and associated regulation, and included a question about their sources of information about fisheries. The fourth section was comprised of questions related to the Theory of Planned Behavior, with the final section covering general demographic information, such as age and gender.

Based on the Theory of Planned Behavior, it was hypothesized that attitudes, subjective norms, and perceived control would all influence intention to use either venting tools or fish descending gear. To test this, scales were created to measure attitudes, perceptions of subjective norms, and perceived control for venting tools and fish descending gear. The scales originally contained 5, 6, and 5 items respectively, and reliability was tested using Cronbach's alpha. Assuming a cut-off value of 0.70 or greater (Vaske 2008), analysis found acceptable Cronbach's alpha values for both venting tool and fish descending gear attitude (0.76 and 0.75) and subjective norm (0.83 and 0.85) scales, but low scores (0.31 and 0.40) for the perceived control scales. Further analysis showed that removal of two of the items restored reliability, with final alpha values of 0.75 and 0.85; therefore the final perceived control scale consisted of

three items. Multiple linear regressions were then used to evaluate the ability of attitudes, subjective norms, and perceived control to predict stated intent to use venting tools and fish descending gear. The survey contained a skip logic function so that only those individuals who stated they were familiar with venting tools answered the attitude, subjective norm, and perceived control questions related to venting tools (and similarly for fish descending gear).

The decision was made to exclude the word “barotrauma” from the survey and instead to describe instances when respondents “encountered a fish that could not return to bottom.” This decision was made based on the understanding that not all stakeholders are familiar with the term barotrauma (Hazel et al. 2016), leading to concern that use of the term might confuse respondents or discourage them from completing the survey. After distribution, nonresponse bias was assessed by comparing the demographics of respondents to that of the original samples (Vaske 2008). Procedures were approved by the University of Florida Institutional Review Board under protocol.

Results

Response Rates and Demographics

A total of 573 recreational anglers, 146 charter license holders, and 270 commercial fishers completed the survey, for response rates of 22%, 12%, and 7% respectively. Response rates were lower for charter and commercial samples, which was likely a result of our inability to directly target reef fishers in those sectors. In order to focus on reef fishers specifically, those individuals who reported “never” reef fishing in the past 12 months were excluded from survey analyses, for final sample sizes of 556 recreational anglers, 137 charter license holders, and 174 commercial fishers.

Demographic analysis showed little nonresponse bias, though males were slightly over-represented in the recreational sector, with females comprising 18% of the sample but only 10% of respondents. Overall, the majority of respondents were white (recreational: 89%, charter: 94%, and commercial: 91%) males (recreational: 90%, charter: 99%, and commercial: 95%) with an average age of 50-52 (recreational: 52, charter: 50, commercial: 51). Only 1% of recreational, 2% of charter, and 3% of commercial reef fishing respondents indicated an average annual household income of less than $20,000; the majority of charter (57%) and commercial (62%) respondents reported an average annual household income of less than $100,000, while the majority (62%) of recreational respondents reported an average annual household income of $100,000 or greater, with 20% reporting an average income of $200,000 or greater. When asked to report the highest level of education attained, the majority (90% recreational, 81% charter, and 85% commercial) reported at least some college, with 51% of recreational and 33% of charter and commercial respondents reporting having attained a college bachelor's degree. Notably, 20% of recreational respondents (and only 6% and 9% of charter and commercial respondents) reported having attained a postgraduate degree of some sort.

Fishing Characteristics

Respondents were asked the rate at which they had reef fished in the past 12 months; results are summarized in Table 5-1. Among recreational reef anglers, the majority (53%) reported reef fishing infrequently (a few times-once a month), with 38% reporting moderately frequent (a few times a month-once a week) and only 9% reporting frequent (a few times a week-daily) reef fishing. Charter respondents reef fished with the highest frequency, with 34% reef fishing a few times a month to once a week and

45% fishing a few times a week to everyday. Among commercial respondents, 41% reported reef fishing a few times to once a month, with 33% fishing a few times a month to once a week and 26% fishing a few times a week to everyday.

Charter operators, recreational anglers, and commercial reef fishers had an average of 13, 26 and 19 years, respectively, of fishing experience in Florida. Recreational anglers most commonly fished from private boats (with 91% agreeing that they fish often or all of the time from a private boat), with only 8% reporting often or always fishing from a charter boat and 13% reporting often or always fishing from shore. Anglers typically reef fished using rod and reel (95%), with about a third (31%) fishing with spears. All (100%) charter captains reported using rod and reel when reef fishing, with 6% using spears as well. Most (79%) commercial fishers used hand reels, followed by electric/hydraulic reels (33%) and spears (32%), with only 5% fishing by bottom longline and 1% by trap. Within the charter sector, the majority of respondents (53%) were licensed to take 5-6 customers on their boat, with 33% licensed for 4 or fewer customers and the remainder licensed for more. Within the commercial sector, 4% of respondents indicated that they participate in the South Atlantic Wreckfish ITQ, with 20% and 15% participating in the Gulf of Mexico Red Snapper and Grouper-Tilefish IFQ's respectively.

Responses indicate that the majority of fishing activity takes place in shallower waters. In the Gulf of Mexico, 70% of recreational, 81% of charter, and 65% of commercial activity occurs in waters less than 90 feet (15 fathoms), while in the Atlantic 58-68% of fishing activity occurs at such depths (Figures 5-1, 5-2). Overall, only 16% of

reported recreational and 14% of reported charter activity occurs at depths of 121 feet or greater, with 28% of reported commercial activity occurring at such depths.

Respondents were asked to rate the frequency with which they caught specific species when reef fishing, with response choices including “Never” (coded as “1”), “Rarely” (2), “Sometimes” (3), “Often” (4), and “All of the Time” (“5”). The most frequently caught species across sectors was mangrove snapper (*Lutjanus griseus*) (average of recreational: 3.26, charter: 3.75, and commercial: 3.52), followed by red grouper (*Epinephelus morio*), red snapper (*Lutjanus campechanus*), gray triggerfish (*Balistes capriscus*), and gag grouper (*Mycteroperca microlepis*), with amberjack (*Seriola dumerili*) also caught relatively frequently in the commercial and charter sectors (Table 5-2). The least commonly encountered species was Goliath grouper (*Epinephalus itajara*) for all sectors.

On average, half the recreational and charter catches (52% and 51% respectively) and one third (38%) of the commercial catches were reported to be discarded (Table 5-2). The highest rate of discard in all sectors was for Goliath grouper (98%, 85%, and 88% for recreational, charter, and commercial sectors), followed by red snapper (60-68% across sectors). Lowest rates of discard were for mangrove and vermillion (*Rhomboplites aurorubens*) snappers (less than one third across sectors). Respondents were also asked to indicate the reason for discard for each species, differentiating between discards that occurred because of regulation (e.g., bag or size limits) and discards occurring because of personal preference (i.e., they didn’t want to keep the fish). Overwhelmingly, discards occurred because of regulation across species (Table 5-3).

