

Florida Fish and Wildlife Conservation Commission

2017 Citizen Science Descending Device Study Final Report

An Evaluation of Anglers' Barriers to Using Descending Devices



Florida Fish and Wildlife Conservation Commission
Division of Marine Fisheries Management
2590 Executive Center Circle, E. Ste. 204
Tallahassee, FL 32301
850-487-0554
Marine@MyFWC.com

Author:
Melissa Crouch

Contributors:
Jessica McCawley, Jim Estes, Martha Guyas, Daniel Ellinor,
Richard Abrams, Alan Peirce, Erika Burgess, Nia Morales



August 2018

Table of Contents

Section	Page
Summary	2
Background	3
Methods	5
Evaluation Design	5
Survey Design	6
<i>Screening Survey</i>	6
<i>Initial Survey</i>	8
<i>Follow-Up Survey</i>	8
Survey Implementation	10
Survey Results	11
Screening Survey	11
Initial Survey for Participants	24
Initial Survey for Volunteers	30
Follow-up Survey for Participants	36
Follow-up Survey for Volunteers	46
Statistical Analysis Results	54
Discussion	55
References	56

Summary

This citizen science study was conducted to determine Florida anglers' barriers to using descending devices. Surveys used in the study were designed to provide insight into anglers' perceptions of barotrauma and descending devices, and gauge the likelihood that they would use a descending device in the future.

Screening surveys were sent out in June 2017; most anglers who answered the screening survey and indicated they did not own a descending device were invited to participate in the study and receive a descending device from the Florida Fish and Wildlife Conservation Commission (FWC). A total of 634 descending devices were mailed out in early July 2017 to the study "**participant**" group (25 charter/for-hire captains, five headboat captains, and 604 private anglers). In addition, anglers who already owned or were willing to obtain a descending device were invited to take part in the study in the "**volunteer**" group.

Follow-up surveys to learn about anglers' experiences using the descending device were sent to both groups on Nov. 1, 2017. Response rates were 54.5% for the participant group and 46.4% for the volunteer group, indicating a high level of interest in taking part in the study and in improving reef fish survival rates post-barotrauma. However, it is important to note that the anglers who took part in this study are more likely to use descending devices and are more likely to want to be engaged with the FWC. Anglers were not chosen by a random sample and results of this study should not be applied to the entire population of all Florida reef fish anglers.

The SeaQualizer was the most used descending device during the study, followed closely by the Fish Saver and the RokLees. The SeaQualizer was rated for the highest levels of satisfaction in the follow-up survey, followed by the Fish Saver, RokLees, and Shelton Fish Descender. On average, participants took about 12 trips to target reef fish during the study period, while volunteers took about 16 trips. Descending devices were most often used at 40-120 foot depths.

Most anglers believed devices were successful at descending fish "nearly 100% of the time" and "very effective" at increasing the survival rates of reef fish with barotrauma during the study period. However, many open-ended responses noted that venting tools can work as well or better than descending devices depending on the situation. Most anglers thought descending devices were "somewhat easy" or "easy" to use and were "very confident" that they can use descending devices correctly. Angler experience when using the device was most often rated as "positive" or "very positive." Most anglers said they are "very likely" or "likely" to continue using a descending device regularly and to recommend purchasing a device to other anglers.

Interestingly, statistical analysis of the pre-study and post-study data shows that participants thought descending devices were more difficult to use, less effective, and had less confidence in using them after the study. However, when compared to the survey results, these findings suggest that although descending devices may be complicated and time-consuming to use, the negatives are not significant enough to greatly affect use. The results of this study suggest that descending devices could be a viable tool used by anglers to assist in reef fish management and help maintain healthy reef fish populations for the future.

Background

Saltwater fishing is a favorite pastime of Florida residents and visitors alike. In 2016, Florida's recreational anglers caught roughly 213 million marine fish, 125 million of which were released (National Oceanic and Atmospheric Administration, 2017). Fish are released for a variety of reasons, but increasing a fish's chances of survival after it is released will help ensure fish populations remain sustainable for future generations. Anglers can use various fish handling methods and gear to increase the chances that released fish will survive. The most common causes of post-release mortality are physiological stress on the fish resulting from struggle during capture, injuries caused by the hook, and mishandling of the fish by the angler. Unfortunately, some fish may die after release even though they appear unharmed and despite efforts by the angler to revive the fish.

Reef fish, such as snappers and groupers, are a popular target of recreational fishing effort in Florida. These economically and ecologically important fishes are often caught in deep waters and may face additional challenges to survive when released. This is primarily due to the gas-filled organ called a swim bladder that controls buoyancy and allows the fish to maintain a certain depth. When fish are pulled up from deep water (typically depths greater than 50 feet), the change in pressure can cause the gas in the swim bladder to expand and in some cases burst. Damage to the swim bladder or other internal organs caused by such a change in pressure is called barotrauma.

Signs of barotrauma include the stomach coming out of the mouth, bulging eyes, bloated belly, and distended intestines. When a fish suffering from barotrauma is released, it is unable to swim back down to capture depth, making it difficult to re-establish normal behaviors and avoid predators. If a fish needs to be released and shows any or all signs of barotrauma, venting tools and descending devices may increase the fish's chance of survival. When using a venting tool or descending device, it is important that the instructions are carefully followed to ensure the device is used properly.

Venting tools are sharpened, hollow instruments such as a hypodermic syringe with the plunger removed. These devices are used to treat barotrauma by releasing expanded gases from the fish's body cavity, enabling fish to swim back to capture depth after release. However, when venting tools are used incorrectly, they can often cause more harm than good.

A descending device (also known as a recompression tool) is used to reverse the effects of barotrauma by lowering the fish back down to a depth where the increased pressure from the water will recompress the swim bladder gases and allow the fish to swim away. In recent years, a number of descending devices have been developed. Research indicates that use of descending devices can increase survival rates of released fish (Jarvis et al. 2008; Rogers et al. 2011; Campbell et al. 2012; Hall et al. 2013; Sauls et al. 2016; Brownscombe et al. 2017).

Devices fall into one of three categories: mouth clamps, inverted hooks, and fish elevators. Mouth clamps are attached to a rod and reel or hand line and use a pressure sensor (releases fish automatically at a predetermined depth selected by the angler) or a weighted spring release mechanism (lets go of fish after the angler gives a sharp tug on the line). Mouth clamps tend to be slightly more expensive and require practice, but devices can be compact. Inverted hooks work similar to mouth clamp devices, but are inserted through the hole made by the hook. Once the fish is deep enough to reverse the effects of barotrauma, the angler reels up the line and the fish swims away. This method is fairly inexpensive, but takes practice. A third option is the fish

elevator, an inverted container such as a milk crate with a rope attached to the top and weights on the bottom. This creates a bottomless cage that brings fish back down to capture depth. This method can be inexpensive and easy to use, but these devices can be cumbersome and have limitations when it comes to the size of fish. Anglers should choose the device and method with which they are most comfortable, that is appropriate for the situation, and that minimizes the amount of time that the fish is out of the water.

