

The Use of Descending Devices in Fisheries Management to Reduce Discard Mortality: Regional Experiences and Considerations



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Executive Summary

The South Atlantic red snapper (*Lutjanus campechanus*) stock is overfished and experiencing overfishing without an open recreational fishing season. Red snapper are caught incidentally when anglers target other species in the snapper grouper complex. While red snapper cannot legally be harvested, many of them do not survive after capture and release. Ascending a red snapper to the surface from depth can cause barotrauma, a pressure-induced depth dependent condition, which often results in mortality and high discard mortality rates. The high amount of red snapper discards continues to exceed the acceptable biological catch resulting in a prolonged closure of the fishery. This problem becomes further complicated as the red snapper fishery has shown signs of recovery and an increase in population, leading to more recreational encounters. The South Atlantic Fishery Management Council is currently exploring ideas to reduce the amount of red snapper discards and to increase survivability of red snapper. Descending or recompression devices could potentially be a solution to increase the survival of discarded red snapper and reduce discard mortality rates. Descending devices reduce symptoms of barotrauma and increase survivability by returning fish to or near their original capture depth. By lowering discard mortality rates this practice can potentially prevent overfishing.

This study identified and analyzed the challenges and opportunities of using descending devices in the South Atlantic red snapper fishery by investigating the process of successful descending device utilization in the Pacific groundfish fishery for three species of rockfish. Through interviews and document analysis this study identified several contributors to successful use of descending devices in the Pacific, including outreach with use of GoPro videos, cohesion, and coordination between the Pacific Fishery Management Council and state management agencies to incentivize and facilitate utilization of descending devices in the recreational fishing community. Pacific interviewees indicated descending devices were effective as a means for flexibility in management, allowed for more accurate data collection, and created more opportunities for recreational anglers. While incentives for use of descending devices are similar

between regions, study participants in the South Atlantic raise concern with the use of descending devices due to the multispecies complex, lack of scientific research and limited survey data. Respondents in both regions agreed descending devices should be used and promoted as a best practice by anglers.

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List of Acronyms

MSA – Magnuson Stevens Fishery Conservation and Management Act

FMP- Fishery Management Plan

ACL- Annual Catch Limit

ABC- acceptable biological catch

SFA- Sustainable Fisheries Act

AM-Accountability Measure

SSC- Scientific and statistical committee

NS- National Standard

OFL- Overfishing limit

MSY- Maximum sustainable yield

MRIP- Marine Recreational Information Program

SRHS- Southeast Region Headboat Survey

Introduction

Despite a year-round prohibition on harvest, the South Atlantic red snapper (*Lutjanus campechanus*) stock continues to be overfished and experience overfishing (SEDAR 41 2016). The South Atlantic Fishery Management Council, which manages fish stocks 3-200 miles offshore from the North Carolina-Virginia border to the eastern side of the Florida Keys [Figure 1], is bound by federal law to address the overfishing status of the red snapper (SAFMC 2007). Since the stock was declared overfished in 2010, management measures to rebuild the stock resulted in more regulations and closed seasons for recreational and commercial fishermen (SAFMC 2017). While the South Atlantic Fishery Management Council takes the necessary measures to manage the stock at sustainable levels, increased regulations and season closures continue to lead to frustrated anglers in this mainly recreational fishery (CCA 2016).



Figure 1: South Atlantic Fishery Management Council jurisdiction. Reprinted from “About SAFMC,” Retrieved from <http://cdn1.safmc.net/wp-content/uploads/sites/default/files/EEZoffSAStatesJune2010Web2.gif>

Signed into law in 2007, the 2006 reauthorization of the Magnuson Stevens Fishery Conservation and Management Act (MSA) established strict requirements for achieving and maintaining biological sustainability. To control fishing mortality in recreational fisheries, managers use tools that include open and closed seasons, size limits, possession limits, season closures, and non-retention policies. However, the success of these management restrictions is dependent upon the survival rate of released fish.

A Discard Dilemma

Red snapper are caught incidentally when anglers target other reef species in the snapper grouper complex that live in the same habitat, such as black sea bass, various species of grouper, scup, trigger fish and vermillion snapper (Coleman et al 2000; Snapper Grouper Complex n.d.). Unfortunately, red snapper cannot legally be retained and many of them do not survive capture and release. The probability of a released or discarded fish experiencing mortality is referred to as release or discard mortality (NOAA 2006). Deep dwelling reef species such as red snapper and grouper are particularly vulnerable to barotrauma contributing to high rates of discard mortality (Burns & Restrepo 2002). Barotrauma is a pressure-induced depth condition caused when a fish is brought to the surface from deep depths (Carlson 2012). As the fish ascends from depth, gas expands in the swim bladder as the pressure decreases. This expansion of the swim bladder often results in ruptured swim bladders, emboli (blood clots or bubbles in the blood), bulging of fish's eyes, or protrusion of the intestines (Burns & Restrepo 2002). If these symptoms are not relieved, this condition often results in delayed or immediate mortality (Carlson 2012).

South Atlantic Red Snapper Management

Managing the overfished red snapper stock is complicated as many factors must be accounted for and legal requirements met. Some of these factors and requirements include: addressing overfishing while accounting for discarded fish, managing a single species in a multispecies complex, and meeting legal management requirements of an overfished stock. To address overfishing and potentially allow for limited harvest of the red snapper stock, in September 2012 the South Atlantic Fishery Management Council

approved Amendment 28 to the Fishery Management Plan for the Snapper-Grouper Fishery of the South Atlantic Region (SAFMC 2013). The amendment created a process to determine if a red snapper season would occur the following year based on total removals, defined as landings plus dead discards (SAFMC 2013). The Amendment specified that if the total removals were higher than the acceptable biological catch (ABC), an allotted amount specified through the council process, the fishery would be closed for the following season (SAFMC 2013). In 2015, despite the red snapper season being closed, discards by fishermen targeting other species exceeded the ABC. As a result the red snapper fishery remained closed in 2016 [figure 1]. A similar set of events occurred in 2014 and 2015, respectively.

Year	2014	2015	2016
Season Status	9 day mini season	Closed	Closed
Acceptable Biological Catch (# of fish)	106,000	114,000	
Dead Discards (# of fish)	205,859	273,879	

Table 1: ABC and dead discards for 2014, 2015, and 2016 (SAFMC 2017).

In the South Atlantic snapper grouper fishery, the combination of regulatory discards of red snapper and high discard mortality rates has contributed to overfishing and sustained fishery closures. Amendment 43, currently under development, will consider actions to address overfishing and recreational reporting in the South Atlantic red snapper fishery (SAFMC 2017). As part of Amendment 43, the South Atlantic Fishery Management Council is considering actions to reduce the number of discards and improve the survival of released red snapper (SAFMC 2017).

Descending and Recompression Devices

Descending or recompression devices could possibly improve the survival of red snapper discards. A descending device is a non-invasive tool used by anglers that can reduce the



effects of barotrauma by descending a fish to or near the original capture depth. This practice ultimately reduces discard mortality rates induced by barotrauma and increases the fish's survival. Descending devices can range from simple inexpensive weighted hooks, to upside down milk crates, to more expensive devices such as the SeaQualizer [Figure 2]. (Drumhiller et al., 2014)

Figure 2: An array of descending devices is shown. Adapted from "How to Release a Bottom Fish Right," by S. Hudson, 2015, retrieved from <http://www.sportfishingmag.com/fish-descender-devices-release-fishing#page-12>

Descending devices could potentially lower the amount of discards and improve the survival of released red snapper. Lowering the discard mortality rate could potentially reduce dead discards, keeping total removals below the ABC. This could potentially led to the opening of the red snapper season.

There are examples where the use of descending devices to lower discard mortality rates has been successful. On the Pacific coast, three species of rockfish – canary (*Sebastes pinniger*), cowcod (*Sebastes levis*), and yelloweye (*Sebastes ruberrimus*) - were constraining the recreational fishery due to their overfishing and non-retention statuses (GMT 2012). Recreational fishermen could no longer avoid these overfished species and exceeded harvest guidelines due to high discards mortality rates. In order to address these

overfished species, the Pacific Fishery Management Council, which manages federal waters from the northern coast of Washington down to the California - Mexican border, implemented large area closures closed to all fishing, to avoid any of these fish from being caught and discarded. Recreational anglers began to use descending devices to promote the survivability of these three species. A few years later the Pacific Council started accounting for use of descending devices by anglers through lowered the discard mortality rates to account for increased survivability. Accounting for the use of descending devices through management lowered discard mortality rates and ultimately led to more opportunities for recreational fishermen.

Study Objectives

This study assesses and analyzes the challenges and opportunities associated with the potential use of descending devices in the South Atlantic red snapper fishery.

Specifically, the study has the following objectives:

- 1) Assess management needs, interests, and questions with regards to descending devices,
- 2) Characterize the implementation of descending devices in the recreational Pacific groundfish fishery, focusing on canary, cowcod, and yelloweye rockfish species,
- 3) Evaluate the possibility of implementation of descending devices in the South Atlantic red snapper fishery,
- 4) Identify opportunities and challenges to successfully implementing and adopting descending devices in other regions.

To meet these objectives, information was obtained from various sources: South Atlantic Fishery Management Council staff, fishery biologists working with the snapper grouper complex, descending device researchers; North Carolina Sea Grant Staff developing

recompression tools and the scientific literature. To characterize the implementation of descending devices in the recreational Pacific groundfish fishery information was collected from sources. These included individuals who were Pacific Council members, participants of the science and statistical committee, members of the groundfish management team, during the process of descending device implementation. Information was also gathered from public Pacific Fishery Management Council reports.

Background

1. Legal Framework

The 1976 Magnuson-Stevens Fishery Conservation and Management Act (MSA) purpose is to promote and conserve the fishery resources of the United States through management principles, and to establish regional fishery management councils (16 U.S.C. 1801 § 2(b)). The Act established eight fishery management councils, made up of members that represent coastal states and fishery stakeholders, to manage fisheries 3-200 miles off shore. Councils are responsible for developing and revising fishery management plans (FMPs). FMPs, amendments, and regulations must be consistent with the National Standards, a set of ten statutory principles for conservation and management. To ensure consistency of the National Standards, each National Standard contains guidelines that provide regulatory guidance for developing FMPs (16 U.S.C. 1851 § 301(a)(2007)).

National Standard 1 of the MSA states, “Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the United States fishing industry” (16 U.S.C. 1851§ 301(1)(2007)). The reauthorization of the MSA in 2006 resulted in new requirements to prevent and end overfishing through the use of “annual catch limits” (ACLs), and “measures to ensure accountability” (AMs) (16 U.S.C. 1853§ 303(15)(2007)). NOAA Fisheries revised National Standard 1 guidelines in 2009 to address these new requirements.

Annual Catch Limits

The MSA states that fishery management plans shall “establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability” (16 U.S.C. 1853§ 303(15)(2007)). ACLs cannot exceed a Council’s Scientific and Statistical Committee’s (SSC) fishing level recommendation referred to as the acceptable biological catch (ABC) (16 U.S.C. 1852 § 302(h)(6)). The ABC is set at or below the over fishing limit (OFL), in order to account for scientific uncertainty. ACLs are set at or below the ABC to account for

management uncertainty. Overfishing occurs when the annual catch exceeds the OFL. The relationship between these limits is depicted in Figure 3.