Experiences with Barotrauma and Barotrauma Mitigation

Only 69% of recreational anglers and charter operators and 67% of commercial fishers reported encountering fish suffering from barotrauma when reef fishing in the past 12 months (Table 5-4). Of those, the majority (over 80% across sectors) indicated that barotrauma was relatively infrequent (occurring only 0-25% of the time) (Figure 5-3). Almost all (96-99%) respondents across sectors were aware of barotrauma mitigation tools; of these, most (98-99%) were familiar with venting tools, while fewer (32-51%) were familiar with fish descending gear.

Of those respondents who had experienced fish suffering from barotrauma, most (77-80%) had used barotrauma mitigation at some point over the past 12 months (Table 5-4). Of these, almost all (96-99%) had used venting tools, with approximately a quarter or less (14-27%) using fish descending gear. The majority of individuals who reported using descending gear also reported using venting tools, with very few (less than 5% of respondents) reporting only using fish descending gear.

Self-reported use of barotrauma mitigation measures was assessed using three survey questions regarding (a) the respondent's own use of such measures, (b) their perception of the use of such measures by others in their own sector, and (c) their perception of use by others when possession of a venting tool was legally required. In all cases, the questions referred to the use of mitigation tools when needed, i.e. when a fish showed signs of barotrauma. More than half (52-69%) of respondents in all sectors reported using barotrauma mitigation most of the time (i.e., 76-100% of the time) when needed; only 15-27% reporting rarely using barotrauma mitigation (0-25% of the time), with the remainder (17-21%) reporting intermediate levels of use (Figure 5-4). Current perceived use by others was substantially lower, with only 30% of recreational anglers,

33% of commercial fishers, and 57% of charter operators perceiving use by others most of the time (76-100%). In all sectors, more respondents perceived use by others had been frequent when possession of a venting tool was required.

General Attitudes Toward Barotrauma Mitigation and Regulation

Respondents were asked about their general attitudes toward barotrauma mitigation in a 5-point Likert-type scale with response options ranging from Strongly Disagree to Strongly Agree. On average, respondents across sectors agreed that returning fish to depth improves fish survival (with an average score of 2.28-2.45 out of 5.0 across sectors for the item “returning fish to depth will not improve the survival of released fish”), that helping fish return to depth will mean more fish to be caught in the future (average score of 3.69-3.93), and that improving survival will enable them to catch more fish in the future (3.80-4.16) (Table 5-5). However, they did not believe that increasing fish survival would lead to greater harvest allowances, with 62-65% agreeing or strongly agreeing that “even if survival of released fish is improved, management will not allow a greater harvest” (average score of 3.77-3.84).

Overall fishers in all sectors were not opposed to (re-) introducing rules that require possession or use of barotrauma mitigation tools or gear (Figure 5-5). Only 26% of all respondents agreed (17%) or strongly agreed (9%) with the statement that there should not be a regulation requiring possession, and only 26-28% agreed or strongly agreed there should not be a regulation requiring use. In addition, more than half of respondents agreed that regulations would increase the number of people using such tools, and expected management to require the use of such tools in the future.

Fishers across sectors reported using a wide range of sources for information on fisheries. Boat captains and other fishers were most commonly used sources across

sectors, with 41-51% of respondents indicating they use them “often or very often” (Figure 5-6). Boat captains were used most often by charter operators and commercial fishers, while anglers were used most often by recreational anglers. This was followed by websites, fishing magazines, state agencies, and tackle shops (used “often” or “very often” by 39-53%, 32-56%, 35-40%, and 20-40% of respondents respectively). Federal fisheries management councils, social media, and fishing workshops were least used, with 18-34%, 24-35%, and 27-30%, indicating they “Never” use these sources.

Theory of Planned Behavior Scales and Analysis

Response options to the attitude, subjective norm, perceived control, and intention scales were given on a 5-point scale ranging from Strongly Disagree to Strongly Agree; results are summarized in Table 5-6. The majority (61-82%) of respondents across sectors agreed or strongly agreed that both venting tools and fish descending gear help fish return to depth and increase survival (Table 5-5). However, attitudes regarding the practicality and costs associated with the two types of mitigation devices differed, with 43-56% agreeing that fish descending gear takes a lot of time, and with approximately a quarter to a third agreeing that it is difficult to use (21-34%) and expensive (26-30%); conversely, only 9-14% agreed that venting tools took a lot of time, 5-10% agreed they were difficult to use, and 2-5% agreed they were expensive.

More respondents perceived subjective norms associated with venting tool use than with fish descending gear. For example, 68-74% agreed or strongly agreed that “fishers like me use venting tools,” while only 23-32% agreed that “fishers like me use fish descending gear.” Similarly, 50-58% agreed that “other fishers expect me to use venting tools,” while only 8-26% agreed that “other fishers expect me to use fish descending gear.” This suggests stronger norms associated with venting tools. Notably,

fewer fishers agreed that they felt social pressure when asked explicitly (13-17% for venting tools), even though their agreement with the other items shows that they feel such pressure, suggesting that social pressures may in this case be subtle (e.g., they are not commonly asked outright about their barotrauma mitigation behavior).

Across sectors, 82-94% and 57-65% of respondents agreed that they feel confident in their use of venting tools and fish descending gear respectively, with only 3-7% agreeing they do not know how to use venting tools and only 7-12% agreeing they do not know how to use fish descending gear. Relatively few (6-17% and 9-21% respectively) felt they needed more training in the use of either mitigation method.

The majority of respondents (81-86% across sectors) agreed that they intend to use venting tools next time they encounter barotrauma. Conversely, only 20-27% agreed that they intend to use fish descending gear. Of those reef fishers who were familiar with both venting tools and fish descending gear, 71-80% indicated intent to use venting tools while only 32-39% indicated intent to use fish descending gear.

Results of the regression indicate that attitudes, subjective norms, and perceived control predict a statistically significant increase in intention to use venting tools (recreational: R^2=0.44, $p<0.001$; charter operators: R^2=0.39, $p<0.001$; commercial: R^2=0.48, $p<0.001$) and fish descending gear across sectors (recreational: R^2=0.50, $p<0.001$; charter operators: R^2=0.64, $p<0.001$; commercial: R^2=0.67, $p<0.001$; Table 5-7). Taken together, these three variables were able to predict a third to just under half the variance in intention to use venting tools and over half of the variance in intention to use fish descending gear. Subjective norms predicted the highest increase in intention to use both fish descending gear and venting tools across sectors (β=0.38-0.52) and

was always a significant predictor of intention ($p<0.001$; Table 5-8). Conversely, perceived control predicted relatively little increase in intention ($\beta=0.08$-0.27), and was not always significant. Attitude was a significant predictor, except in the case of the charter and commercial venting tool models, but predicted only about half the increase in intention relative to subjective norms ($\beta=0.13$-0.38).