Due in part to the popularity of fishing for reef fish and creation of more strict fisheries regulations, there has been a rise in the number of reef fish that are released by recreational anglers. The increase in releases of reef fish has contributed to higher discard mortality. One way to help reduce discard mortality is to conduct outreach and education efforts targeted at recreational anglers. The FWC provides numerous resources to educate anglers on catch-and-release methods and barotrauma, including how-to videos, articles, news releases, social media, web pages, brochures, and in-person interactions that teach anglers the skills needed to assist fish with barotrauma.

Various marine fishery regulatory agencies are considering the possibility of creating regulations that could require descending devices when fishing for reef fish. Due to possible regulatory changes and the desire to learn more about Florida's recreational saltwater anglers, the FWC conducted this citizen science descending device study to help determine anglers' barriers to using descending devices, as well as learn if certain devices are preferred over others or appear to be more effective than others. Surveys used in the study were designed to provide insight into anglers' perceptions of barotrauma and descending devices, as well as gauge the likelihood that they would use a descending device in the future. Another goal of the study is to increase the use of descending devices by fine-tuning existing outreach and education efforts. The findings of this study will also be useful to state and federal fishery managers as they develop management strategies to help maintain healthy reef fish populations.

Methods

Evaluation Design

To learn about anglers' barriers to using descending devices, FWC evaluated two groups:

- **Participants:** Anglers who did not yet own a descending device, completed the screening survey before all devices were allocated, and were provided with a device by FWC
- **Volunteers:** Anglers who already owned a descending device or were willing to buy one

FWC acquired 634 descending devices and provided them to 634 participants who did not already own a descending device. FWC also invited volunteers who already owned or were willing to purchase a descending device to take part in the study. Participants and volunteers were asked to use a descending device during the study period, from July 1, 2017, to Oct. 31, 2017 (*extended from Sept. 30, 2017 due to the impacts of Hurricane Irma; notification of the study period extension was sent via email to participants and volunteers on Sept. 22, 2017*), and answer survey questions based on their experiences. The number of descending devices allocated to participants is shown in *Table 1* below.

Type of Descending Device	Total # of Descending Devices Given	Private Anglers	Charter/ For-Hire Captains	Headboat Captains	Gulf Anglers	Atlantic Anglers	Both Gulf and Atlantic
SeaQualizer (pressurized mouth clamp)	145	140	4	1	69	70	6
RokLees (spring-release mouth clamp)	146	140	5	1	68	72	6
Shelton Fish Descender (inverted hook)	147	142	4	1	71	70	6
Fish Saver (inverted hook)	134	127	6	1	66	61	7
Safe Release Weight (inverted hook)	38	34	3	1	18	17	3
Inverted milk crate (fish elevator)	24	21	3	0	12	8	4
TOTAL	634	604	25	5	304	298	32

Table 1. Descending Devices Allocated to Study Participants

Anglers who received a descending device from FWC (**participants**) were mailed a letter, a how-to video link for their device, a sample logbook page, a catch-and-release brochure, directions from the manufacturer (if provided), three pounds of weight (if needed for their type of device), and the descending device. They were also contacted by email and provided with the how-to video link for their device and an electronic copy of the sample logbook page.

Anglers who already owned or were willing to purchase their own descending device (**volunteers**) were contacted by email and provided with how-to video links for various devices and an electronic copy of the sample logbook page. Participants and volunteers were required to follow state and federal fishing regulations during the study.

Survey Design

Three surveys were created to fully capture anglers' experiences with descending devices:

- 1) [Screening survey](#): Gathered a wide range of information about a large group of anglers
- 2) [Initial survey](#): Gathered additional details about study participants and volunteers prior to the start of the study period
- 3) [Follow-up survey](#): Gathered details on anglers' experiences using the descending device during the study period and possible use of the device in the future

The surveys were designed to ask questions in a logical order, with options to skip questions that did not apply, but still requiring the questions necessary to glean important information from the respondent. All surveys were conducted using www.SurveyMonkey.com. Survey protocol and questions were developed by FWC's Division of Marine Fisheries Management and a Human Dimensions Specialist. Surveys are described below and in schematic flow charts (*Figures 1-3*).

1) Screening Survey

The screening survey was designed to gather a wide range of information about the angler. Information sought included:

1. Previous fishing patterns (mode, frequency, species targeted, depth, location)
2. Understanding of barotrauma
3. Experience with descending devices
4. Reasons for not using a descending device (presently and in the future)
5. Preferred method to receive information about descending devices
6. Name, county of residence, age, email address, and comments