Accountability Measures (AMs)

Accountability measures are management strategies that prevent the ACL from being exceeded. Examples of AMs that prevent ACLs from being exceeded include in season measures, gear restrictions, catch limits, or seasonal closures (16 U.S.C. 1853§ 303(15)(2007)).

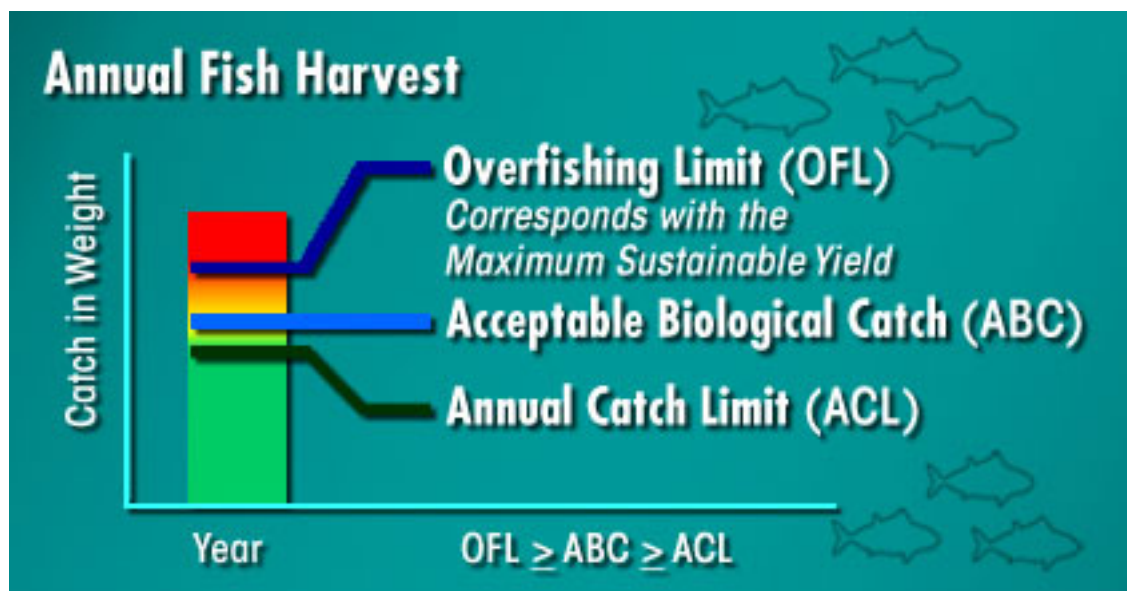


Figure 3: A visualization of limits and their relativity. Reprinted from “NOAA Fisheries,” retrieved from http://www.fpir.noaa.gov/SFD/SFD_regs_acls.html

Rebuilding timelines

As mandated by the reauthorization act, if a stock is determined to be “overfished” or “approaching overfished” within two years councils must implement and prepare management measures to immediately end overfishing and rebuild affected stocks (16 U.S.C. 1854 § 304(e)(2007)). The reauthorization placed further restrictions on the duration of rebuilding timelines by mandating affected stocks be rebuilt, “as quickly as possible” and rebuilding must “not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an

international agreement in which the United States participates dictate otherwise... ” (16 U.S.C. 1853 § 303 note (104)(b)(2007)).

2. South Atlantic Red Snapper

The South Atlantic Fishery Management Council takes the necessary measures to manage the red snapper stock at a sustainable status and provide fishing opportunities for recreational and commercial anglers. This is a challenge due to several factors including the current management of the stock, the rebuilding and increase in population of the stock, limited recreational surveys, and uncertainty in the amount of discards and estimating discard mortality.

2.1 South Atlantic Red Snapper Management

Amendment 17 - Moratorium and big area closure

In July 2008, the South Atlantic red snapper stock was determined to be overfished and experiencing overfishing (SEDAR 15 2008). Amendment 17A to the snapper-grouper FMP (2010) was adopted to rebuild and end overfishing of South Atlantic red snapper (SAFMC 2010). Amendment 17A established a rebuilding plan and measures to end overfishing, including a prohibition on harvest and retention of red snapper and an extensive area closure (SAFMC 2010).

Amendment 28 – Process to determine season and limited harvest

In September 2012, the South Atlantic Fishery Management Council approved Amendment 28 to create a process to determine if a red snapper season would occur and, if so, a process to determine the amount of harvest (SAFMC 2013). The amendment included three measures (SAFMC 2013):

- 1) A process to determine if a red snapper fishing season will occur each year, which would include specification of the allowable harvest and season lengths for the commercial and recreational sectors.
- 2) An equation to determine the annual catch limit (ACL) amount for each sector.
- 3) Management measures if fishing is allowed.

Below in figure 4 is the formula specified by Amendment 28. If the total removals are greater than the ABC specified by the Council’s SSC then the ACL is equal to zero for the following fishing season, meaning no open season for red snapper (SAFMC 2013).

$$\text{If total removals}_{yr-1} > ABC_{yr-1}, \text{ then } ACL_{yr} = 0 \tag{1}$$

$$\text{If total removals}_{yr-1} < ABC_{yr-1}, \text{ then} \tag{2}$$

$$ACL_{yr} = \left(\frac{ABC_{yr-2} - estCSR_{yr-2}}{ABC_{yr-2}} + \frac{ABC_{yr-1} - estCSR_{yr-1}}{ABC_{yr-1}} \right) / 2 \times ABC_{yr}$$

Figure 4: The equation to determine a season, and how to determine the limits for a season (SAFMC 2013).

There have been mini seasons ranging from three to nine days in 2012-2014, however the fishery has been closed since 2015 (SEDAR 41 2016).

2.2 Stock Status and Population

In the last stock assessment, completed in 2016, the red snapper was determined to be overfished and overfishing was still occurring (SEDAR 41). The population of red snapper has increased from 318,000 fish (1991) to over a million fish (2014) (Figure 5). Large recruitment classes from 2006-2008 and in 2014 contributed to the growth in the population (SAFMC 2017).

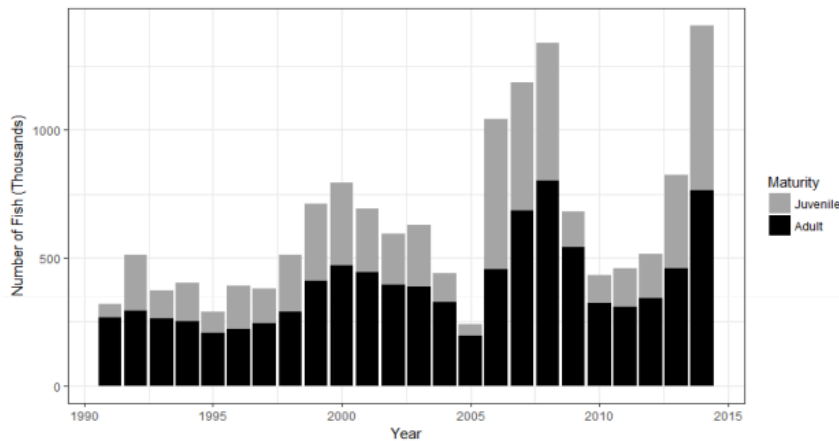


Figure 5: Number of fish of juvenile and adult red snapper from 1991 to 2015. Reprinted from “Amendment 43 Scoping Document,” SAFMC, 2017, retrieved from https://safmc.net/download/Amendment43_ScopingDoc.pdf

Even though the biomass of red snapper is increasing, the stock is still overfished. To be considered rebuilt, the spawning stock biomass, the amount of fish in a stock that are old enough to reproduce, must reach 30%. Currently the spawning stock biomass is only at 20% of what it needs to be in order to be considered rebuilt [Figure 6].

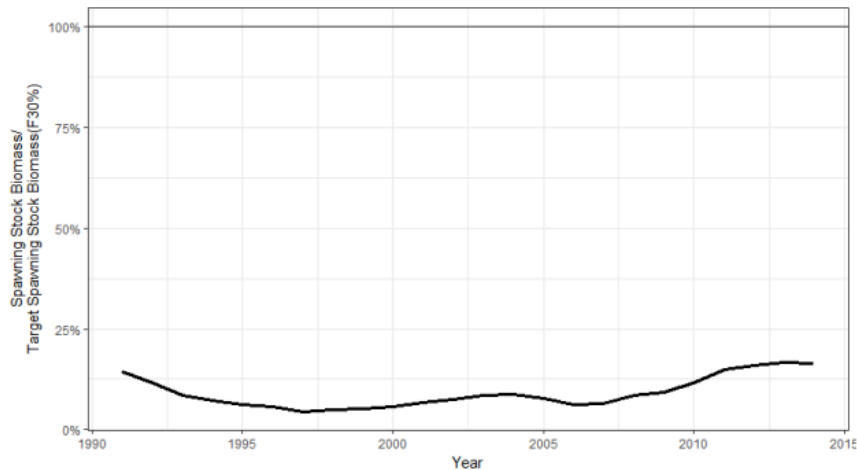


Figure 6: The ratio of annual spawning stock biomass compared to 30% of spawning stock biomass which corresponds in the figure to 100%, or the point at which the stock will be no longer considered overfished. Reprinted from “Amendment 43 Scoping Document,” SAFMC, 2017, retrieved from https://safmc.net/download/Amendment43_ScopingDoc.pdf

However, with the increase in the South Atlantic red snapper population, fishermen are accidentally catching red snapper while targeting other species (SAFMC 2010). It is important to ensure the survival of young and the sexually mature red snapper to allow the population to continue to increase (SAFMC 2017).

2.3 Discard Mortality

Mortality discards of South Atlantic red snapper range from 1%-93% according to reports in SEDAR 24 (2010). This large range is due to several factors including various fishing techniques, handling times, improper venting techniques, capture depths and thus incidences barotrauma (SEDAR 24 2010). Discard mortality estimates were developed from a Burns et al. (2002) depth related discard mortality model (SEDAR 15 2009). Annual rates are calculated by multiplying the model discard mortality rate by total discards from each fishery fleet (SEDAR 24 2010). This can be seen in Table 2.

2.4 Data Reporting

To be in compliance with MSA, in order to end overfishing the total removals, landings and dead discards of red snapper must be less than 100,000 fish per year and as low as 20,000 fish. For reference, there were between 200,000-300,000 removals in 2014 and 2015 (SAFMC). Since a potential season is based on the number of removals, it is important that the numbers of discards are accurate. After each trip commercial and recreational headboats are required to report catch and effort. The proposed For-Hire Electronic Reporting Amendment would require weekly electronic reporting by charter boats (SAFMC 2017). Currently, no electronic or mandatory reporting of catch and effort is required for recreational charter boat and private recreational anglers (SAFMC, 2017).