Discussion

This study found that venting tools are the primary barotrauma mitigation method used by Florida reef fishers. Of those who had used barotrauma mitigation in the past year, almost all (96-99%) had used venting tools while relatively few (14-27%) had used fish descending gear. In addition, most (81-86%) indicated that they intend to use venting tools the next time they encounter a fish suffering from barotrauma.

Fishers perceived stronger subjective norms associated with venting tools than with fish descending gear, and subjective norms were the most important predictor of intention to use either method. This suggests that outreach campaigns focused on emphasizing and re-enforcing norms would have the greatest impact on increasing barotrauma mitigation use among fishers. Subjective norms have been found to be significant predictors of fisher behavior in other contexts (for example, compliance with regulations), and campaigns targeting norms have been shown to be effective in producing desired behaviors (Schultz et al. 2007). Key drivers of change in subjective norms include communication, education, and governance. In general, respondents indicated that they use their peers as their primary source of fisheries information, with charter operators and commercial fishers most often using boat captains and recreational anglers most often using other anglers. Given the strong influence of subjective norms on intention to use barotrauma mitigation, fishery managers should

take advantage of the social influence of industry leaders to educate and encourage the use of barotrauma mitigation practices. Websites, fishing magazines, state agencies, and tackle shops were also commonly used sources of information that may be productive avenues to communicate barotrauma-related information to fishers.

The survey found that fishers across sectors had positive attitudes regarding the impact of barotrauma mitigation on fish survival. Respondents on average agreed that both venting tools and fish descending gear help fish return to depth and improve fish survival. In addition, fishers agreed that returning fish to depth improves survival, that helping fish return to depth will mean more fish to be caught in the future, and that improving fish survival will enable them to catch more fish in the future. Similarly, recreational and tournament anglers in the northern Gulf of Mexico surveyed before removal of the venting tool requirement agreed that venting tools increase fish survival (Scyphers et al. 2013). Notably, this perception of positive impacts does not translate directly into use of barotrauma mitigation. For example, only 61% of commercial fishers who agreed or strongly agreed that venting tools improve fish survival report using barotrauma mitigation with great frequency (more than 76% of the time when needed), and 23% report using it rarely (0-25% of the time when needed). This supports the finding that attitudes are not the only nor the most important factor influencing an individual's intention to use barotrauma mitigation.

While fishers agreed that both barotrauma mitigation methods had positive impacts on fish survival, they differed in their attitudes regarding use of each method. Respondents overall had more favorable attitudes toward the use of venting tools than toward fish descending gear. Greater numbers of fishers in the survey agreed that

descending gear is difficult to use, time consuming, and expensive. The perception that venting tools are easier to use and less expensive than fish descending gear likely contributes to the preference for venting tools among respondents.

Fishers across sectors felt confident in their ability to use both venting tools and fish descending devices, and perceived control had little influence on their intention to use either method. While fish descending gear is relatively un-invasive, venting requires a general understanding of fish anatomy, and proper venting technique has a substantial influence on the effectiveness of this approach (Drumhiller et al. 2014). Although fishers in the survey were confident in their ability to use venting tools, previous research indicates that many fishers use improper venting techniques (Hazel et al. 2016); notably, they also show that knowledge of proper venting methods is not linked to fishing experience (Scyphers et al. 2013). Therefore, outreach efforts focused on technique are still important; though they may not increase frequency of use, ensuring fishers are using venting tools properly will improve the efficacy of barotrauma mitigation, especially considering the finding that the majority of fishers use venting tools over fish descending gear. However, outreach efforts will have to address the fact that fishers may be overconfident in their ability to use venting tools correctly and do not perceive the need for additional training, making them unlikely to seek out additional information, and efforts should therefore also focus on challenging fisher's belief that they know the correct use of venting tools.

Results suggest that a high proportion of fishers are using barotrauma mitigation, with more than half reporting having used it most of the time when they encountered a fish suffering from barotrauma in the past year. However, given that there seem to be

strong norms associated with barotrauma mitigation (and in particular venting tools), it is possible that social desirability bias would lead respondents to over-report their own use of barotrauma mitigation in order to conform with subjective norms (Fisher 1993, Nuno and John 2015). For this reason, respondents were also asked about their perceptions of the use of barotrauma mitigation by others, and overall reported use was somewhat lower (with 30-57% reporting that they believe others use it most of the time when needed). The perception of use by others was highest in the charter sector; this agrees with the finding that subjective norms were strongest in the charter sector, though the difference was minor (for example, with 74% of charter operators agreeing that fishers like them use venting tools compared with 70% of commercial and 68% of recreational). It is likely that actual use lies somewhere in between self-reported use and the reported use of others, which still indicates that fishers are using barotrauma mitigation with at least moderate frequency when needed.

Interestingly, survey results indicated that relatively few stakeholders were opposed to a regulation requiring possession or use of barotrauma mitigation devices. In addition, stakeholders across sectors perceived that use of barotrauma mitigation was higher when the historic venting tool requirement was in place. Reinstating such a regulation would show support on the side of management for the use of barotrauma mitigation, enforce subjective norms and would likely increase use of barotrauma mitigation by fishers.

Notably, attitudes and behavior differed little across sectors in this study, suggesting that outreach messages need not be tailored differently for each audience. Discard mortality rates are thought to be higher in the commercial sector, but

commercial fishers in this survey reported discard rates that were below the other fishing sectors. Furthermore, the sheer number of recreational anglers in the state of Florida far exceeds the number of commercial fishers (NOAA Fisheries 2012). These factors should be taken into consideration when deciding where it would be most effective to focus outreach efforts.

Respondents reported discarding on average ½ to 1/3 of their catch, with discards largely due to regulation (and not personal preference). Regulatory discards were notably high among red snapper and gag grouper, which are among the most intensively managed reef fishes. The finding that discards are due to regulation suggests that if regulations are lessened in future, harvest rates will increase for these species, as there appears to be little culture of catch and release fishing in the reef fish complex (unlike for many inshore species, such as snook).

Goliath grouper had the highest rates of discard; this was expected, as this species is currently under a harvest moratorium. However, none of the sectors reported 100% discard rates for this species. Though this could be viewed as evidence of illegal harvest, it is more likely indicative of reporting error. It is possible that the question may have confused some respondents, who may for example have reported the total number of fish discarded rather than the percentage. In this light, it may be best to view the results as representative of a lower threshold of discarding; actual discard rates may in fact be higher. In future, analysis comparing discard behavior in this survey to observed discards would be useful in evaluating the accuracy of self-reported discard rates. Understanding discard behavior is critical to assessing and managing our reef

fish stocks, yet discard rates are difficult to capture, particularly in the recreational sector.