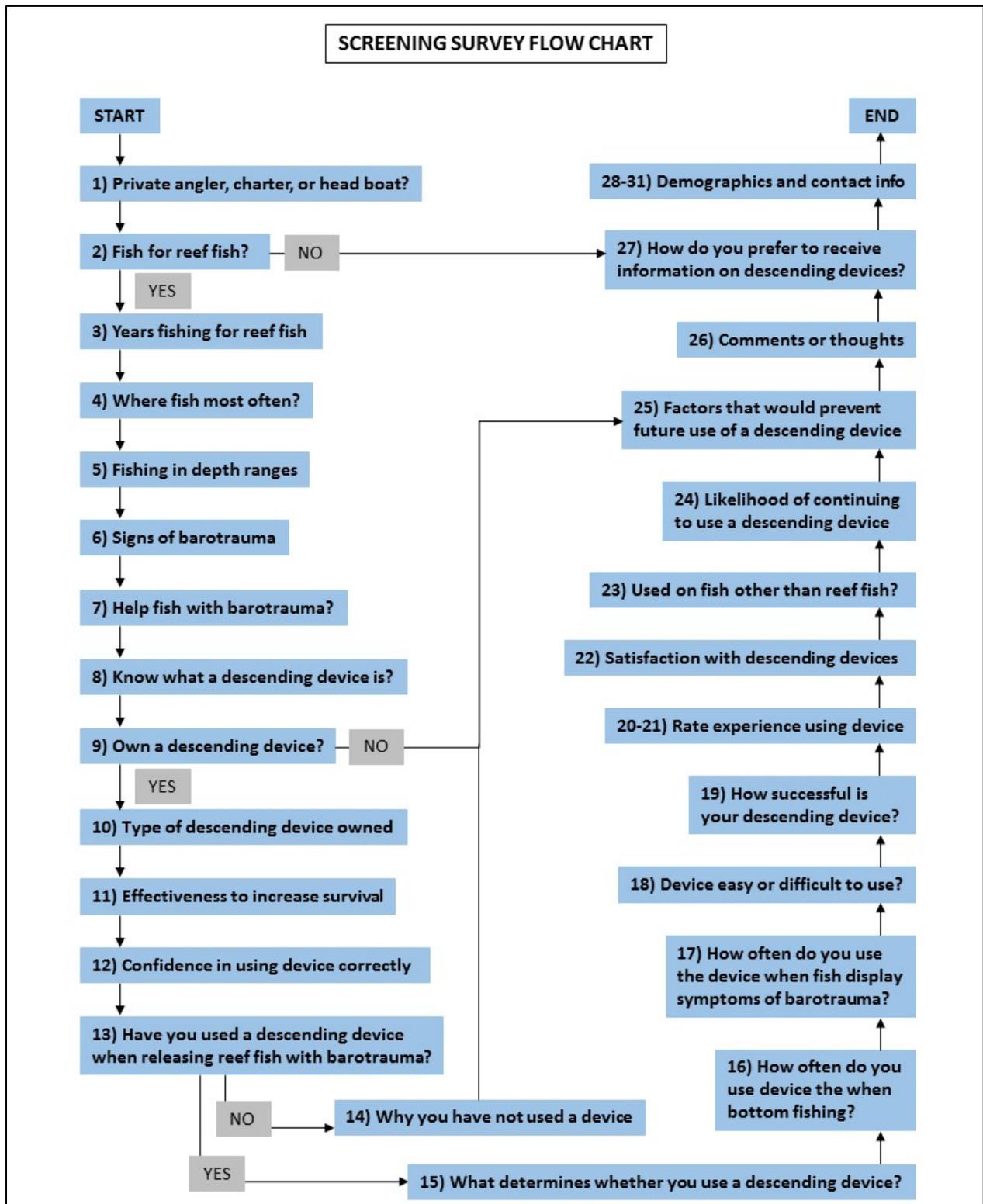


Figure 1. Screening Survey Schematic Flow Chart

2) Initial Surveys (pre-study)

The initial surveys were designed to gather additional details prior to the start of the study period, as well as gauge whether the angler retained information from the 3.5-minute video on barotrauma and descending devices.

Separate initial surveys were administered for the participant and volunteer groups, to allow for more streamlined data analysis. However, initial and follow-up survey questions were identical for the two groups.

Information sought included:

1. Understanding of barotrauma
2. Knowledge and level of confidence in using descending devices
3. Experience with descending devices
4. Reasons for not using a descending device in the past
5. Name, mailing address, age, email address, and pre-study comments

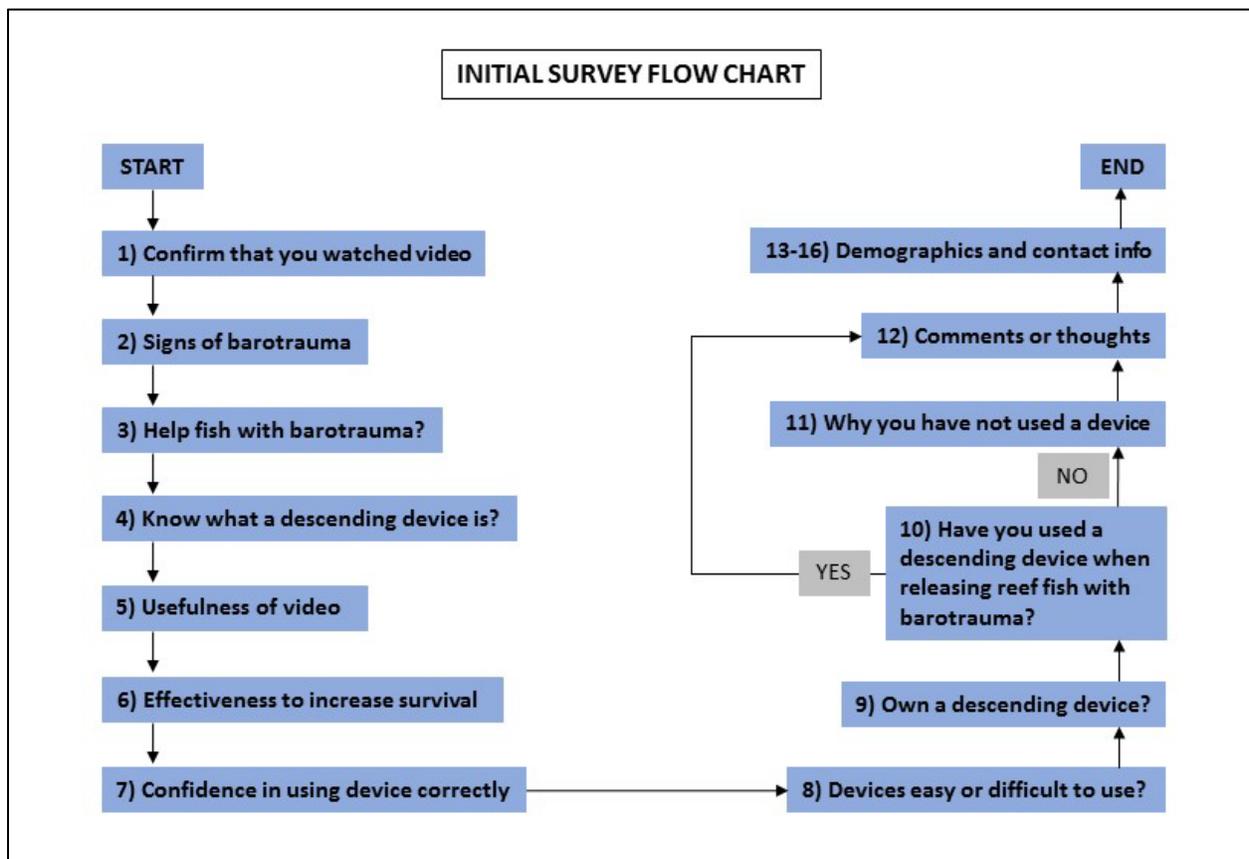


Figure 2. Initial Survey Schematic Flow Chart

3) Follow-Up Surveys (post-study)

The follow-up surveys were designed to gather details on anglers' experiences using the descending device during the study period and possible use of the device in the future.

Separate follow-up surveys were administered for the participant and volunteer groups, to allow for more streamlined data analysis. However, initial and follow-up survey questions were identical for the two groups.