Recreational data is estimated through the Marine Recreational Information Program (MRIP). MRIP is a program through NOAA that provides estimates on catch per unit effort, landings and discards, and total effort (NOAA n.d.). These are estimated for two six-month periods, or waves, of each year (NOAA n.d.). Estimates on catch and effort are acquired through survey methods that include dockside interviews and mail surveys. As seen in table 2, most recreational private boats have the highest amount of discards at 470,487 fish and dead discards at 183,490 fish (SFSC 2016).

Sector	Landings (numbers)	Landings (whole pounds)	Discards (numbers)	Dead Discards (numbers)	Total Removals (numbers)
Commercial	557	3,162	47,453	22,777	23,334
Recreational Headboat	750	4,010	54,405	22,306	23,056
Recreational Charter Boat	904	10,035	110,503	45,306	46,210
Recreational Private Boat	639	5,452	470,487	183,490	184,129
Total	2,850	22,659	682,848	273,879	276,729

Table 2: Landings, discards, and total removals of the red snapper fishery in 2015. Reprinted from “Total Removals of Red Snapper (*Lutjanus campechanus*) in 2015 from the U.S. South Atlantic,” 2016, retrieved from http://sero.nmfs.noaa.gov/sustainable_fisheries/s_atl/sg/2016/red_snapper/documents/pdfs/red_snapper_total_removals_2015.pdf

Methods

Semi-structured interviews were conducted with fishery specialists, fishery scientists, and fishery managers. A snowball sampling method was used to identify individuals for interviews. In the Pacific, individuals identified others who had worked with or on the Pacific Fishery Management Council during the process in which attempts were made to account for descending devices in order to lower discard mortality rates. These included members of the groundfish management team (GMT) who developed appropriate discard mortality rates that accounted for use of descending devices by anglers, individuals who were members of the Pacific Council, members of the SSC, and members of the ground fish advisory committee. Individuals in the South Atlantic included those who work for the South Atlantic Fishery Management council or with descending devices in the South Atlantic. Participants were contacted via email with a description of the project purpose and objectives and invited to participate as an interview participant. Semi-structured interviews were conducted via phone, Skype, or in person depending on the participant's preference. Interviews ranged in time from 30 minutes to an hour in length.

Interviews began with a brief introduction of the project purpose and objectives, a description of the interviewee, and explanation of the interviewees' confidentiality rights. Interviews were based around central questions developed from objectives (1) and (3) (see appendix A). Based on the semi-structured nature of the interview, modifications were made based on the conversation and interviewee area of expertise. This allowed for more in depth conversation on certain topics. Interviews also varied based upon region. Since the Pacific had already accounted for the use of descending devices, individuals from the Pacific were first asked questions about the process, timeline, and events leading to the implementation. These questions were followed with questions that paralleled interviews in the South Atlantic. The questions included questions regarding challenges, opportunities, drivers, and incentives for the use of descending devices. At the end of each interview respondents were given the opportunity to add additional comments or topics they felt were relevant but not covered in the interview.

In total 7 interviews were completed for the South Atlantic and 7 interviews were completed for the Pacific. With permission, all 14 interviews were recorded and transcribed. Semi-structured interview transcripts were analyzed for reoccurring themes and patterns and other considerations and emerging ideas. Comparisons of themes from case studies we analyzed. After analyzing case studies, considerations were developed for the use of descending devices in the South Atlantic red snapper fishery.

Results

Results are presented in three parts. Part 1 describes the process and timeline of Pacific implementation of descending devices. Part 2 presents the results of Pacific semi-structured interviews categorized based on common themes. Part 3 presents results of South Atlantic semi-structured interviews also categorized based on common themes.

Part 1. Pacific Implementation of Descending Devices

1. Timeline

The fisheries in the Pacific and South Atlantic region exhibit complementary characteristics and situational similarities. The three species of rockfish in the Pacific and red snapper in the South Atlantic are all long-lived, deep-dwelling fish, vulnerable to barotrauma and, as a result, experience high discard mortality rates. Anglers in the Pacific, similar to fishermen in the South Atlantic, experienced incidental catch of the overfished species when targeting other fish. Anglers tried to avoid these overfished species altogether. Pacific anglers were at a point where they could no longer avoid incidental catch of the overfished stocks. The high discards led to the Pacific Council implementing large area closures in order to avoid any discards. Pacific recreational anglers motivated to return to their original fishing grounds and avoid further regulations began to use descending devices voluntarily to increase the survival of discarded fish.

The timeline of accounting for the use of descending devices by adopting lower depth based mortality rates for the recreational rod-and-reel fishery discards of cowcod, canary, and yelloweye rockfish is explained below. This timeline was constructed from interviewee accounts and from Pacific Fishery Management Council documented reports and decisions displayed in table 3. Interviewees described important events that took place before and outside of the council process. These events are described below as

early interest in descending devices and events that took place outside of the council process.

Early Interest in Descending Devices

In 2004, a recreational Rock Fish Fishery on the west coast and the descending device company SeaQualizer developed a “Deep Water SeaQualizer” for deep-water rockfish release. The recreational fishery was facing deep-water closures and constrained in the areas in which they could fish. The fish that were constraining were the overfished rockfish species of canary, cowcod, and yelloweye rockfish. In 2007, by way of outreach, state fish and wildlife departments as well as Sea Grant agencies promoted the use of DD as a best release fishing practice. In 2008 there was a comprehensive review of how states (California, Washington, and Oregon) estimated discard mortality rates. In 2011 National Marine Fisheries Services (NMFS) began a push to start looking at ways to reduce discard mortality. Conferences were held on the East coast to discuss how to reduce discard mortality and the potential use of descending devices. Additionally at this time the SeaQualizer won first runner up in WWF International Smart Gear Competition, further validating its use as a best practice for releasing bottom dwelling fish.

Timeline of Council Process Events to Lower Discard Mortality

The sequence of events that took place within the council process in order to develop a rule that lowers discard mortality rate by accounting for the use of descending devices is shown in the table below.

<u>Date</u>	<u>Pacific Fishery Management Council Process</u>
June 2012	<ul style="list-style-type: none"> • First motion to consider accounting for the use of descending devices to lower discard mortality rate for canary, cowcod, and yelloweye. • Council tasks GMT to develop a report on lowering the discard mortality rate from 100% at surface release for cowcod, yelloweye, and canary fish by accounting for the use of descending devices in the recreational rod-and-reel fishery. (GMT June 2012)
November 2012	<ul style="list-style-type: none"> • GMT Progress Report “Developing Mortality Rates for Rockfish Released Using Descending Devices.” • GMT reviewed progress report with SSC. • GMT briefed Council and Groundfish Advisory Subpanel (GAP) on progress report. (GMT Nov 2012)
April 2013	<ul style="list-style-type: none"> • GMT creates rates with buffers against uncertainties included for short and long term mortalities. • Confidence intervals account for management uncertainties. • GMT recommends Council to approve rates and select mortality estimates that incorporates confidence interval (GMT 2013). • States propose methods for accounting for anglers using descending devices for review. (Supplemental ODFW, WDFW, CDFW reports) • “The Council adopted depth-based mortality rates for cowcod, canary, and yelloweye rockfish associated with the use of descending devices as recommended by the Groundfish Management Team (GMT) with some minor changes. The Council tasked the Scientific and Statistical Committee (SSC) and GMT to do further work refining these mortality rates for further consideration at a future Council meeting.” (PFMC 2013)
March 2014	<ul style="list-style-type: none"> • Council adopted new depth-based mortality rates for cowcod, canary rockfish, and yelloweye rockfish discarded in the recreational fisheries using descending devices. Rates based in upper 90% confidence intervals. (GMT 2014)

Table 3: Summary of Pacific Council actions and decisions.

Events outside of Council Process

Interviewees described other events that occurred during the Council processes.

Specifically participants described ongoing research at Universities to collect more data for larger sample sizes in order to make the confidence intervals tighter. Creating larger

sample sizes also increased accuracy in the survival rates of descended fish. Participants also described several meetings and reviews with the science and statistical committee (SSC). After the Council approved the discard mortality rates, the states were able to implement rates on their own timeline once they had an accurate understanding of what was happening in their state. When the rates were approved by the Council states were all at different stages. California had not been asking about descending device use, Washington had just started, and Oregon had been asking about depth of capture since 2009 and started asking about use of descending devices in 2013. Once states had a proper understanding of what was happening with regards to descending device use rates, they incorporated descending devices into management and lowered discard mortality rate.

2. Outreach by Pacific States

The importance of outreach was mentioned by all Pacific interviewees as a major contributor to successful stakeholder utilization of descending devices and therefore decreased discard mortality. The strategy for each state's outreach plan, along with comments from those associated with implementing and conducting outreach in those states is provided in this section.

California

Descending and recompression device outreach began earlier in California than in Oregon and Washington. Descending fish was promoted as a best fishing practice. In 2007 California Sea Grant and the California Department of Fish and Wildlife (CDFW) made a brochure called, "Bring That Rockfish Down." The brochure included information about the benefits and process for properly descending a fish. The brochure was distributed and mailed out in bulk to organizations that distribute fishing licenses such as harbormasters, license vendors, and bait and tackle shops. Recreational survey samplers were also given the brochure to distribute to anglers. When a groundfish management area was opened to fishing, samplers were there to engage with anglers on opening day to hand out brochures and, sometimes, descending devices themselves. The brochure was also translated into other languages to accommodate for the Hispanic,

Vietnamese, and Chinese populations. In addition to outreach in the field, staff from CDFW worked with fishing organizations including Coastside Fishing Club, Humboldt Tuna Club, and party boat associations such as the Sportfishing Association of California. Staff provided clubs with web links and other educational materials in order to make information accessible to groups. CDs were made for headboat captains to show anglers how to descend fish on trips. Many of the clubs and organizations purchased descending devices to give to club members and anglers (California outreach participant, personal communication, March 13, 2017).

Washington

California Sea Grant and CDFW shared the original “Bring That Rockfish Down” brochure and allowed other states to adapt it. The Pacific States Marine Fisheries Commission, which provides a state coordination role, provided financial support and purchased descending devices. Washington Department of Fish and Wildlife (WDFW) staff was able to hand out descending devices at meetings with fishing clubs and associations. Similar to California, for opening days in Washington the WDFW staff and recreational surveyors were present at major ports with recompression information to pass out to anglers. Staff from the WDFW set up meetings with fishing associations chapters in Washington State in order to educate clubs about the effectiveness of descending devices and their benefits. Information was also distributed at sportsman hunting and fishing shows in order to engage with stakeholders. Meetings with charter boat associations were also conducted. At these meetings the range of descending device options were presented. Some clubs took the information provided to them and created their own outreach materials. Additionally, Washington’s outreach campaign expanded to include the distribution of fish ID cards. This was done to ensure anglers correctly identified species in order to appropriately report species to recreational survey samplers (Washington outreach participant, personal communication, March 15, 2017).