It is possible that familiarity also plays a role in the preference for venting tools over fish descending gear. The historic venting tool requirement, in addition to the fact that descending gears are relatively new on the market, likely contribute to the finding that more respondents were familiar with venting tools than with fish descending gear. However, even those familiar with both fish descending gear and venting tools show a preference for venting, supporting the finding that other factors (in this case, subjective norms followed by attitudes) play a significant role in influencing fisher's intention to use a barotrauma mitigation method.

Synthesis

This study was the first to survey reef-fishing stakeholders across sectors to discover their experiences with barotrauma and preferences for barotrauma mitigation methods. Results show that outreach efforts focusing on re-enforcing subjective norms should have the greatest impact on increasing fisher's use of barotrauma mitigation methods. Because previous studies indicate that venting and recompression have similarly positive impacts on fish survival, outreach should encourage use of either method; however, should future findings show one method to be more effective than the other, these findings would be useful in shifting angler preference. The reef fish complex includes some of the most popularly targeted species in the southeastern U.S., and results show high rates of regulatory discards for many species, which contributes to overall mortality through dead discards. Therefore, reducing release mortality rates would have important benefits to sustainability of these important fish stocks. In this light, encouraging behavior that might reduce discard mortality, such as through the use

of barotrauma mitigation methods, would have important impacts. In addition, it would likely be met more favorably than further reducing harvest in these already controversial fisheries.

Table 5-1. Percentage of respondents in each sector who reported reef fishing within broad frequency categories in the past 12 months.

	Angler %	Charter %	Commercial %
Infrequent (A few times-once a month)	53	21	41
Moderate (A few times a month-once a week)	38	34	33
Frequent (A few times a week-daily)	9	45	22

Table 5-2. Catch and discard for each species listed in the survey across recreational (angler), charter, and commercial ("comm.") sectors. Catch frequency and discard rates are averaged across each sector. Catch frequency was coded from a 5-item Likert-type scale such that Never=1, Rarely=2, Sometimes=3, Often=4, and All the time=5.

	Catch Mean			Discard (%)		
Species	Angler	Charter	Comm.	Angler	Charter	Comm.
Gag Grouper	2.83	3.00	3.16	55.04	58.63	37.34
Red Grouper	3.02	3.12	3.32	52.29	58.49	34.19
Goliath Grouper	1.68	2.23	2.28	97.89	85.63	87.90
Other Groupers	2.46	2.49	2.96	48.16	54.00	30.55
Red Snapper	2.99	2.87	3.07	62.84	68.05	59.67
Vermillion Snapper	2.81	2.80	3.06	35.03	29.66	22.19
Mangrove Snapper	3.26	3.75	3.52	30.37	34.30	13.28
Mutton Snapper	2.24	2.26	2.62	36.69	31.57	20.77
Yellowtail Snapper	2.40	2.40	2.67	36.57	38.62	24.95
Black Seabass	2.31	2.50	2.46	51.16	55.23	35.96
Gray Triggerfish	2.87	3.36	3.25	60.22	56.36	39.85
Amberjack	2.78	3.05	3.22	59.88	42.08	43.66

Table 5-3. Reasons for discard for each species in the survey; reasons for discard were presented as a binary question, and respondents could select between discards due to regulation (i.e., “wasn’t allowed to keep”) and discards due to personal preference (i.e., “didn’t want to keep”); this table shows the percentage of individuals in each sector who selected each option as a reason for discard for each species.

	Regulation (%)			Preference (%)		
Species	Angler	Charter	Comm.	Angler	Charter	Comm.
Gag Grouper	93.15	86.84	98.08	6.85	13.16	1.92
Red Grouper	88.61	83.65	95.92	11.39	16.35	4.08
Goliath Grouper	86.14	89.61	93.51	13.86	10.39	6.49
Other Groupers	84.51	84.91	92.65	15.49	15.09	7.35
Red Snapper	92.81	94.87	95.56	7.19	5.13	4.44
Vermillion Snapper	65.22	69.09	87.88	34.78	30.91	12.12
Mangrove Snapper	78.10	74.36	90.14	21.90	25.64	9.86
Mutton Snapper	79.25	84.62	90.74	20.75	15.38	9.26
Yellowtail Snapper	81.12	78.43	85.00	18.88	21.57	15.00
Black Seabass	64.06	71.19	77.36	35.94	28.81	22.64
Gray Triggerfish	71.48	75.29	80.49	28.52	24.71	19.51
Amberjack	65.52	58.62	77.53	34.48	41.38	22.47

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Table 5-4. Proportion of individuals in each sector who responded “yes” to each of the following items regarding barotrauma experience and barotrauma mitigation behavior.

	Angler	Charter	Commercial
Experienced barotrauma in the past 12 months	0.69	0.69	0.67
Aware of barotrauma mitigation tools	0.96	0.99	0.98
Familiar with venting tools	0.98	0.99	0.99
Familiar with fish descending gear	0.32	0.51	0.34
Used barotrauma mitigation in the past 12 months	0.79	0.77	0.80
Used venting tools in the past 12 months	0.96	0.97	0.99
Used fish descending gear in the past 12 months	0.16	0.27	0.14

Table 5-5. The average score (and standard deviation, SD) on a 5-point Likert-type scale for each of the following items regarding general attitudes toward barotrauma mitigation across sectors.

	Angler Mean (SD)	Charter Mean (SD)	Commercial Mean (SD)
Returning fish to depth will not improve survival of released fish	2.28 (1.04)	2.29 (1.09)	2.45 (1.12)
Helping return fish to depth will mean more fish to be caught in the future	3.79 (0.94)	3.93 (0.97)	3.69 (0.98)
If survival of released fish is improved, I can catch more fish in the future	3.87 (0.94)	4.16 (0.86)	3.80 (1.04)
When reef fishing, most fishers when use some sort of method to help return fish to depth	3.39 (0.89)	3.78 (0.90)	3.42 (1.01)

Table 5-6. Proportion of respondents across sectors (with “comm.”=commercial) that indicated that they agree or strongly agree with items from the Theory of Planned Behavior attitude, subjective norm, perceived control, and intention scales.