Information sought included:

1. Descending device use during the study (type, satisfaction, location, trip information)
2. Level of success using the descending device
3. Effectiveness of descending device
4. Ease of use of descending device
5. Confidence level in using the descending device
6. Rating of descending device experience
7. Factors that prevented descending device use during the study
8. Factors that will prevent descending device use in the future
9. Likelihood of using and recommending descending devices in the future
10. Preferred method to receive information about descending devices, post-study comments

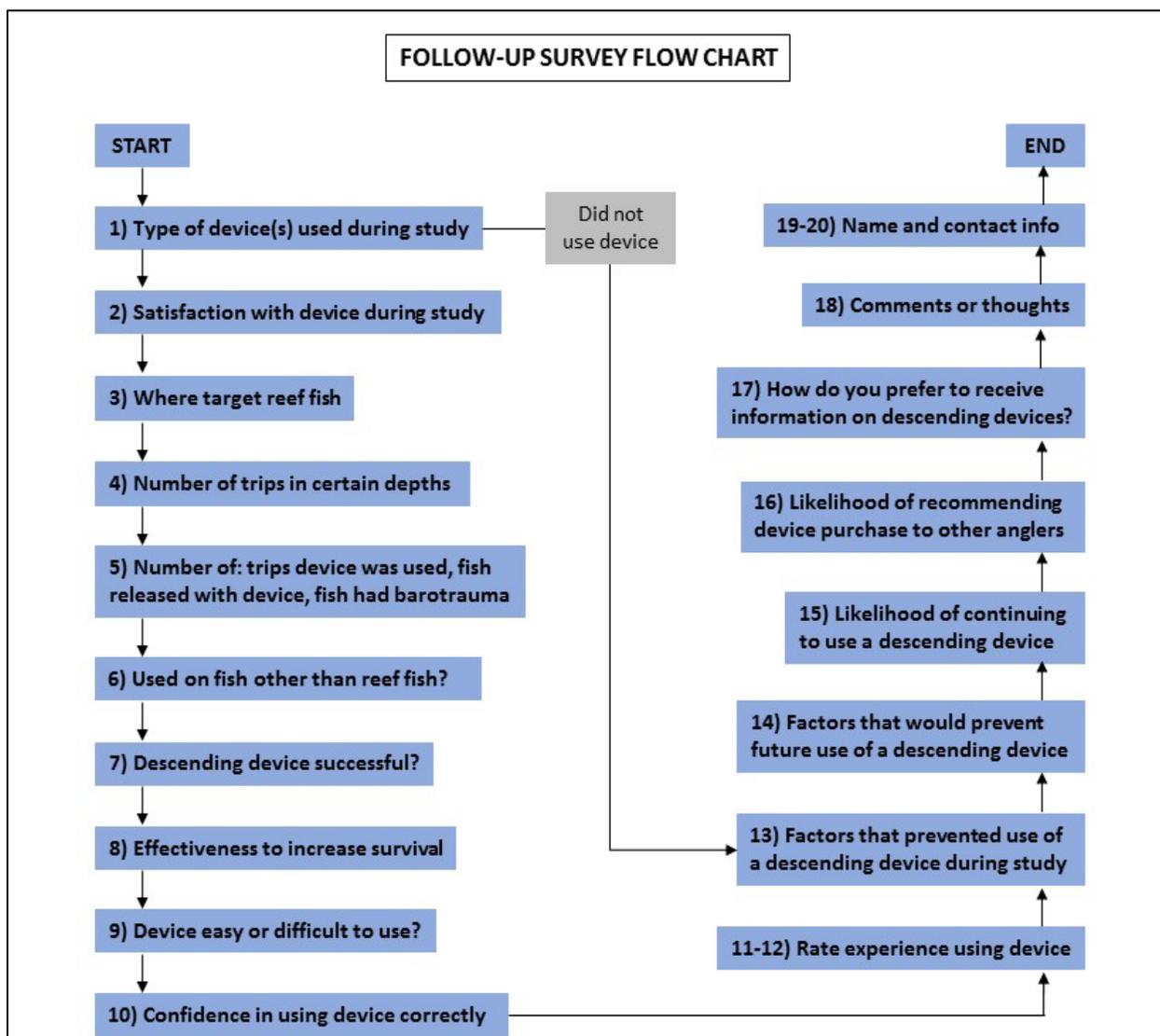


Figure 3. Follow-Up Survey Schematic Flow Chart

Survey Implementation

1) Screening Survey

In June 2017, a new release explaining barotrauma and asking for citizen scientists to participate in the study was emailed via GovDelivery (a means of government-to-citizen digital communication) to more than 1 million email addresses, including those who signed up to receive FWC news releases (407,388); those who wanted information on public comment opportunities, all 2017 Florida saltwater license holders with a valid email address, and those who signed up for the FWC Gulf Reef Fish Survey, required for anglers who fish for various reef fish species (649,827); and media and FWC staff (11,554). Interested anglers were directed to a screening survey link to evaluate their fishing experience, knowledge of barotrauma, and perceptions of descending devices.

2) Initial Surveys (pre-study)

A: Initial Survey for Participants

Anglers who completed the screening survey, indicated they fished for reef fish, were Florida residents, and did not own a descending device were invited to participate in the study and receive a descending device from FWC. To participate, they were required to take an initial survey to give more information on their knowledge and perceptions of descending devices before the study began. The initial survey for participants was provided via a link in an email that was sent to 1,097 anglers in June and early July. These anglers were selected because they did not yet own a device and they completed the initial survey before all devices were allocated. Anglers were asked to watch a 3.5-minute video on barotrauma and descending devices before taking the survey (the video was embedded in the first page of the survey).

After removing duplicates and those who did not fully-complete the initial survey, there were 634 descending devices mailed to participating anglers in July and early August. Each participant received a descending device, three pounds of weight, and instructions on how to use their device, including a link to a how-to video posted on YouTube, a catch-and-release best practices brochure, and a sample logbook form to document their experiences during the study.

B: Initial Survey for Volunteers

Anglers who answered the screening survey and indicated that they already owned a descending device were invited to take part in the study by taking an initial survey for volunteers and using their own descending device during the study period. Also, anglers who indicated they did not fish for reef fish, as well as anglers who took the screening survey after all available descending devices had been allocated to participants, were invited to take part in the study by taking an initial survey for volunteers and acquiring their own descending device to use.

The initial survey for volunteers was provided via a link in an email that was sent to 291 anglers from June through August. Anglers were asked to watch a 3.5-minute video on barotrauma and descending devices before taking the survey (the video was embedded in the first page of the survey). Each volunteer received instructions on how to use various types of descending devices, including links to how-to videos posted on YouTube, a catch-and-release best practices brochure, and a sample logbook form to document their experiences during the study.

3) Follow-up Surveys (post-study)

A: Follow-up Survey for Participants

A follow-up survey was sent via an email link on Nov. 1, 2017, to 634 participants who were provided a device. Participants were asked to complete the follow-up survey by Nov. 14, 2017.

B: Follow-up Survey for Volunteers

A follow-up survey was sent via an email link on Nov. 1, 2017, to 56 volunteers who indicated that they would utilize their own device. Volunteers were asked to complete the follow-up survey by Nov. 14, 2017.

Survey Results

Findings of these surveys will be discussed in the order in which the surveys and their respective questions were administered. Open-ended responses for “Other” answer choices are not listed in this report, but can be obtained by request from the author.