Oregon

Starting in 2011, any public meeting involving Oregon Department of Fish and Wildlife (ODFW) descending devices and plush toys were brought to demonstrate how to use the

devices and explain their benefits. In 2012 ODFW worked with an angler education group called Oregon Coalition for Educating ANglers (OCEAN). OCEAN and ODFW worked together and got a grant to purchase a bunch of descending devices. ODFW did a dedicated mailing to any registered vessel owner whose vessel had been interviewed marine fishing in the last two years. In total around 5,000 devices were mailed out. ODFW obtained more descending devices and gave them to all registered charter vessels in Oregon as well as commercial near shore permit holders. As the yelloweye impacts continue to become more constraining and descending devices more known, several angler groups are conducting their own outreach campaigns and also distributing descending devices. Hogle Zoo in Salt Lake City, Utah even helped out. The Zoo developed a new Pacific Coast fish exhibit, and as part of every exhibit they must also complete conservation work on the species exhibited. As part of this conservation work they purchased several descending devices for anglers. Additionally, the Zoo helped provide outreach materials, specifically an eye-catching flyer about rockfish release.

Pacific states have also been receiving grants through the National Marine Fisheries Service. They were able to purchase many descending devices and pass them out to the different states. Since 2010, ODFW distributed over 15,000 recompression devices to anglers. Distributing devices was an important aspect, but ODFW also made informative videos on how to use the different descending devices. ODFW created a webpage with content on recompression and descending devices. The web page includes the biology and physiology behind how the devices work. Additionally ODFW created a flyer on how anglers can make their own descending devices from modified plastic vice grips. After the mail out, campaigns usage rates went from 35% to over 70%. Anytime there is a big educational or outreach push, there seems to be a bump up in usage and then last spring in 2016 the rates dropped down again. Oregon fisheries experienced problems with yelloweye and had to take some fisheries restrictions. Consequently there was a large outreach push before summer halibut opener and then rates were back up at around 65-70%. (Oregon outreach participant, personal communication, April 12, 2017).

Part 2. Pacific Themes and Patterns

Participants in the Pacific were asked questions pertaining to the timeline of events as presented in Part 1 and questions related to challenges of descending device implementation, opportunities and outcomes descending devices achieved, and main drivers that contributed to accounting for the use of descending devices by lowering discard mortality rates. Interviewees responses were organized based on common themes and patterns across interviews. Themes identified in the Pacific included drivers to use descending devices, challenges in the council process and determining descending device user rates, contributors for success of both utilization and developing effective mortality rates, and perceived outcomes the use of descending devices achieved. While interviewees discussed the process and procedure of determining how to adjust mortality rates to account for descending devices in management, their responses focused more on drivers and contributors to success outside of the council and management process.

While many themes discussed by participants overlapped, themes are organized here to provide and generate insight for fisheries managers considering requiring or lowering discard mortality rates to account for descending devices. In presenting these findings, a brief analysis of the theme and response is followed with representative quotes from interviews.

1 Avoidance and best practice

While all respondents indicated descending devices should be used as a best practice, most respondents pointed out that the best practice before descending fish should be to avoid the overfished or constraining species in the first place. Participants commented that anglers started using descending devices because they could no longer avoid the species of fish that were constraining the fishery.

2 Drivers and incentives for adopting the use of descending devices

Several participants discussed drivers, feelings or events that contributed to the use of descending devices by anglers. These included frustrations felt by fishermen in regards to

regulations, the perceived waste of fish caused by regulatory discards, making the use of descending devices a voluntary best practice versus a mandatory requirement, and the potential for use of descending devices to affect regulations and create fishing opportunities.

2.1 Fishermen's frustration with regulations

All interviewees noted the frustration of recreational fishermen with regards to regulations as a main driver. Recreational anglers were facing closures, shorter seasons, and coming close or exceeding harvest guidelines. As recreational fishermen experienced more restrictions through regulations, the initiative and drive to address the restrictions grew.

“When we exceeded the harvest guideline for yelloweye we had to close our fishery for bottom fish and that was devastating to fishermen, it was extremely hard on our coastal communities.”

“There was a lot of ground roots and ground swell of need based we need to do something, we need to do this to get our fishing back.”

2.2 Angler ethics and perceived waste of discarded fish

In addition to closures and shorter seasons, participants described the frustration of fishermen perceiving regulatory discards as a wasted resource. It is frustrating to fishermen to throw a fish overboard that they knew would not survive.

“We hear it all the time from people you know, ‘why can't we keep canary rockfish. We throw them back and they float away on the surface, and the seagulls poke their eyes out’ ... They are disappointed and it affects their experience and it takes some of the joy out their trip.”

“They hate throwing these fish back and seeing them float away. That is not something that fishermen like seeing, they hate seeing that, they hate seeing the waste.”

2.3 Use of descending devices as a voluntary best practice vs. mandatory

Several participants discussed the benefits of accounting for angler use of descending devices in order to lower discard mortality rates versus a mandatory regulation.

Accounting for the use of descending devices to lower discard mortality rates rather than mandating their use, served as a driver for anglers to descend fish. There was also concern if use was made mandatory, fishermen participating in dockside surveys might over report their use of descending devices. Additionally, if made into a regulation, a hardened, consistent definition of descending devices and its proper use would need to be made clear. This would create a new challenge given the wide variety of techniques and units available. However, some participants noted during outreach activities several anglers expressed their desire for the use of descending devices to be a mandatory rule.

“We kind of decided to make it work with the fishing community in order to get them to use them voluntarily and have more accurate information on the frequency of use.”

“There was a lot of folks saying, ‘you need to make this a rule right away. Make it mandatory.’ Our approach was really voluntary for a couple of years as we did this outreach.”

“It was hard to get compliance in the beginning, because they weren't counting the use of descending devices to reduce the mortality, it became extremely difficult... when the change in the mortality came to the council then the fishermen were told, ‘if you do this, then we are working now on getting you credit for doing it’ and that changed the whole thing... like a lot of people, they were looking for a return on investment.”

2.4 Descending device use as incentive to increase recreational fishing opportunities

Interviewees described accounting for the use of descending devices as a way to increase fishing opportunities as an incentive tool during outreach programs. Since anglers were close to or exceeding harvest limits, any reduction in discard mortality could potentially allow for longer seasons prevent further closures. During outreach programs, the use of

descending devices in order to lower discard mortality rates to allow for increased fishing opportunities was promoted as an incentive for use.

“Coincidentally at the same time as we were doing this in Washington, we exceeded our recreational harvest guideline for yelloweye. I kept my [outreach] presentations focused on this is going to give us a little bit of cushion...From a policy point of view, I presented it as for now, as we are getting started until we know more about how people are using them or not, this is really just going to save us from this potential emergency closure if we are up against are harvest guideline again.”

“I think it is really important to sell the use of descending devices to anglers as -- helping rebuild these fish is important, conserving every fish is important, but really what I have tried to press upon them is do this for your own selfish reasons. Do this because you want to potentially have greater fishing opportunity.”

3 Challenges in council process and determining descending device user rates

Most of the challenges identified by interviewees were associated with the council process, such as the science and statistical committee review, and the processes of obtaining scientific and user rates.

3.1 Limited scientific data and information on user rates

During the process of accounting for descending devices in the Pacific, respondents indicated limited science and data, in addition to limited information in order to understand and acquire user rates of descending devices by anglers as major challenges.

3.1.1 Device utilization monitoring and accountability

Interviewees discussed the challenges associated with several data gaps. These included data gaps within the recreational fishing survey data and lack of scientific information. Gaps in recreational fishing survey data included rates of anglers using descending devices, if devices were being used properly, the depth at which anglers were

encountering overfished species, and which were being discarded and descended with devices. Interviewees discussed the lack of scientific information regarding research on descending devices increasing rockfish survivability as a major challenge.

“This was a recreational driven initiative. Within the recreational fishing data it is always difficult to acquire. In large part it is because it is collected on the dock as we come back and it is self reporting.”

“The first problem is how do you know who is actually using the descending device and how do you know they are not just saying they are using it, and how do you know they are using it well?”

“The biggest stumbling blocks were trying to identify information that we could use in that ad hoc fashion in order to develop mortality rates that were representative.”

“First of all the data sources available on survivability on rockfish that undergo barotrauma was pretty limited.”

However, while most respondents indicated a lack of information, some respondents noted that more information was available than they had originally perceived.

3.1.2 Acquiring information for accurate representation of use

In order for user rates to accurately reflect what was happening in the field, dockside surveys conducted to understand catch and effort rates were modified to ask anglers for which species and at what depth a descending device was used. However, as several interviewees noted, fisheries surveyors are busy and usually need to ask anglers several questions. Several interviewees mentioned it was a challenge to ask surveyors to make descending device questions a priority.

“...Our samplers are extremely busy they ask anglers a lot of questions, they have a high sampling rate, which we are supportive of maintaining, so it was asking a lot to ask them to add another question to their survey.”

“Sometimes those samplers are really, really busy and there are competing priorities...”

“The council process moves pretty slowly even if you have a priority. Like I said we had plenty of other things that were important here as well.”

3.2 Council process

One of the main challenges described by participants was council process. The concept of accounting for descending devices in order to lower discard mortality rate was new council territory, which led to reluctance from some council members and required intense review by the SSC. Additionally, making the use of descending devices a priority was difficult as the Council had several other items that needed to be addressed.

3.2.1 New council territory

Interviewees described the council process, specifically the review by the Science and Statistical Committee (SSC) challenging and demanding. The SSC is a group of scientists that review stock assessments, FMPs, or other documents to ensure the fishery management councils are making decisions on the best available science as mandated in National Standard 2 (PFMC 2017). If documents or FMPs are approved by the SSC, they do not move forward in the council process. There were several meetings between the SSC and GMT to ensure rates appropriately reflected user rates and the scientific literature. Interviewees also discussed the conservative nature of the council members since this was a new concept to the Council.

“NMFS [National Marine Fisheries Service] were more skeptical than others in the community about this. We [NMFS] did push back pretty hard and asked for scientific review both by the fisheries science center as well as the council's SSC.”

“So that was an easy thing to identify, that we needed to focus on these fish [canary, cowcod, and yelloweye] that were constraining the fishery here. Getting the scientific community to move in that direction was harder.”

“It was kind of a new thing, and the Pacific council is fairly conservative with regard to accepting total mortality.”

“It doesn't come without a cost and it doesn't come without some hurdles and some work to surmount those hurdles, so yes there definitely were some challenges there. But none that were necessarily insurmountable if the interest is there and the funding is put in the right places to do those things like the science.”

4 Contributors to Success

Interviewees described contributors to success, as contributors that increased descending device utilization by anglers, and events that contributed to the Council deciding to account for descending devices to lower discard mortality rates.

4.1 Contributors to success in council process

Participants described the intense review of the SSC, identifying and utilizing available science, and leadership and leadership as important factors contributing to the Council deciding to account for the use of descending devices in management.

4.1.1 Intense review of the SSC

While all respondents described the challenge of the SSC process, interviewees noted the rigorous review process contributed to council's justification for agreeing to account for the use of descending devices in setting discard mortality rates.

“Jumping through the hoops with the science and statistical committee was not easy. You know having a full vetting of all of the uncertainties and a reasonable conversation about that went a long way to addressing their concerns and then having buffering through the use of the upper 90% confidence interval.”