	Venting Tools			Descending Gear		
	Angler	Charter	Comm.	Angler	Charter	Comm.
N	531	133	174	169	67	60
Attitudes						
Use will help fish return to depth	0.76	0.87	0.83	0.68	0.79	0.72
Use will improve survival of released fish	0.64	0.75	0.69	0.62	0.68	0.53
Use takes a lot of time	0.09	0.09	0.14	0.43	0.56	0.50
Is difficult to use	0.10	0.05	0.07	0.21	0.34	0.26
Is expensive	0.04	0.02	0.05	0.26	0.30	0.29
Subjective Norms						
Fishers like me use	0.68	0.74	0.70	0.28	0.32	0.23
Other fishers like me expect me to use	0.52	0.58	0.50	0.13	0.26	0.08
Fisheries managers expect me to use	0.70	0.75	0.68	0.29	0.39	0.37
Other fishers like me support the use of	0.58	0.71	0.65	0.37	0.28	0.28
Other fishers like me think use can improve the survival of released fish	0.55	0.66	0.60	0.47	0.42	0.28
I feel social pressure to use	0.13	0.19	0.17	0.07	0.12	0.02
Perceived Control						
I am confident in my ability to use	0.82	0.94	0.89	0.63	0.65	0.57
I do not know how to use	0.07	0.05	0.03	0.12	0.12	0.07
I need more training on how to use properly	0.17	0.07	0.06	0.21	0.18	0.09
Intention						
I intend to use next time I experience a fish that cannot return to depth	0.81	0.83	0.86	0.20	0.27	0.22

Table 5-7. Multiple Linear Regression model results run with attitudes, subjective norms, and perceived controls as predictors of intention to use either venting tools or fish descending gear across sectors.

	R^2	F	*p*
Venting Tools			
Angler	0.44	132.96	<0.001
Charter	0.39	25.48	<0.001
Commercial	0.48	44.30	<0.001
Fish Descending Gear			
Angler	0.50	52.72	<0.001
Charter	0.64	32.32	<0.001
Commercial	0.67	32.72	<0.001

Table 5-8. Results of a Multiple Linear Regression showing the relative ability of attitudes, subjective norms, and perceived control to predict intention to use either venting tools or fish descending gear across sectors.

		Beta	p
Venting Tools			
Attitudes	Angler	0.21	<0.001
	Charter	0.13	0.165
	Commercial	0.13	0.111
Subjective norms	Angler	0.47	<0.001
	Charter	0.50	<0.001
	Commercial	0.48	<0.001
Perceived control	Angler	0.08	0.022
	Charter	0.14	0.112
	Commercial	0.27	<0.001
Fish descending gear			
Attitudes	Angler	0.31	<0.001
	Charter	0.25	0.034
	Commercial	0.38	0.001
Subjective norms	Angler	0.38	<0.001
	Charter	0.52	<0.001
	Commercial	0.45	<0.001
Perceived control	Angler	0.20	0.003
	Charter	0.18	0.059
	Commercial	0.22	0.020

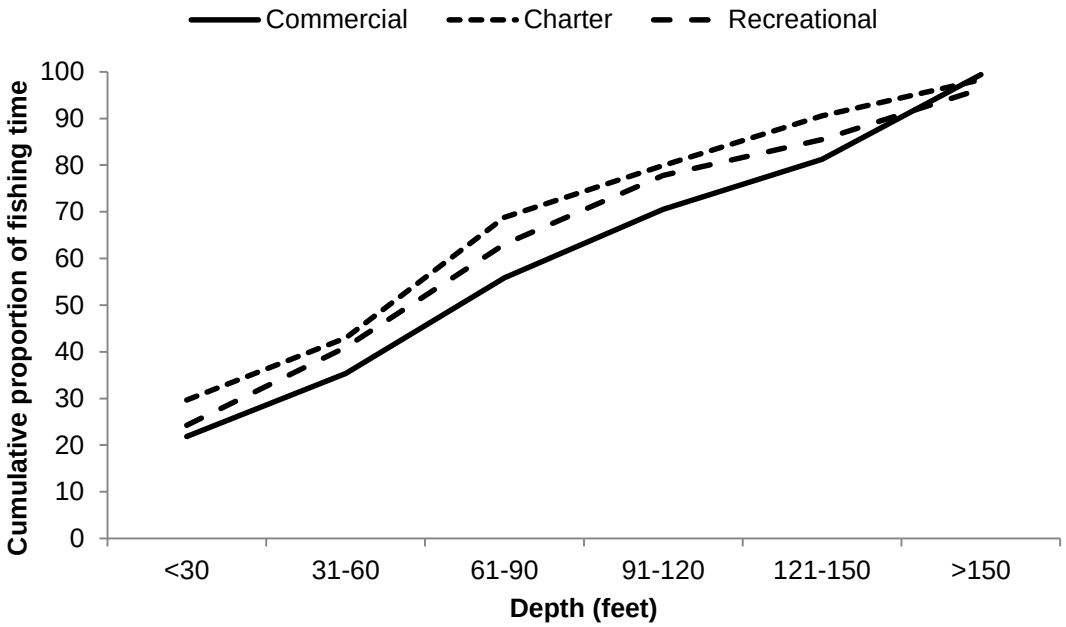

Figure 5-1. Fishing depth profile by sector for the Atlantic Ocean.

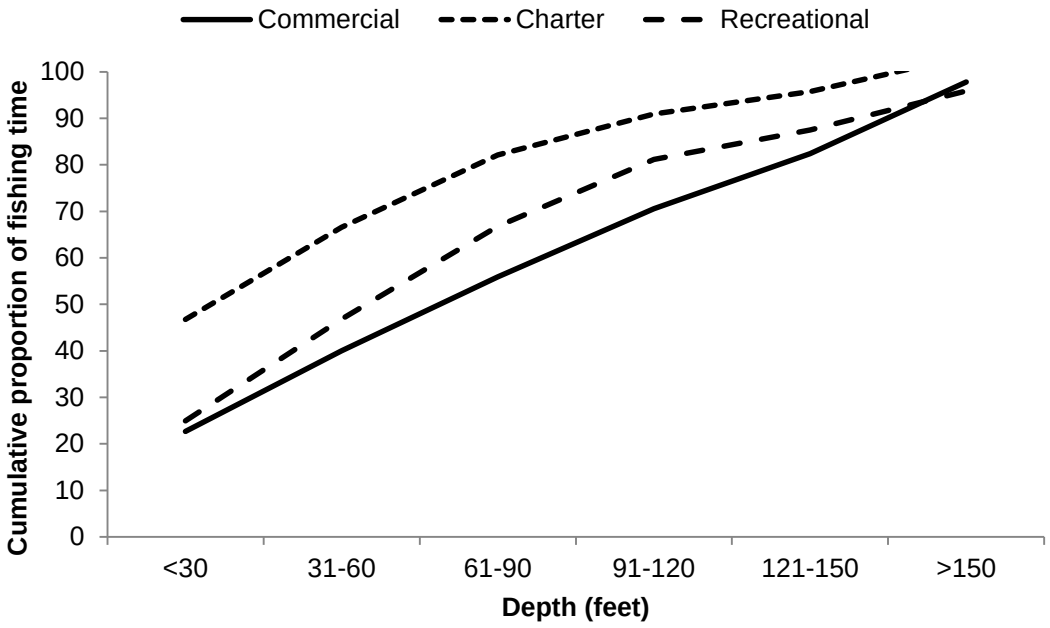

Figure 5-2. Fishing depth profile by sector for the Gulf of Mexico.