1) Screening Survey

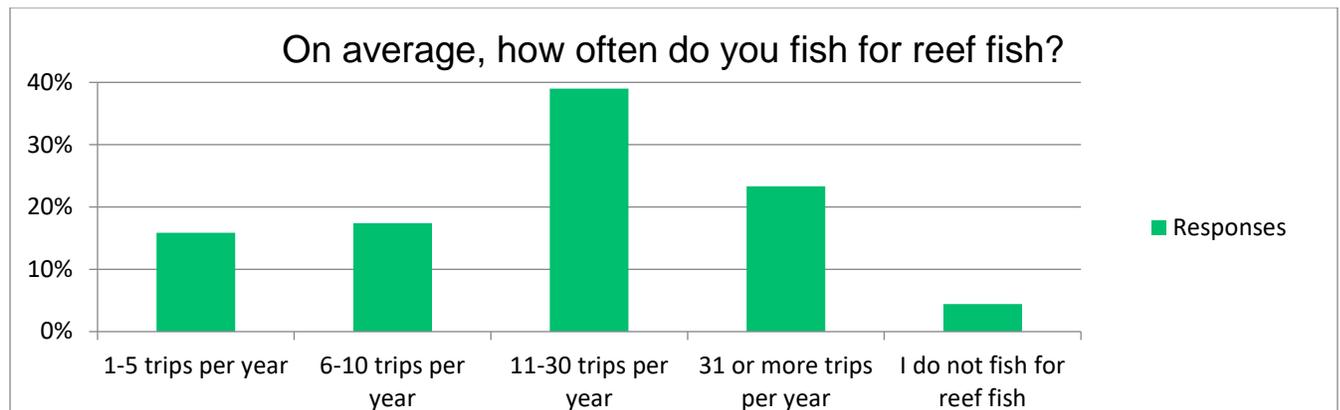
A GovDelivery news release was sent out to over 1 million email addresses in June 2017. In response to the news release, a total of 2,031 screening surveys were taken. Of those, 1,413 screening surveys were fully-completed to include demographics and contact information. A meaningful response rate cannot be accurately determined, since data were not collected on the number of people that deleted the email message without opening or reading it, or the number of respondents who failed to submit a partially completed survey.

Fishing Behavior Questions

There were 2,031 respondents to each question in this section.

#1. Which of the following best describes you? The vast majority of respondents were private recreational anglers (95.77%; 1,945 people), followed by charter boat captains/owners/deckhands (3.4%; 69 people) and headboat captains/owners/deckhands (0.84%; 17 people).

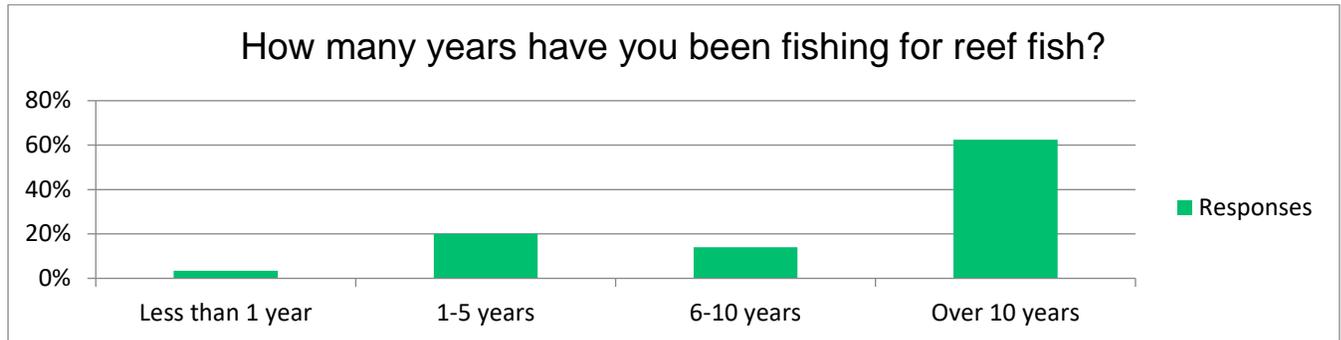
#2. On average, how often do you fish for reef fish (snapper, grouper, etc.)? The majority of respondents (39%) indicated that they take 11-30 trips per year to fish for reef fish, followed by 31 or more trips (23.34%), 6-10 trips (17.38%), 1-5 trips (15.85%), and no trips for reef fish (4.43%). Those who indicated they do not fish for reef fish were taken to question 27.



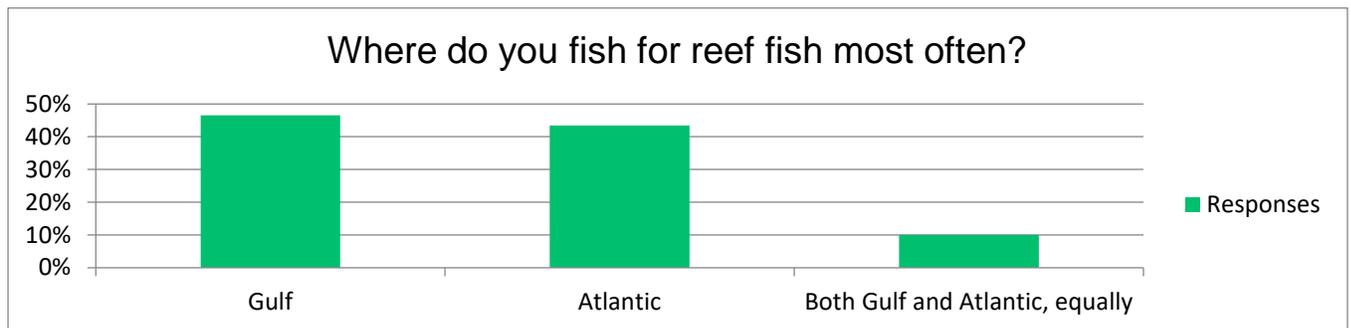
Experience Fishing for Reef Fish

There were 1,754 respondents to each question in this section.

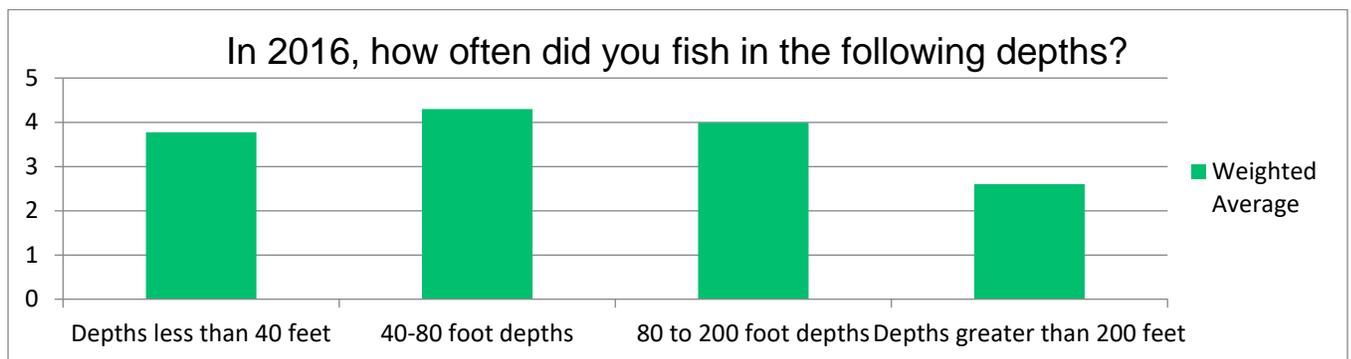
#3. How many years total have you been fishing for reef fish (snapper, grouper, etc.)? A majority of respondents (62.43%) indicated they have been fishing for reef fish over 10 years, followed by 20.07% for 1-5 years, 14.08% for 6-10 years, and 3.2% for less than one year. These findings indicate that most respondents are experienced reef fish anglers.