Another interviewee, who was sitting on the council stated,

“I in particular was very skeptical and I think at the beginning I was telling my staff ‘I don't see how we could ever do this, ever provide any kind of credit,’ but I will say, as we went forward and I learned more about the scientific information

that underpinned this, I was more and more comfortable to have some sort of credit.”

4.1.2 Identifying and utilizing available scientific research

All participants described the importance of using all the science and data available. While lack of information and data was described as a challenge, interviewees found that more information existed than they originally thought.

“...One of the things we got into was we thought there was only a little bit of data and then the more we looked into it the more there was actually little studies here little studies there that were able to be incorporated into the discussion.”

“So we were fortunate that that data was available. That would have been a major stumbling block had that information not been available. The science has to come first. You have to have that information.”

Also discussed by several respondents was the species-specific nature of descending devices, meaning descending devices work well for some species and not for others. Interviewees discussed this and further emphasized the importance of scientific studies specific to the species. Another interviewee described this by comparing the use of descending devices for yelloweye and canary rockfish species.

“Works well in some species and does not work as well in others and you need to incorporate the science specific to the fishery that you are interested in.”

“And it [yelloweye] is only encountered so frequently, so it really not that much of an inconvenience to put one back down using a descending device. But when you have something like a canary rockfish that is more common and more abundant just by virtue of its life history it is found in greater numbers. And it is a schooling fish, so you end up getting into A LOT of them all at once. And it can start to become difficult for the deckhands to use a device to get the fish back down.”

4.1.3 Importance of a champion or leader

It was interesting to discover that several respondents mentioned the importance of a “champion” contributing to efforts to account for the use of descending devices in fisheries management. Respondents placed high importance and emphasis on a leader in achieving success.

“You need a sponsor. Someone who is willing to dedicate him or herself to making this happen. You need an individual sponsor and someone who is willing to say, this is a good idea, I am going to make this happen... That is number one. You need someone willing to dedicate themselves to making it happen.”

“This is how these things have to bubble up to some degree, they have to have a champion within the Council in order to bring it forward... [the chair] to some degree served as a lightning rod in really pushing for this to be a high priority.”

4.2 Contributors to successful utilization of descending devices

Study participants described a “groundswell” or grass movement involving fishing organizations and environmental groups, outreach, and a cultural shift as major contributors to the success of utilization of descending devices.

4.2.1 “Groundswell” movement

All participants discussed accounting for the use of descending devices as a groundswell movement. The coordination of groups, outreach, and availability of devices was mentioned by all interviewee’s contributors to success.

“It was a bottom up movement and I think that is what made it a success was that it was a bottom up process. That was crucial.”

4.2.2 Fishing groups and organizations as part of “groundswell” movement

All study participants considered the role of groups and organizations as a significant factor in of the “groundswell” movement contributing to the successful utilization of descending devices. Groups and organizations frequently discussed were recreational,

charter and party(head) boat associations, fishing clubs and their respective chapters, NGOs, and environmental groups.

“The NGO and environmental groups were with and highly in support of us using them.” “Showing them the different devices that were available I think was helpful so I went to a whole bunch of these chapter meetings and then the chapters have smaller groups.”

4.2.3 Importance of headboats and captains

While the importance of individual clubs and environmental groups were mentioned, most all interviewees discussed the significance of the charter and party boat fleet and their associated groups. These groups were particularly important because they encounter fishermen who do not regularly fish and are not as familiar with regulations or best fishing practices.

“... the charter boat fleets were invaluable in this. The sport fishing association of California, in southern California is a charter boat association and they got onboard from the very beginning and did a lot of outreach to their riders. When they would take a group of guys out for a fishing day, they would start off with ‘we are going to descend fish today. Here is why and here is how.’ They made CDs to educate all the captains. They showed those to their customers as they went in and out.”

4.2.4 Cohesion and collaboration on state and federal levels

Interviewees also talked about the significance of cohesion, the coordination of groups and agencies, for a successful policy change. Participants also discussed the importance of the state agencies working with the federal council.

“...collaborative policy making is the best way to go...”
“Having those [mortality rates] available for the states to implement through their sampling programs on their own timeline, and allowing that process to

happen as appropriate for each state. To let that be done by the states as they worked through it I think was really helpful.”

4.2.5 Outreach and GoPro videos as powerful outreach tools

Respondents indicated outreach and educating anglers on the use of descending devices and policy implications of use was a large contributor in the successful implementation. Interviewees specifically discussed the importance of availability and access to information regarding descending devices.

“The other component was outreach. And educating the public on what is the problem and what can they really do about it.”

“Trying to spread the word and increase the frequency of use because you know if we can account for it then that is great, but if the people aren’t using them then nothing is going to change.”

“So I have often told guys in my outreach activity, ‘look even if 100% of the fish survive, if only 1% of us do it, we won’t move the needle very far. We have to have compliance on this.’ So it was a huge outreach effort to get people interested in doing this.”

The power of videos to incentivize people to use descending devices during outreach events was mentioned by several respondents. Convincing an angler a bloated fish was not a dead fish, and if recompressed had a decent chance of survival was no easy task. Participants all described the importance of GoPro videos allowing anglers to see that the devices worked. Watching a fish survive and swim away after their descent created buy in from anglers.

“The video shows it [the fish] coming up and looking dead, then the video shows it being descended in a cage and swimming off. I think people were pretty impressed by that. And like ‘oh ok, well that fish I threw over that I thought was dead actually swam away.’”

“And then, believe it or not, GoPro had a really big impact on this because the fishermen started putting their GoPros with little housing on the descending devices proving that the fish survived... So after a certain time you know it works, you just don’t know the extent to which it works.”

4.2.6 Availability of descending devices

In addition to outreach and education, respondents discussed the availability of devices as a critical aspect to increase utilization of devices. Providing the information on how to use the devices in addition to the physical devices themselves eliminated the barrier of anglers obtaining or purchasing.

“There has been a lot of grants given to the fishery management commission, the non profits to hand out descending devices. There has been a big push to hand those out at the ports.”

“There were also a lot of efforts on our part, Pacific States Marine Fisheries Commission part and the state to get descending devices in the hands of folks and I think some of the environmental community paid money to get them into the hands of people. If anyone wanted one, they could get one either very cheaply for free.”

4.2.7 Cultural shift through peer pressure

Respondents also discussed a “cultural shift” in the perception and use of descending devices along the Pacific coast. Specifically, respondents explained how peer generated a cultural shift. This was brought up in context with the use of descending devices on headboats. As discussed, if the charter boat does not descend fish, they are vulnerable to bad publicity and public relations.

“... there is cultural imposition, the culture has accepted that descending devices are the right thing to do... and so when they [anglers] go on charters that don't do that [descend fish] it gets spread all over the message boards. So it is bad pr for the charter that doesn't do it. They publicly shame them if they don't do it.”

“... we discussed what the best way to get people to change their behavior and one of the major things that came up, and what we tried to press on our current leaders in the fishery, and the leaders of the fishing clubs, was that this stuff really works from them to their constituency of you know the people they represent, the people they work with in creating a peer pressure, that is what really really push the change to the point where it is a cultural shift. And people say, ‘hey what are you doing over there bob? I see fish floating around your boat man. What are you doing? Use your descending device.’ That is the kind of peer pressure can often tip the scales for those anglers who are more old school or just recalcitrant in their behavior....”

“If some anglers are using them and some aren’t, they are real keen to motor over or call over on the radio if they see a bunch a floaters behind the boat. The anglers are putting pressure on each other.”

5.0 Perceived Outcomes

The perceived outcomes from accounting for the use of descending devices to lower discard mortality rates mentioned by interviewees included perceived measurable benefits and benefits for relationships in fisheries management. It is important to note that these are interviewees’ perceptions of benefits, not necessarily substantiated claims.

5.1 Perceived benefits

Themes discussed in this category include increased fishing opportunities, ecological benefits, improved fishing estimates, and flexibility within management.

5.1.1 Increased fishing opportunities

One respondent who was also an active recreational fisher indicated accounting for descending devices provided increased fishing opportunities. By reducing the discard mortality rates through the use of descending devices, seasons remained open longer, and anglers were able to fish in areas previously closed off to them. In addition to providing opportunities, it also helped avoid further restrictions and regulations.

“It gives commercial and recreational fisheries opportunities to expand so we can fish responsibly for these fish. So lots of good opportunities to get out and recover some of the fisheries that have been lost to us for years and years.”

“They [accounting for descending devices] made it possible to complete an entire season in Oregon anyway without bumping up against the numbers on yelloweye rockfish.”

“And so the states were able to maintain their fisheries without having to shut them down and then not have to get into sticky allocation battles as well.”

5.1.2 Ecological benefits from less fishing pressure

Since the total available fishing areas increased from the opening of previously closed areas, fishing effort could be distributed over a larger area, thus decreasing effort in shallower areas that had historically seen high levels of fishing effort. This allowed shallow species to experience less fishing pressure.

“It is reducing the impact on some of our near shore shallow species. And that is making it easier to craft regulations that are more favorable to fishermen.”

5.1.3 Improved fishing estimates and data on recreational fishery

Interviewees felt that changes to the dockside survey angler questions to obtain information about descending device usage improved fishing estimates. Additionally, by allowing anglers back into previously closed areas managers were able to obtain better estimates of stocks in these areas. Previously when anglers were now allowed in the deep-water area closures, these areas were not included in dockside surveys. Once anglers.

“It has improved our estimate of mortality. I think there is that. Taken some pressure off for yelloweye, knowing that it is there.”

“The fact of the matter is, that it is a better representation of what is actually happening in the field.”

5.1.4 Provided flexibility in management

Some respondents mentioned that accounting for the use of descending devices provided flexibility within management measures such as season closures, bag limits, and area closures.

“You are really affecting the impacts that go toward the estimates that are measured against those limits and potentially allowing for additionally fishing opportunity and reducing your impacts on that end.”

“Having the use of the descending devices, even though it was a very small percentage overall reduction, it helped.”

“It really is just that marginal reduction that you sometimes need in order to extend the season.... When it is the primary portion of the season you are missing, it is going to take you a lot of fish to get over the hump, to the point where you can provide that opportunity again. So depends on where you are in the fishery as well.”

While some respondents claimed the use of descending devices has allowed for flexibility in management, some respondents claimed it was too early to know if that was the case.

“A lot of that still remains to be seen because we have only started accounted for the use of descending devices in 2015, we started that and we are going to be using 2015 and 2016 data in the projections for 2019 and 2020 fisheries.”

5.2 Benefits for relationships in fisheries management

This category describes the perceived positive benefits of improved working relations between anglers and management due to accounting for descending devices in the calculation of discard mortality rates.

5.2.1 Provides a “positive” for fisheries management

The overall process and experience of lowering discard mortality rates to account for descending device use and promoting angler utilization of devices was described as

positive and successful by all participants. Several participants described the experience as both a win for management and for anglers.

“The fact that it had come to the council for consideration made a big difference in the culture of the recreational fishermen.”

“I think it is just good management when you have the management agencies and stakeholders on the same page about something. Then working together to increase awareness I think that is a positive right there.”