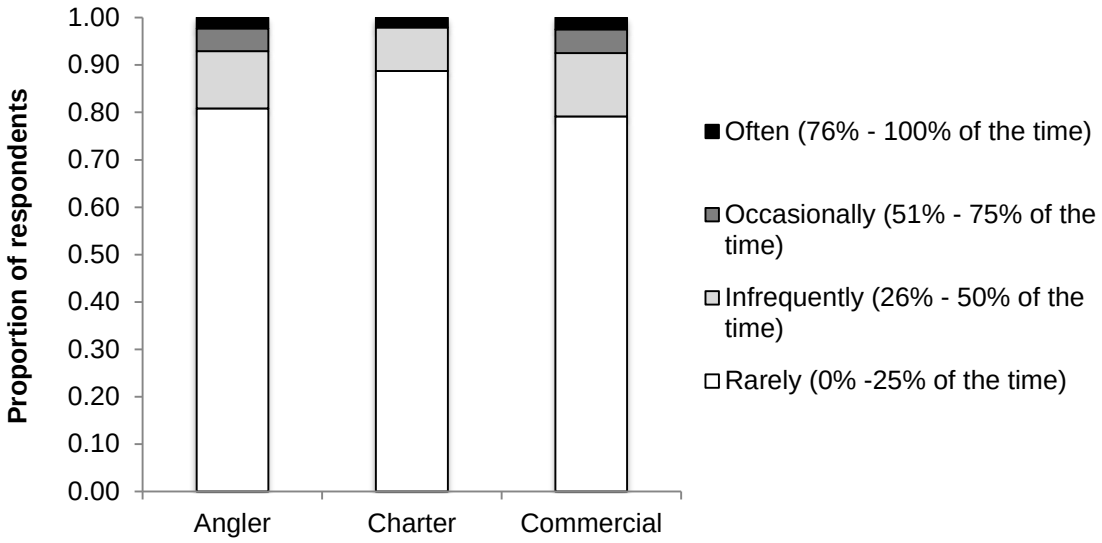

Figure 5-3. Proportion of individuals in each sector who indicated that they encounter a fish who has trouble returning to depth (i.e., is suffering from barotrauma) 0-25%, 26-50%, 51-75%, or 76-100% of the time when they are reef fishing.

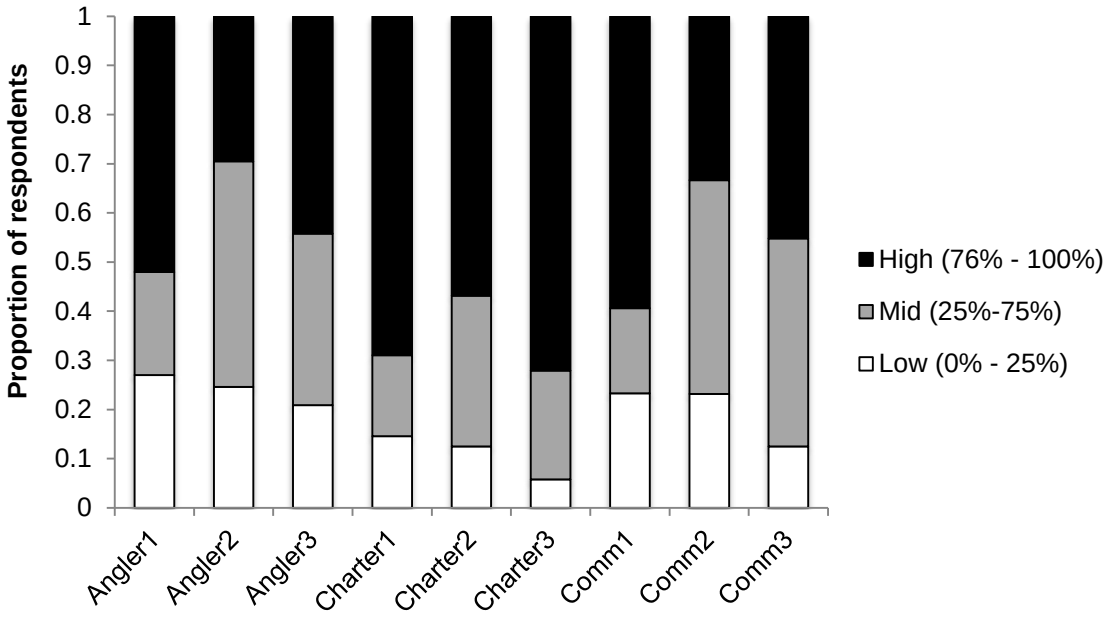

Figure 5-4. Reported proportion of the time barotrauma mitigation is used when necessary (i.e., with a fish who is suffering from barotrauma) across recreational (angler), charter, and commercial ("comm") sectors, reported according to 1) respondent's own use in the past 12 months 2) current perceived use of others and 3) perceived use by others historically when regulation was in place for barotrauma mitigation tools.

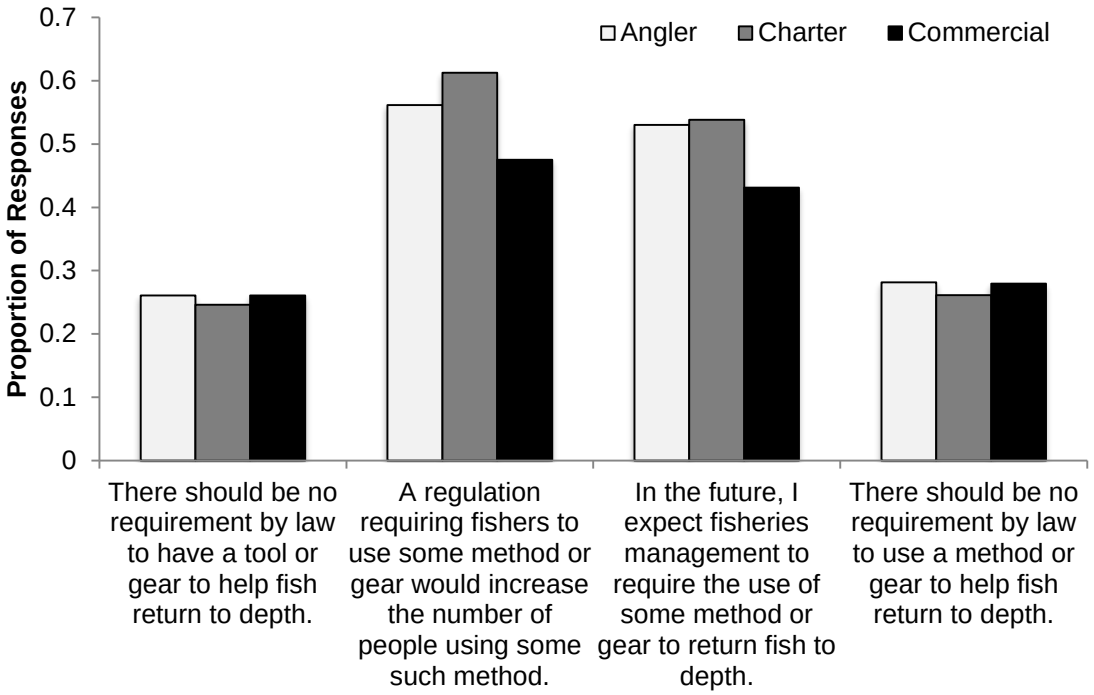

Figure 5-5. Proportion of respondents who agreed or strongly agreed with items related to barotrauma mitigation regulation across sectors.