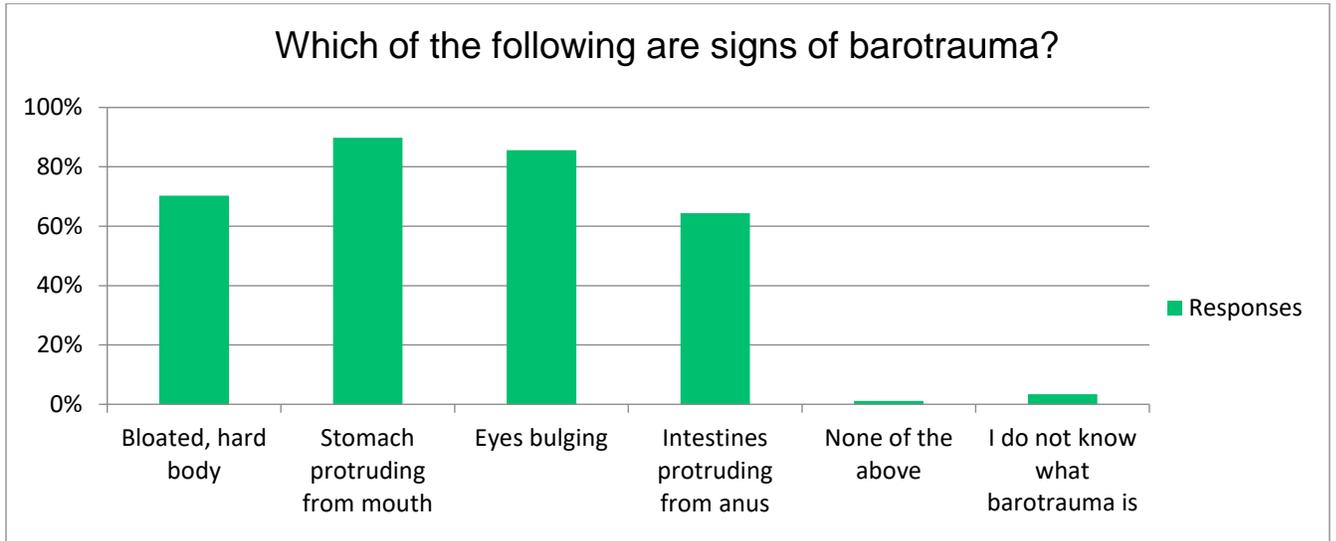
#4. When fishing for reef fish (snapper, grouper, etc.), where do you fish most often? The respondents to this question were almost evenly split between fishing in the Gulf of Mexico and Atlantic Ocean, with 46.58% indicating Gulf, 43.44% indicating Atlantic, and 9.98% indicating both Gulf and Atlantic equally.



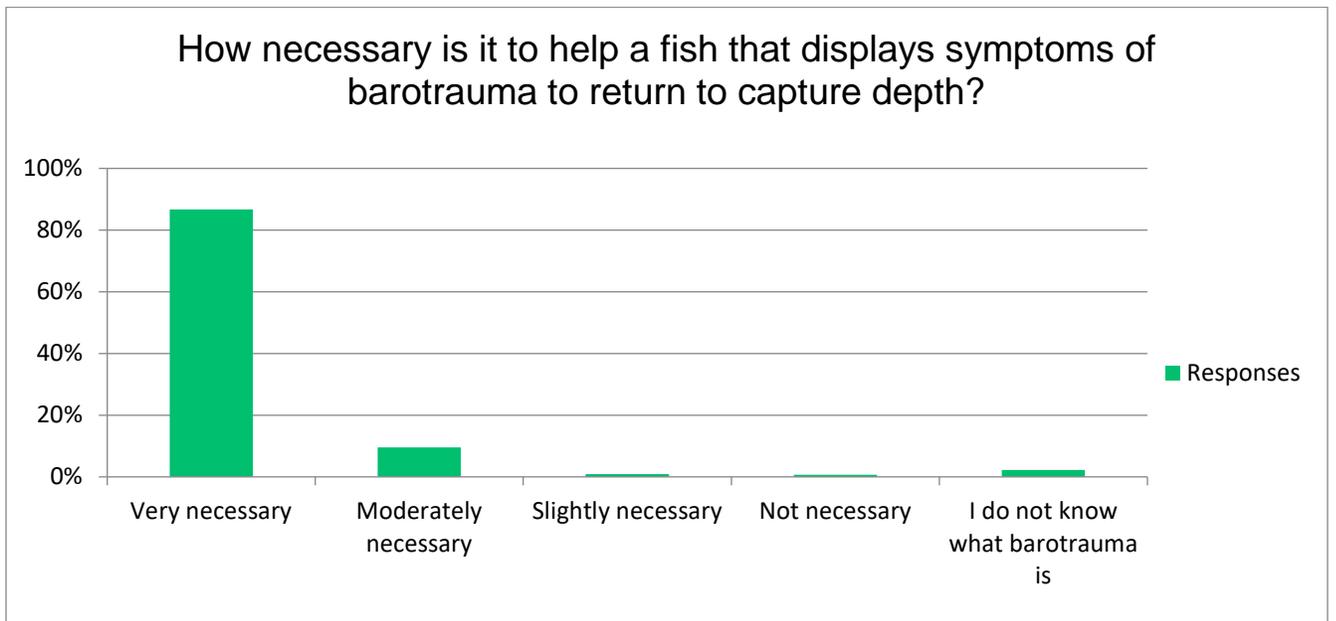
#5. In 2016, how often did you fish in the following depths? Using weighted averages of answer choices (1 = no trips, 5 = 31 more trips), respondents indicated that they fished in 40-80 foot depths most often in 2016, followed by 80-200 foot depths, less than 40 foot depths, and greater than 200 foot depths. Most trips occurred in depths greater than 40 feet, which are depths where barotrauma symptoms are more common.