“Going to the meetings of the stakeholder groups was really a fun outreach opportunity because it was one of the few things you do where everyone is says, ‘absolutely this is fantastic, and if this is truly the best way this is what we want to do. We love this resource, we love being able to go out there and do it, and if down the road there is a chance for more opportunity or flexibility we are all for it.’”

5.2.2 Provides managers with answers for frustrated fishermen

As noted earlier in this section, one of the drivers of descending device utilization described by interviewees was fisherman’s frustration with regulations. Anglers experienced and expressed frustration of throwing fish overboard knowing it would eventually die after release. Some participants discussed that descending devices are an answer for frustrated fishermen.

“At least nowadays I have a response to those anglers when they are frustrated and I say, ‘Well do you know about descending devices?... I understand your frustration, but use a descending device to get them back down. That way you can keep on fishing and not have to worry about it.’ I think people see that it is the right thing to do and that there isn’t an excuse.”

5.2.3 “Rewards” Fishermen

As noted by some interviewees, accounting for the use of descending devices “rewarded” fishermen for descending fish. Accounting for utilization of descending devices lowered discard mortality rates and allowed fishermen more fishing opportunities.

“They presented their cases very well, so I think this was a win for the fishermen. Their work is being recognized in a management regime and being rewarded with extra availability of fish... it was supported by all the managers, but they started it themselves, and it kind of rewarded them for their hard work and to me that is the biggest thing that came out of here.”

Part 3. South Atlantic Themes and Patterns

Participants in the South Atlantic were asked similar questions to those in the Pacific. These questions included topics on potential benefits and opportunities of descending device use, major challenges associated with requiring or accounting for descending device use, and main drivers to contribute to descending device utilization in the South Atlantic (Appendix A). The responses to these questions resulted in several considerations and questions. Considerations and questions were classified and organized based on themes. Main themes included perceived benefits, potential motivations and incentives for descending device use, considerations for mandating the use of descending devices, and considerations to promote descending device utilization regardless of voluntary or mandatory regulation.

1 Perceived Benefits from the Use of Descending Devices

Perceived benefits or positive consequences from the use of descending devices include positives for management and anglers by potentially avoiding future restrictions and regulations. Participants also discussed ecological benefits for the red snapper and other stocks within the snapper grouper complex.

1.1 Benefits of descending device use to avoid future restrictions

Several interviewees felt that accounting for or mandating the use of descending devices could have the benefits of avoiding area closures, large shut downs and moratoriums, decreased bag limits and other management measures. Additionally there might be fewer regulations in the future if descending devices were accounted for or mandated. Avoiding future regulations and restrictions would be beneficial for both management and anglers.

“It could help avoid closures essentially. They have considered it in the past in terms of depth closures... With implementation of descending devices I think you could help take that off the table. Since you are mitigating that discard mortality.”

“We are hoping it can avoid large scale shut downs.”

One interviewee described a conversation with fishermen who used descending devices who hoped that the use of descending devices would allow fishermen to maintain bag limits.

“This resource savings [by descending devices] would translate. Maybe not necessarily in more fish, but that they wouldn’t reduce the allowable catch. That if they started doing these practices now that the bag limits would be maintained.”

“Well if we can get more to live another day than they will keep our catch amount the same.”

All participants did not explicitly state that red snapper season is warranted, but rather more information is needed to justify a season opening.

1.2 Ecological benefits for red snapper and other stocks in the snapper-grouper complex

All interviewees discussed the potential biological benefits of descending device utilization as improving the health of the red snapper and other stocks in the snapper grouper complex such as scamp, black sea bass, and several grouper species.

“... if this catches on and other people start using them there are plenty of other species that these could benefit such as grouper. [There are] ... other species that can be sent down with these devices that goes beyond the red snapper realm.”

“We hope people would use it for gag [grouper] which aren't doing that great. Hope they would use it for red grouper, scamp, there is indication that those stocks are not doing all that well either.”

2 Potential motivations and incentives for descending device use

The use of descending devices could potentially create both ecological benefits for fish stocks and benefits for management and anglers through fewer restrictions. Either through voluntary or mandated use, interviewees discussed several potential incentives and drivers for descending device utilization by anglers.

2.1 Drivers and incentives for descending device utilization based on angler values and experiences

Commonly discussed by interviewees were potential incentives for angler use of descending devices related to individual angler values and experiences.

2.1.1 Angling ethics and resources savings as incentives for descending device use

Ethical angling, conservation, and potential resource saving were discussed by interviewees as possible incentives for stakeholder utilization. Interviewees felt that anglers, who are conservation minded, want to preserve the resource, and would be more likely to use descending devices. Other interviewees discussed potential resource savings for anglers by increasing the survivability of fish. By returning fish and potentially increasing the population or health of the stocks would be in the interest of the fishermen. Additionally, it was discussed that conservation minded fishermen do not want to see fish float off or become easy prey to a predator.

“...any conservation minded person that understands that these things are effective, that would be all the incentive they needed.”

“They shouldn’t really need any incentive because we know this works, you should do it, it is in your interest.”

“...no one really wants to fish float off. I think folks would be fairly open to it.”

2.1.2 Practice of descending fish allow anglers to experience direct benefits of descending devices

In addition to conservation and ethical angling incentives, participants commented on the practice of descending fish allow anglers to see the direct benefit of descending devices. Unlike a large area closure, which is often perceived as negative by anglers, anglers can experience and contribute to the health of the fish and stock through the practice of descending fish.

“...it is something that individual people can see the benefit of, a lot of times with management you don’t necessarily see the benefit of doing something, but when you are putting a fish back by saving it and putting it back in better condition, the individual can actually see that benefit themselves. A closed season they don’t see the benefit to them they just see the harm.”

2.2 Drivers and incentives for descending device utilization based on fishing sector

While incentives for increased descending device could be influenced by an angler’s ethics or ability to experience the benefits of descending devices, the multiple fishing sectors in the red snapper fishery was discussed as challenge. As participants explained, different sectors have their own stakes and interests in the red snapper fishery. The stakes and interests based on sector influence the buy in and uptake of descending device use.

“Not an easy topic especially when you have several groups involved with their own vested interests. When you have this issue of whether to require or electively use discard promoting survival devices [descending devices] it becomes a contentious issue really fast because everyone has their own terms to protect.”
“I think a commercial guy is driven by something totally different than a charter boat captain and they are driven by something different than a private recreational angler.”

Participants discussed the difference of incentives and possible barriers for descending device use for commercial, headboats, and recreational fishing sectors. Each are divided by sector and discussed below.

2.2.1 Commercial

Interviewees shared different perspectives on commercial fishermen descending device utilization. Some said commercial fishermen would be less likely to use descending devices because they are operating under a profit motive and their time is money. The time they spend descending red snapper is time away from obtaining their targeted catch. In contrast, some interviewees described the use of descending devices would protect commercial fishermen's interests.

“For a commercial guy if it is a 20 lb red snapper and worth 6 dollars a pound, doesn't move much and you can tell him there is a potential season coming up. That is \$120 that he would be protecting for his pocket. If it goes over dead he's guaranteed not to ever land any value for that fish. But if he can be convinced that he can get money out of it he is more willing to take his time to protect it.”

“Not only combining this information from the tagging that we have for survivorship of red snapper it also shows us where the fish go, and typically they don't move that far. So if you protect that fish, most likely you are going to catch that fish again on the same reef. So for him it would be an added benefit.”

2.2.2 Headboats

Headboats, are essentially large scale charter vessels that take 25-65 anglers fishing in exchange for a fee. Participants generally discussed convincing the headboat fleet to use descending devices as improbable. Factors that might inhibit descending device utilization were multiple anglers, paying customers, and valuable deck space on a headboat.

“I think you would have a hard time convincing either captain that it is worth it to them to have a basket for small black sea bass or whatever and then when they

accumulate 5 or 6 of them to throw this net overboard and drop it back down, because it taking up space along the rail that is valuable space for their clientele and its introducing a high potential for tangles.”

In contrast, some noted the use of descending devices by headboats could be beneficial as a marketing strategy, and also protect the reefs and fish that support their businesses. Headboats could market themselves as ethical anglers and in the process protect their resource. An interviewee described that anglers would more likely choose a headboat with conservation practices where fish were descended over another headboat.

“Look how great you could market yourself as an ethical angler. So finding out ways to let them know that this could help your bottom line too in addition to helping that resource that’s when you are going to be like, ‘ok yes I will do it.’”

2.2.3 Recreational

Convincing recreational anglers to use descending devices was described as easier as compared to headboats or commercial fleet. Participants described the limited number of people on recreational boats as compared to headboats as a potential positive factor for descending device use. Recreational fishermen also do not have paying customers or a limited amount of time compared to commercial fishermen or headboat fleets.

“I think generally speaking they have a few people on the boat, they don't have any paying customers there and I think it would be not a far reach to try and convince those individuals that it is worthwhile to them and to their livelihood, or their recreation, to start descending these fish.”

2.3 Past adoption efforts of best fishing practices by anglers

While differences in incentives were considered based of fishing sector or personal angler conservation beliefs, interviewees discussed past adoption efforts of other best fishing practices by anglers. Past adoption of other best fishing practices discussed included the use of circle hooks, dehooking tools, and venting of fish experiencing barotrauma.

Interviewees thought, if anglers adopted these practices, then they might be willing to adopt the use of descending devices as a best practice. Several respondents gave the example of anglers participating in the red drum fishery adopting proper handling practices and the use of circle hooks.

“... a bunch of fishers recognized ‘hey you can still catch a lot of red drum using circle hooks and they are swimming off aggressively which is a good sign.’ You would almost hope to some degree that fishers would have a feel good feeling and a perception that descender device was working before it was required.”

“A decade ago you wouldn’t catch any flack for that and now you would, at least some people would say that fish didn’t make it.”

3 Considerations for mandating the use of descending devices

In order to lower discard mortality through the use of descending devices can be achieved through a mandated requirement to use descending devices, or as seen in the Pacific, by accounting for voluntary use of descending devices. In interviews with South Atlantic respondents, most interviewees indicated they were unaware of successful descending device utilization through voluntary use in the Pacific. Since they were unaware of the Pacific case study, most interviewees discussed and provided considerations on the use of descending devices in the South Atlantic as a mandated rule. While discussing the use of descending devices as a potential mandated regulation, several considerations and questions were identified and raised. These considerations included: the development and interpretation of required descending device use into regulation, compliance and enforcement of the mandated rule, the spatial diversity of species and multiple species in the snapper grouper complex. Interviewees also discussed the challenge of developing an effective regulation with limited survey information and scientific uncertainty regarding descending devices increasing survivability of released red snapper.

3.1 Regulation development pertaining to compliance and enforcement

In order to be in compliance with a mandate that would require the use of descending devices, participants indicated the regulation could only require anglers to be in

possession of descending devices. One interviewee discussed requiring descending devices in the way that life jackets, boat flares, and fire extinguishers are required on boats for compliance. Several interviewees discussed that the physical practice of using a descending device cannot be enforced. Participants discussed the uniqueness of descending devices in that they are a practice that must be completed by the fisher and not something that is installed such as a turtle excluder device (TED). Further because it is a behavior and practice, it would be difficult to enforce.