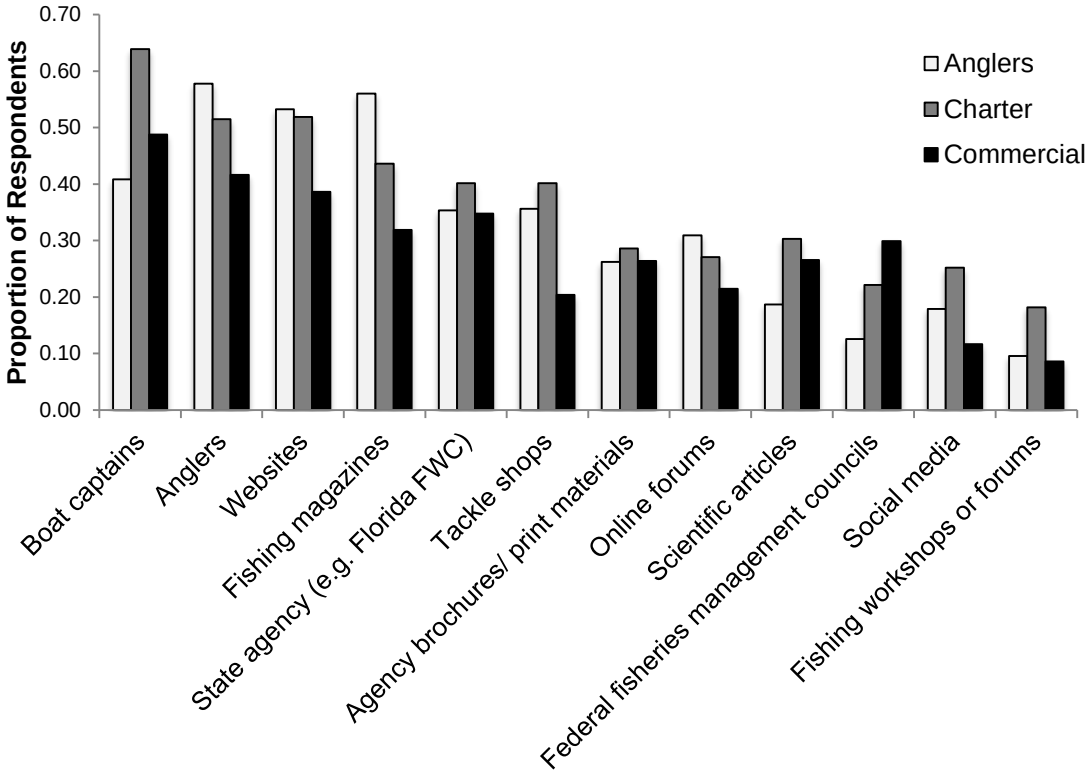

Figure 5-6. Proportion of respondents across sectors who indicated they use each source of information about fisheries either “quite often” or “very often”.

CHAPTER 6
CONCLUSIONS

Synthesis of Approaches

In this dissertation I explored stakeholder participation in Florida's marine fisheries management through three pathways: participation in management decision-making (Chapters 2-3), participation in research (Chapter 4), and participation through actions taken to improve fish survival (Chapter 5). To begin, I used qualitative interviews targeted at highly engaged stakeholders in southwest Florida as a preliminary step to understand stakeholder attitudes toward the idea of place-based management and current management engagement (Chapter 2). Interview results then informed the creation of a quantitative survey, which was used to get baseline perceptions of meaningful action and satisfaction with management among southwest Florida stakeholders (Chapter 3). In addition, a quantitative survey was created to identify motivations and barriers to participation in voluntary angler data collection programs, using the Angler Action Program as a case study (Chapter 4). Finally, I explored the use of barotrauma mitigation methods across sectors, using the Theory of Planned Behavior to identify what influences fisher intention to use either venting tools or fish descending gear (Chapter 5). In this chapter, I synthesize the findings of these studies for a holistic understanding of stakeholder participation in the management of Florida's marine fisheries.

Current Perceptions of Management and Engagement

One of the key findings of this research was the indication that many of Florida's marine fisheries stakeholders do not have positive perceptions of fisheries management or of current engagement opportunities. Half of interview respondents cited

management as a source of concern for local fisheries, with a third expressing dissatisfaction with the process by which management decisions are made (Chapter 2). In addition, three quarters of interview respondents did not feel able to influence management decisions, for example sharing the perception that engagement was insincere and that managers were not listening to them or taking their needs into account (Chapter 2). Though most survey respondents agreed that public input should be included in the management decision-making process, only 19% agreed that it is currently incorporated and only 13% agreed that managers listen to public input (Chapter 3). In addition, almost half of survey respondents were on average dissatisfied with management, with 14% very dissatisfied and only 6% very satisfied (Chapter 3). Analysis showed a significant correlation between perceptions that one is able to have meaningful action in the management process and satisfaction with management, with those who feel able to influence management more satisfied and vice versa (Chapter 3).

The majority of interview respondents cited other fishers as their source of information about fisheries, with only a third citing the state management agency, and respondents shared difficulties in accessing and understanding the science that was available (Chapter 2). In addition, almost half expressed concerns over the quality of fisheries science, citing it as an issue of concern for local fisheries (Chapter 2). Similarly, boat captains and other fishers were the most commonly used sources of information by reef fishers across sectors, with federal management councils among the least used (Chapter 5). Overall, Extension/Sea Grant was rated as the most trustworthy source of information, with almost a quarter of survey respondents rating federal councils as Very Untrustworthy (Chapter 3). Perceptions of meaningful action

corresponded with levels of trust in that HMA individuals rated fisheries professionals across categories as more trustworthy than LMA individuals (Chapter 3).