#6. Which of the following are signs of barotrauma and indicate that a fish may need assistance to return to the bottom? Most respondents were aware of the signs of barotrauma, with “stomach protruding from mouth” chosen most often (89.79%), followed by “eyes bulging” (85.63%), “bloated, hard body” (70.24%), and “intestines protruding from anus” (64.42%). Only 1.14% of respondents selected “none of the above” and only 3.42% selected “I do not know what barotrauma is.” This question was asked again in the initial survey to help gauge if respondents’ knowledge of barotrauma increased after watching an educational video.



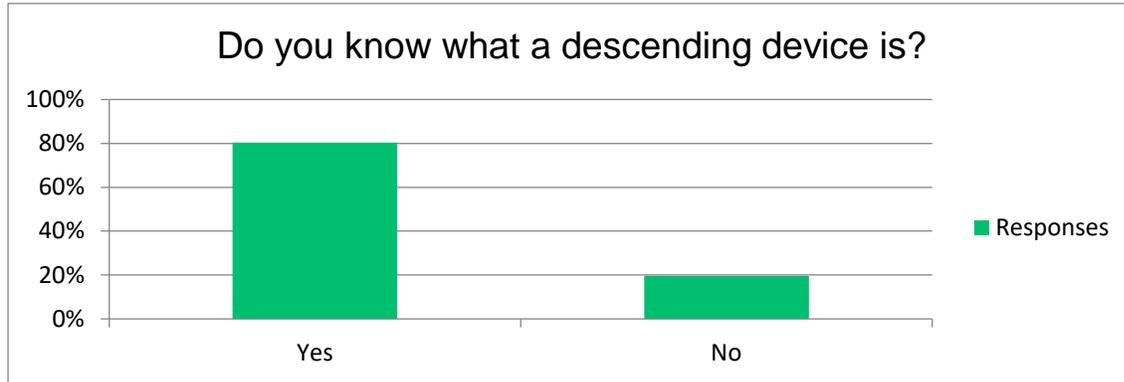
#7. How necessary do you think it is to help a fish that displays symptoms of barotrauma to return to capture depth? Most respondents (86.72%) indicated that they think it is “very necessary” to help fish suffering from barotrauma to return to capture depth. Only 9.52% found it “moderately necessary,” 0.91% chose “slightly necessary,” 0.63% chose “not necessary,” and 2.22% indicated “I do not know what barotrauma is.” These findings indicate that a majority of reef fish anglers in Florida think it is important to assist fish with barotrauma.



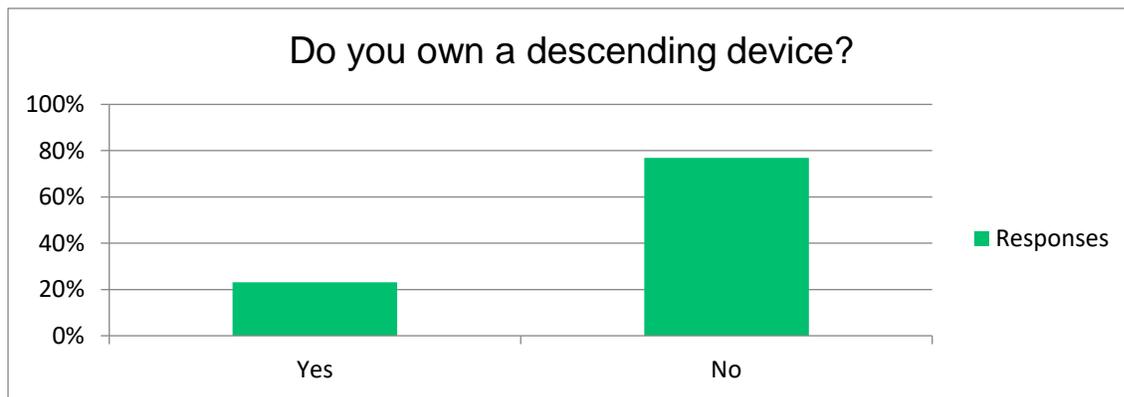
Experience with Descending Devices

There were 1,747 respondents to each question in this section.

#8. Do you know what a descending device is? A majority of respondents (80.42%) indicated that they know what a descending device is, with only 19.58% indicating that they did not know. This finding is promising, but also shows that more outreach is needed on these devices.



#9. Do you own a descending device? Although a majority of respondents indicated that they know what a descending device is, only 23.13% indicated that they own a device (those who indicated that they do not own a descending device, 76.87%, were taken to question 25.)