“All we would be able to do is to require the possession of a descending device on board when you have snapper grouper in your possession.”

“I think if you had a regulation, the easiest way to implement and enforce the regulation would be to say, ‘if you are going reef fishing, deep drop, deep water, you must carry a descending device to use on all fish.’”

“... just because someone has it on the deck doesn’t mean they are actually using it either.”

The interviewee described this as a scenario between an angler and an enforcement officer stating,

“[the] coast guard or the marine police stop someone and check their cooler and say, ‘ok you caught snowy grouper, three wahoo, and triggerfish. You are possessing bottom fish, you must have bottom gear on board, may we see your descender device please?’ Otherwise you are going to have an issue with non compliance.”

3.2 Species spatial depth diversity and the multispecies complex

A regulation mandating the use of descending devices could be species or depth specific. Discussing how to develop a regulation mandating descending device use, participants commonly spoke of the challenge of the multispecies snapper grouper complex and the variability of species at different depths. The same species can be found in shallow areas where descending devices use would not be needed but also in deep areas where

descending devices would be beneficial to the survival of discarded fish. Most participants described depth as more important and effective than managing by species.

“Even though red snapper like other reef species aggregate. You are never exclusively going to catch one fish. Your catch for certain is not going to be any one species in this complex.”

“...we are seeing folks in the keys interact with red snapper quite a bit now but they are catching them very deep, over 150 -200 feet deep. Then on the continental shelf off of Florida there are encountering them in 50-60 feet of water, then when you get up to North Carolina or South Carolina about 80 feet out.”

“...to reiterate the challenge of when you are looking at a region that has very different fisheries depending on where you are is something to keep in mind. As far as where these species are encountered.”

3.3 Mandate may require physical and opportunity costs to anglers

If descending devices were required, some participants discussed the physical cost and opportunity cost of descending devices as a potential source for non-compliance. In contrast others described the devices as cheap and easy to use and something anglers would invest in if required by management. Participants described the use of descending devices as an opportunity cost because anglers could be spending their time fishing instead of descending. However, other respondents felt that the amount of time it takes to descend a fish is a small investment when considering the payoffs descending devices could potentially achieve.

“The only argument on the side of from people who don't want to use these things. Number one would be the cost associated with requiring one... And number two the opportunity cost of using one.”

“There are some tried and true ones, or there are some you can make yourself or some you can buy. Your interest level your income level, gives you options in what you want to do.”

“But they are pretty easy to use. And they are pretty fool proof... Especially the market ones, the ones you can buy online. They are easy to use and don’t take a lot of time.”

3.4 Angler avidity of recreational anglers may inhibit descending device use

Another consideration participants discussed if descending devices were mandated was angler avidity, or the frequency anglers participate in fishing more than others. Seasonal anglers and inland residents who fish in federal waters only a few times a year were mentioned as a concern by interviewees. People who only fish a few times a year would not be familiar with descending devices or their potential regulations.

“In the discard world 70% are coming from private recreational fishermen that don’t do this everyday and we need to figure out a way to do it that is easy for them. That’s the hard part.”

Another interviewee discussed angler avidity as potentially negative for red snapper. In describing infrequent anglers that live inland which only fish a few times a year the participant said,

“...when they see a red snapper they are going to stop everything and unfortunately catch a photo of the fish but that increases air exposure... hopefully they know it is a do not take (DNT) or required device, the descender device is required, hopefully they drop everything and get it down back in the water ASAP.”

3.5 Limited information and scientific uncertainty in order to develop effective mandate

All participants commented on the amount of uncertainty in the number of discards, uncertainty in terms of where people are encountering red snapper, in addition to limited scientific data regarding descending devices increasing long-term survivability of red snapper. One participant described concern about the uncertainty in discard estimates

(recreational catch and effort are estimated using a combination of survey methods, including an in-person intercept survey). Additionally, the depth at which anglers are encountering red snapper is unknown, and more research is needed on factors that impact survivability. Variables including, water temperature, time out of water, air exposure, and user error were discussed as factors needing further research. However, some interviewees felt there was sufficient information including research that could be adapted from other regions.

“When you take those 50-60 intercepts through 4 states, and over 6 waves [2-month data collection periods], that survey begins to have troubles when you are looking maybe a few positive intercepts representing catch for the coast.”

“Deck time and handling time especially for a novice can be significant and I think it is good to have this be condoned but I am not sure if requiring it, or categorically or uniformly requiring it for the entire Federal South Atlantic snapper grouper fishery is warranted at this time without more data.”

3.6 Further research needed to develop effective mandate

Participants discussed further research needs related to the use of descending devices on other species, survivability of red snapper after being descended, water temperature, air exposure and the effectiveness of various devices. Additionally, it would be important to understand the effect descending devices could potentially have on discard mortality within the recreational fishery.

“...I think that the factor of air time needs to be exclusively brought in to any modeling exercise and get a better handle at what device does or does not work better than another.”

“That is the number one issue in the red snapper fishery right now is the recreational discards from the private boat sector. Need projections on what kind of effect the descending devices would have on the discard rates.”

4 Considerations to promote descending device utilization under voluntary or mandatory regulation

While participants identified considerations for the development of a potential mandate, interviewees also discussed considerations to promote utilization of descending devices under a voluntary or mandatory regulation.

4.1 Involve fishermen in policy development to gain trust and compliance

Interviewees commented that working directly with fishermen to develop a policy regarding the use of descending devices promotes trust and compliance. As mentioned in an earlier section, this could be key especially when developing a mandatory regulation that is difficult to enforce and requires a lot of trust. Not involving anglers in the process could potentially create doubt and prevent buy in from fishermen. Participants also discussed the importance of working specifically with captains. Gaining the compliance of the Captains might promote other anglers and fishing sectors to use descending devices.

“First of all I think involving them in the research is really important.

Unfortunately, it has come to the point where people are skeptical of science.... I think the key is having that collaborative data.”

“I think if fishermen can do that [descend fish] and come up with inventive ways to do it, I think we can work together and make this a very good situation.”

“Because obviously if they captain's embrace it, some of what we call highliners, or captains that are very respected in the industry, if they supported it, than usually other people would start doing it.”

4.2 Outreach as effective tool to inform anglers about descending devices and their benefits

In addition to involving fishermen in the process regulation development, regardless of whether descending devices are required, all participants discussed outreach as an important factor to increase angler utilization of descending devices in the South Atlantic. Outreach is important to inform anglers of the practice and benefits of descending

devices. Additionally, it was noted by some that outreach is key to making descending devices a mainstream practice and widely accepted. Identified companies that make descending devices, fishing shows, and the South Atlantic Council as potential platforms and opportunities for outreach to be conducted.

“Outreach would be one of the biggest things and the biggest component in terms of making it mainstream and widely accepted. In addition to having the South Atlantic council say “yes this is a best practice” if you see it on fishing shows, if you see it in magazines, and in different formats I think it would help catch on. Just knowing and being able to see the tangible credit that the use of these could involve.”

“Having fishermen buy into the usage of them for decreasing discard mortality...To me it is the outreach part of it. Telling fishermen that this is a good tool.”

“Basically boils down to if outreach really helps, as opposed to folks just coming up with a rule based on some relatively minor data.”

During all interviews, videos were described as a powerful outreach tool. The ability to see the device in practice and watching the fish swim off was described as a potential large buy in factor for anglers.

“Definitely outreach and videos I think are really important. Seeing is believing.”

“All those videos, the videos made a world of difference, just having the videos out there for fishermen to believe in.”

4.3 Early signs of descending device adoption by anglers

While no coordinated outreach campaigns on descending devices in the South Atlantic have been conducted, interviewees commented on the increased awareness of descending devices in recent years. While it is difficult to understand the amount of people currently using descending devices in the South Atlantic, and particularly for red snapper,

participants discussed how at fisheries meetings descending devices are becoming more prevalent and fishermen discuss descending devices at fisheries meetings.

“Used a delphi approach where Less than 5% are using them.”

“From my time I have seen it go from kind of ‘oh we have these descending devices’ to now you see people at fisheries meetings handing out samples of these devices or showing GoPro videos and they post them online.”

“We are already hearing it that some of the fishermen would like this to be required, so that is a really good sign. Others, are definitely reluctant in willingness to use it so maybe they would be more convinced to do something like venting.”

4.4 Descending device use as a best fishing practice as the preferred option

While respondents were not convinced mandating descending fish would be advisable at this time without further research, all participants agreed the use of descending devices should be adopted and promoted as a best practice.

“It is a small investment in the grand scheme of things to send a fish down. So certainly individually we should encourage it and say it is a best practice just like circle hooks.”

Considerations for Descending Devices in the South Atlantic Red Snapper Fishery

From the analysis of experiences in the Pacific and insights about the South Atlantic region, there are a number of factors fishery management councils should consider when developing management policies for bottom dwelling species and the incorporation of descending devices. Presented below are similarities and differences that existed across both regions and their respective fisheries followed by considerations for the South Atlantic Fishery Management Council.

Similarities of regions

Potential outcomes from descending device utilization

Potential outcomes discussed by interviewees of the South Atlantic were similar to original possible outcomes described in GMT reports and in Pacific interviews. The report, “GROUND FISH MANAGEMENT TEAM REPORT ON DESCENDING DEVICE MORTALITY IN RECREATIONAL FISHERIES” issued during the April 2013 Pacific Fishery Management Council meeting, stated

“It is likely that the difference in mortality for cowcod, canary and yelloweye rockfish resulting from adopting mortality rates reflecting the use of descending devices and the current usage rates, compared to current mortality based on surface release mortalities, will not be sufficient to allow less restrictive management measures. However, it may prevent additional inseason restrictions, including closures, from being necessary. As angler awareness and use of devices increases, some liberalization to current regulations could be considered in the future.”

This description is similar to the potential outcomes interviewees in the South Atlantic expressed. Integrating use of descending devices into management to lower discard rates could avoid more restrictive measures and regulations.

Outreach critical for descending device utilization

Whether requiring or through voluntary use, respondents from both regions discussed the importance of outreach to promote the use of descending devices. In the Pacific,

interviewees discussed outreach as a large contributor to successful implementation and utilization. Specifically, almost all interviews discussed GoPro videos as descended and released fish as a powerful outreach tool in order to gain angler buy in. Videos give anglers the ability to see the effectiveness and ease of operation of the devices.

Fishery management circumstance similarities

As described in the results, the Pacific and Atlantic were and are under different circumstances regarding their overfished species. Anglers in the Pacific could no longer avoid the overfished species. Experiencing deep-water area closures, no fishing in certain areas to avoid incidental catch of the overfished species, anglers were motivated to address the high number of discards through use of descending devices. In the South Atlantic, the red snapper fishery may continue to experience closures with the retention of red snapper is prohibited; however no area closures have been implemented. There have been proposals as a measure to reduce red snapper discards. Action 6 of Amendment 43, states “Establish closed areas to reduce red snapper bycatch and mortality. Additional areas that are under review and could be established during the development of this amendment are the five closed area recommendations for Spawning SMZs in Amendment 36.” The South Atlantic may soon be in the same situation as the Pacific, unable to avoid overfished species and experience large area closures if measures are not taken to address the high number of discards.