Participation in Management

Half of survey respondents had never participated in management, and those that did participated largely through opinion surveys (Chapter 3). However, two-thirds were interested in participating in the future through data collection or opinion surveys, with about half interested in participating in educational seminars or public meetings/workshops (Chapter 3). Almost half (41%) agreed that they would like to be included in the management decision-making process, though only 15% agreed that there are currently opportunities for them to participate (Chapter 3). In addition, LMA individuals were less likely than HMA individuals to agree that there are opportunities for them to participate, though there were no significant differences in number of individuals who had participated in some way across the two groups, demonstrating the importance not only of actual participation but of the impression that there are routes available for participation (Chapter 3).

The AAP consisted largely of “dabbler”-type participants (Eveleigh et al. 2004), with only 18% of AAP respondents currently logging trips (and only half of those logging most or all of their trips) and only 10-29% of forum participants having attended most or all of the meetings (Chapter 4). Participation in barotrauma mitigation was higher, with half to two thirds of respondents reporting using barotrauma mitigation most of the time when needed; however, this may be an overestimate, as only a third to a half reported that others use barotrauma mitigation most of the time when needed (Chapter 5).

All surveys showed nonresponse bias with regard to gender, with males overrepresented among survey respondents (Chapters 3, 4, 5). Respondents were also

relatively avid, with moderate to high frequency of fishing and for the most part viewing themselves as at least equal in skill to other anglers (Chapters 3, 5).

Management Implications

It is important to create an environment that supports meaningful action in the management process. Stakeholders want public input included and many of them want to participate themselves, yet at the same time a minority see opportunities to participate and many do not perceive current engagement as genuine or meaningful. There is a significant correlation between meaningful action and satisfaction with management, therefore providing more meaningful opportunities to engage should also increase stakeholder satisfaction. In addition, supporting meaningful action would enable more reasonable (and less contentious) interactions between stakeholders and management. There are a number of different ways that stakeholders can participate in the management process. Respondents indicated interest in participating through citizen science efforts, opinion surveys, educational seminars, and public meetings/workshops, and further opportunities to participate should be explored.

It is important that participatory approaches to management take equity concerns into account and ensure that minority groups are also represented. In this case, we saw that males and avid anglers were more likely to participate in surveys, with lower representation from females and from less avid anglers. Management should explore engagement through a variety of means to ensure opportunities for all types of anglers who desire to participate, but should also explore why certain groups may be underrepresented.

It is critical that stakeholders perceive participatory efforts as meaningful. In many cases results showed that stakeholders do not see a link between their

participation and changes in management, which was often associated with feelings of frustration. Management should therefore make links between stakeholder input and management decisions transparent and easily accessible.

Future Directions

One important avenue to explore in future is the underrepresentation of females and less avid anglers in engagement efforts. Fisheries stakeholders are a diverse group, and it likely that different groups would be better engaged in different ways. However, it is also possible that a subset of stakeholders has no desire to participate in the management process. Future research should explore barriers to participation and whether alternate engagement strategies would be preferable or if certain groups are uninclined to participate.

Contribution to Knowledge

In this dissertation I document stakeholder perceptions of participation in the management process in the context of marine fisheries in the state of Florida. Though previous research has shown links between perceptions of meaningful action and volunteer satisfaction as well as acceptance of management regulations, this study is the first to demonstrate a relationship between meaningful action and stakeholder satisfaction with management. In addition, though many studies have explored motivations to participate in volunteer and citizen science efforts, this is the first study to synthesize these findings into a single understanding of the diversity of participant motivations, as well as the first to explore fisheries citizen science participant motivations and barriers in depth. Finally, this work was the first to document experiences with barotrauma and barotrauma mitigation use across sectors, with the application of the Theory of Planned Behavior showing the importance of subjective

norms in influencing intention to use barotrauma mitigation. Together these results give important insights into stakeholder participation in the fisheries management process.

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BIOGRAPHICAL SKETCH

Chelsey Crandall was born in Tampa, Florida, and moved to Gainesville in 2004 to attend the University of Florida (UF) as an undergraduate majoring in zoology. While an undergraduate Chelsey volunteered with a variety of research labs. In 2005, she assisted Dr. Iske Larkin in surveying manatees and boaters in Kings Bay, Florida, and was later hired as a lab technician by then Ph.D. student Elise Hoover to assist with a project studying triploid clam survival in varying environmental conditions. That year she also began volunteering in Dr. Harvey Lillywhite's lab, where she assisted with fieldwork studying cottonmouth snakes on Seahorse Key, Florida. She also began working with the lab's then graduate student Leslie Babonis, assisting on her research exploring marine snake osmoregulation. As part of this work, she conducted field work and lab trials with the marine snakes in Florida and in Taiwan; this work continued through 2008.

In the summer of 2006, Chelsey worked as an intern for the SeaKeys program, based out of Long Key, Florida, while also volunteering for the Sea Turtle Hospital on Marathon Key. That fall, she was awarded a University Scholars grant to study the relative abundance of invasive rats (relative to bird nesting sites) on Seahorse Key. Chelsey also began volunteering that fall with the Florida Program for Shark Research, where she assisted on shark age and growth and reproduction research as well as helped with fieldwork tagging cownose rays in Mosquito Lagoon, Florida. She continued volunteering with them through 2008.

In 2007, Chelsey began volunteering with the Invertebrate Division of the Florida Museum of Natural History and was soon hired as a collections assistant; she continued

to work for the collection through 2009. Chelsey also assisted in research in the Division under Dr. Gustav Paulay studying diversity in sea cucumbers.

Chelsey graduated from UF in spring 2008 with a Bachelor in Science degree. After graduation, Chelsey was hired to work as an intern under Dr. Kenneth Emberton documenting diversity in Madagascar's land snails; this work was conducted first in Madagascar and then in Invertebrate Division of the Florida Museum of Natural History; she continued this work until summer 2009. In fall 2008, Chelsey also became a certified Science Diver and was hired for two weeks to assist then graduate student Mary Hart on a field project collecting chalk bass in Carrie Bowe Cay, Belize. In 2009, Chelsey was hired by the Florida Program for Shark Research, where she worked as their field technician conducting field studies surveying sawfish abundance and tagging sharks in both coasts of Florida. Chelsey also joined the Murie/Parkyn lab for brief field trips in summer 2009 and summer 2010 as a field assistant on a reef fish habitat use study in St. John's, USVI.

In 2010, Chelsey began her master's degree in fisheries and aquatic sciences at the University of Florida under Dr. Daryl Parkyn. Her thesis explored otolith shape as a tool to elucidate stock structure in greater amberjack in the Gulf of Mexico. Chelsey graduated from the program in fall 2012, and immediately began work on her Ph.D. in interdisciplinary ecology under Dr. Kai Lorenzen, co-advised by Dr. Martha Monroe. Chelsey's dissertation centered around stakeholder participation in the management of Florida's marine fisheries, exploring stakeholder engagement in the management decision-making process, in research, and in efforts taken to improve fish survival. Chelsey graduated from the program in fall 2016.