Promotion of descending devices as best fishing practice

Across all interviews, interviewees agreed descending or recompressing fish through the use of descending devices should be considered and promoted as a best fishing practice. If promoted as best practice, anglers may adopt the use of descending devices without a mandated requirement.

Differences of regions

Contrast in knowledge of recreational fishery

The lack of scientific data regarding descending devices, and their ability to increase survivability of red snapper and limited survey information identified by South Atlantic

respondents, may be a major obstacle regardless if descending devices would be required or accounted for. As discussed by former members of the groundfish management team, who helped develop lower discard mortality rates in the Pacific, integrating the use of descending devices into management was more about reflecting an appropriate representation of rates of use and the state of the fishery. Obtaining information from each state's recreational survey sampling program including the depth at which anglers were encountering rockfish, the species they were discarding, and if they were using descending devices, was crucial information to reflect appropriate discard mortality rates. As expressed by interviewees from the South Atlantic, there is uncertainty in the amount of discards, amount of anglers encountering red snapper, and the depth at which red snapper are encountered. Due to these factors and the small number of intercept surveys, it would be difficult to understand the potential effects of mandating or requiring descending devices in the red snapper fishery.

Unknown effect of lower discard mortality rates on red snapper fishery

If the South Atlantic Council decided to move forward with a mandatory regulations or accounting for voluntary use, the goals of the South Atlantic Council should be thoroughly examined. In the Pacific, they were able to avoid further regulations, allow for longer seasons, and open previously closed areas, the Pacific discard situation is different than that of the South Atlantic. Interviewees from the Pacific indicated that since they were extremely close to, or just over, their harvest guidelines for certain species, only a marginal reduction was needed to impact regulations. A modest reduction in discard mortality made enough of a difference to extend seasons, increase bag limits, and open previously closed areas to anglers. As one interviewee stated, "When it is the primary portion of the season you are missing, it is going to take you a lot of fish to get over the hump, to the point where you can provide that opportunity again." Some interviewees felt accounting for the use of descending devices affected limits and regulations more than the ecology of the fish stock. While a small difference in discard mortality in the Pacific made a difference, the South Atlantic may be facing a much larger challenge with red snapper. As indicated by red snapper discard reports, in order to end overfishing and allow for a potential season red snapper discards must be reduced to less than 100,000

fish per year (SAFMC, 2017). For reference, red snapper dead discards from 2015 were 273,879 fish (SAFMC, 2017).

Top down versus bottom up management

Respondent from the Pacific and South Atlantic discussed mandated use of descending devices and voluntary use differently. As noted in the results section, most South Atlantic participants discussed requiring descending devices through a mandated regulation as opposed to accounting for voluntary use of descending devices to reduce discard mortality rates. Allowing for the use of descending devices to be voluntary was noted by respondents in the Pacific as a main driver and as an incentive for use. Because a red snapper season is dependent upon the total removals being less than the ABC there could be incentive for anglers to over report the amount of descended fish in order to lower the amount of dead discards. This potential for over reporting were reasons the Pacific Council did not require and enforce the use of descending devices in federal waters.

Role of headboats to increase descending device utilization

Participants in the South Atlantic and Pacific discuss utilization of descending devices by headboats or party boats contrastingly. Participants from the Pacific stated working with the party boat fleet and specifically the boat captains, was one of the main contributors to the success of descending device utilization. In contrast, interviewees of the South Atlantic felt the use of descending devices by the headboat fleet improbable. In the Pacific, Captains performed outreach themselves and instructed passengers to descend fish. Participants of the South Atlantic did not mention or discuss passengers descending fish. Instead South Atlantic respondents mentioned barriers that may inhibit descending device utilization as multiple anglers needing assistance descending fish, paying customers do not want to take time away from fishing to recompress fish, and valuable deck space that could be used by a paying customer may be taken up by a dedicated descending device rod or apparatus.

Considerations

From similarities and differences among regions considerations, or topics that warrant further discussion, were developed for the use of descending devices in the South Atlantic red snapper fishery.

Further studies and modeling to determine if red snapper season could occur

Since studies show the red snapper populations are increasing, councils keep in mind these considerations to conduct further studies and modeling exercises to examine the interaction of the rebuilding population and reduced discards to understand the potential outcomes from using descending devices. These modeling exercises and studies may determine if the use of descending devices to lower discard mortality rates may potentially allow or a red snapper season.

Outreach is key to promote angler utilization of descending devices

If the South Atlantic Fishery Management Council decides to mandate or promote descending devices as a best practice, outreach campaigns and videos should be considered to promote uptake and buy in from anglers.

Recreational management situation may influence descending device utilization

The South Atlantic may be facing large area closures, as the Pacific experienced, if measures or actions are not taken to address high red snapper discards. The use of descending devices to lower discard mortality rates should be considered in order to avoid further regulations and large area closures.

Investigation of potential descending device use by headboats in South Atlantic

Further examination of headboat likelihood to use descending devices should be considered. Research specifically on passenger, headboat Captain, and deckhand, willingness to use descending device on headboats should be considered.

Several areas of uncertainty in red snapper recreational fishery

As expressed by interviewees from the South Atlantic, there is uncertainty in the amount of discards, anglers encountering red snapper, and the depth at which red snapper are

encountered. Due to these factors and the small number of intercept surveys, it would be difficult to understand the potential effects of mandating or requiring descending devices in the red snapper fishery. There exists a need to develop more accurate methods or programs to for collection recreational catch and effort data.

Best fishing practice

Until more information on the recreational red snapper fishery is obtained, descending devices should be considered and to be promoted as a best fishing practice by fishery managers.

Conclusion

The goal of this study was to assess and analyze the challenges and opportunities associated with the potential use of descending devices in the South Atlantic red snapper fishery. The objectives developed to achieve this goal included: Assess management needs, interests, and questions with regards to descending, characterize the implementation of descending devices in the recreational Pacific groundfish fishery, focusing on canary, cowcod, and yelloweye rockfish species, evaluate the possibility of implementation of descending devices in the South Atlantic red snapper fishery, and identify opportunities and challenges to successfully implementing and adopting descending devices in other regions.

Several considerations and questions were identified regarding the specific development of a required mandate in the South Atlantic. These included the challenge of developing an effective regulation with limited survey information and scientific uncertainty regarding descending devices increasing survivability of released red snapper.

The implementation of descending devices in the recreational Pacific groundfish fishery for three species of rockfish was described as a positive situation for both management and anglers. Several contributors to successful implementation of descending devices in the Pacific included outreach with the use of GoPro videos, cohesion, and coordination between the Pacific Fishery Management Council and state management agencies to incentivize and facilitate utilization of descending devices in the recreational fishing community. Pacific respondents also indicated descending devices were effective as a means for flexibility in management, allowed for more accurate data collection, and created more opportunities for recreational anglers.

Throughout my analysis, it was clear that descending devices may not be the essential element in a sustainable path for the South Atlantic red snapper fishery. However, descending devices might avoid large-scale deep area closures that would be closed to all fishing, and other additional restrictive regulations. Participants discussed challenges of a

required descending device mandate in the South Atlantic region due to the diversity in depth in which species can occur and the multiple species in the snapper grouper complex.

From investigating both regions, it is clear recreational fisheries are tough to manage under strict management measures. While regions exhibited different circumstances in both management and the biological aspects of the fisheries themselves, recreational fisheries experience similar challenges. Recreational fisheries data is difficult to obtain, can contain several sources of uncertainty, and can vary depending on region. Although they might not be translatable, considerations from the Pacific Council's experiences accounting for descending devices and experience promoting angler utilization of descending devices should be considered.

While descending devices may not be a catch-all solution for overfished stocks that experience high discard mortality rates due to barotrauma, it is clear descending devices can provide several potential benefits and outcomes. Whether those outcomes are fewer regulations due to lowered discard mortality rates, or potential seasons, the intent of the Councils goals should be thoroughly considered. Regardless of mandated or voluntary use, it was agreed by all participants that descending devices should be promoted and used as a best fishing practice.

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Appendix

Appendix A

Interview Questions:

	Pacific Region	Atlantic Region
1.)	What types of resources in regards to the implementation of descending devices would you recommend?	What information would you want/need in order to proceed with the implementation of descending devices?
2.)	What challenges did you encounter during the implementation of descending devices?	What do you foresee as the major challenges in the management process of implementing descending devices?
3.)	What did you feel contributed to the success of descending device implementation?	What do you think will contribute to the success of implementing descending devices?
4.)	What opportunities/outcomes do you think descending devices achieved?	What opportunities/outcomes do you think descending devices could achieve?
5.)	What do you think the implementation of descending devices helped the fishery avoid?	What could the implementation of descending devices help the fishery avoid?
6.)	What do you think were the main drivers that contributed to the implementation of descending devices?	What do you think are the main drivers that could contribute to the implementation of descending devices?
7.)	What advice or considerations would you give to another council considering implementing descending devices?	What considerations do you want other fishery managers to consider in order to proceed with the implementation of descending devices?

Appendix B

IRB Consent Form:

Contact: Kelsey Dick

Email: kelsey.dick@duke.edu

Phone: (614) 565-6789

My name is Kelsey Dick and I am a master's student at Duke University's Nicholas School of the Environment. I am conducting a study to provide information to fisheries managers that assesses and analyzes the challenges and opportunities of descending devices in the red snapper fishery. If you agree to participate, I will ask you questions about the implementation of descending devices in the Pacific rockfish fishery/Atlantic red snapper fishery. This study will be used for my master's project as part of my Master of Environmental Management degree at Duke University.

I am seeking your participation in this study, which requires a semi-structured interview by phone or video call depending on your preference. The interview will take 30 minutes to an hour. To protect your privacy, your name and personal information will be confidential. However, other information such as the name of your employer, profession, and demographic region in which you work, may be used. Therefore, there is risk that this information may allow you to be identified. The final product of this study will consist of a written report and presentation that will occur in April. A copy of the report will be accessible on Duke University's Nicholas School of the Environment website. During the interview I will ask that you describe your position to the level of detail you are comfortable with me writing in the final report. With permission of the participant the interview will be audio taped. The tape will be used to help in the analysis of the interviews. No one but myself and my advisers will have access to the audio tape. At the end of the study, the tape will be destroyed.

Participation in this study is entirely voluntary and you may choose to discontinue your participation at any time. Participants may choose to end the interview, ask for clarification, or skip questions at any time. Additionally, if you have any questions about this study or after the interview, please contact Kelsey Dick (614) 565-6789 or Kelsey.dick@duke.edu. For answers to any questions you may have about your rights as a research subject, contact the Duke University Program for the Protection of Human Subjects at campusirb@duke.edu or (919) 684-3030.

If you would like to participate please check and fill out the lines below. Your time and participation is greatly appreciated. Thank you.

[] I allow the discussion to be audio taped.

[] I do not allow the discussion to be audio taped.

Please sign below if you would like to participate, please fill out the lines below. Please keep a copy of this form for your records.

Name, Printed: _____ Signature: _____ Date: _____