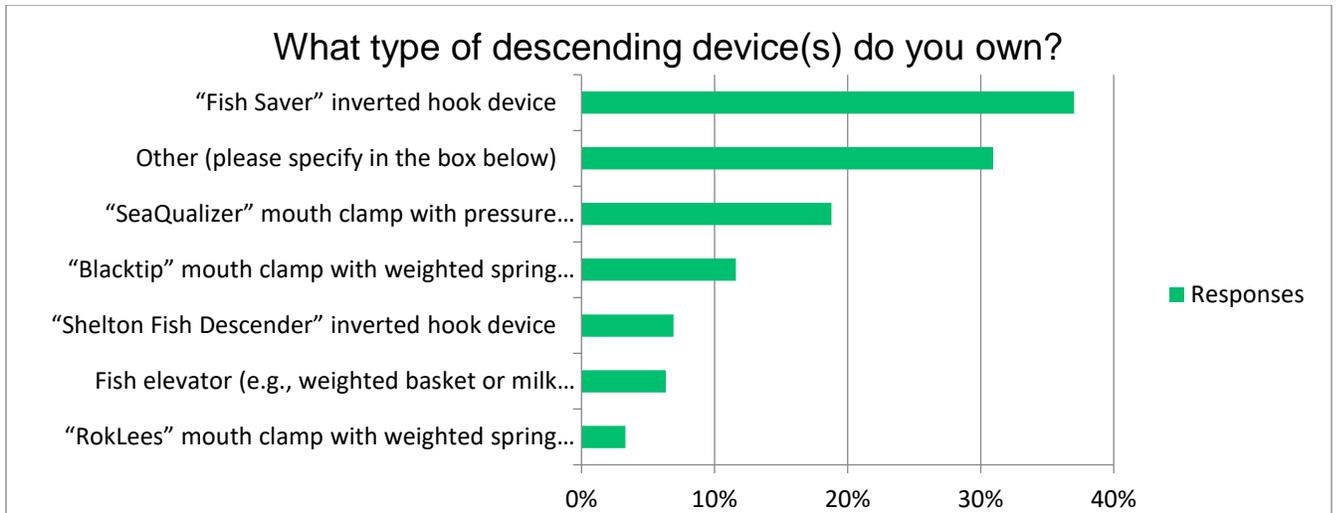


Experience with Barotrauma and Descending Devices

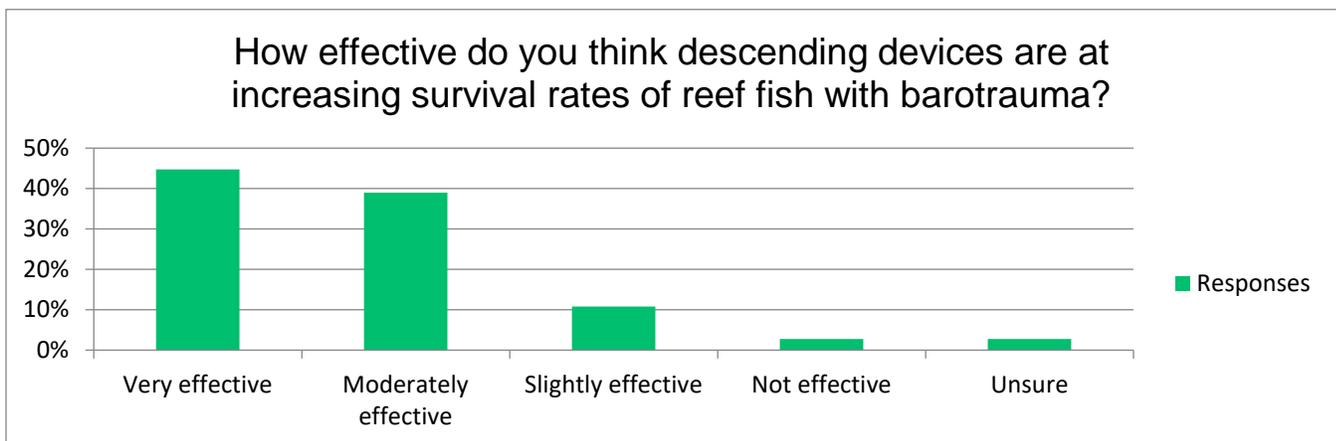
Only 362 respondents answered each question in this section. This section was only presented to respondents who indicated that they own a descending device, allowing more information about their experiences to be gathered. These respondents were also invited to participate in the study as volunteers and provide their own descending device to use during the study period.

#10. What type of descending device(s) do you own? The device most commonly owned by respondents was the "Fish Saver" (37.02%). The next common was "Other" (30.84%), for which most open-ended responses indicated either a venting tool or homemade descending device. Less common devices were "SeaQualizer" (18.78%) and "Blacktip" (11.6%). Least common were "Shelton Fish Descender" (6.91%), "Fish elevator" (6.35%), and "RokLees" (3.31%).

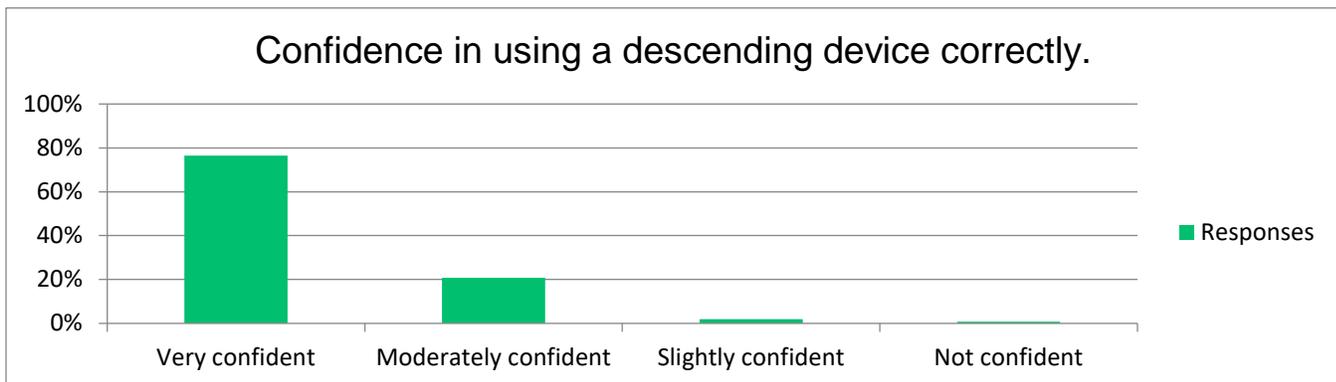
The misunderstanding between the definition of venting tool and descending device in "Other" shows that more education needs to be done on barotrauma mitigation tools. The video shown before the initial surveys were administered may have helped to clear up this misunderstanding.



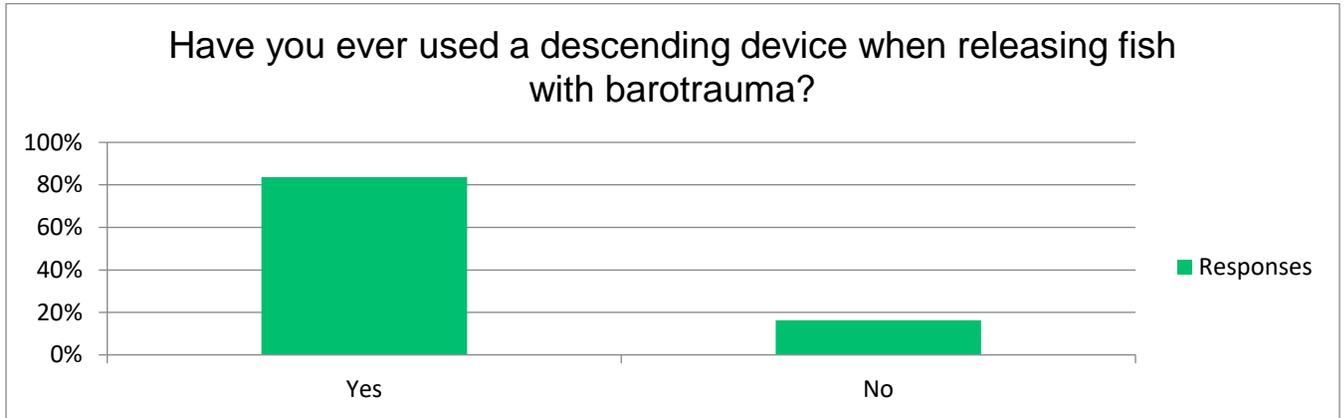
#11. How effective do you think descending devices are at increasing the survival rates of reef fish with barotrauma? Most respondents indicated that descending devices are “very effective” (44.75%) or “moderately effective” (38.95%) at increasing survival rates of reef fish with barotrauma. Only 10.77% chose “slightly effective,” while very few chose “not effective” (2.76%) or “unsure” (2.76%).



#12. How confident are you that you can use a descending device correctly? Most respondents were “very confident” (76.52%), while 20.72% were “moderately confident,” and very few were “slightly confident” (1.93%) or “not confident” (0.83%).



#13. Have you ever used a descending device when releasing fish with barotrauma? Most respondents answered “yes” (83.7%) and were taken to question 15. “No” was selected by 16.3% of respondents, who were taken to question 14, then question 25.

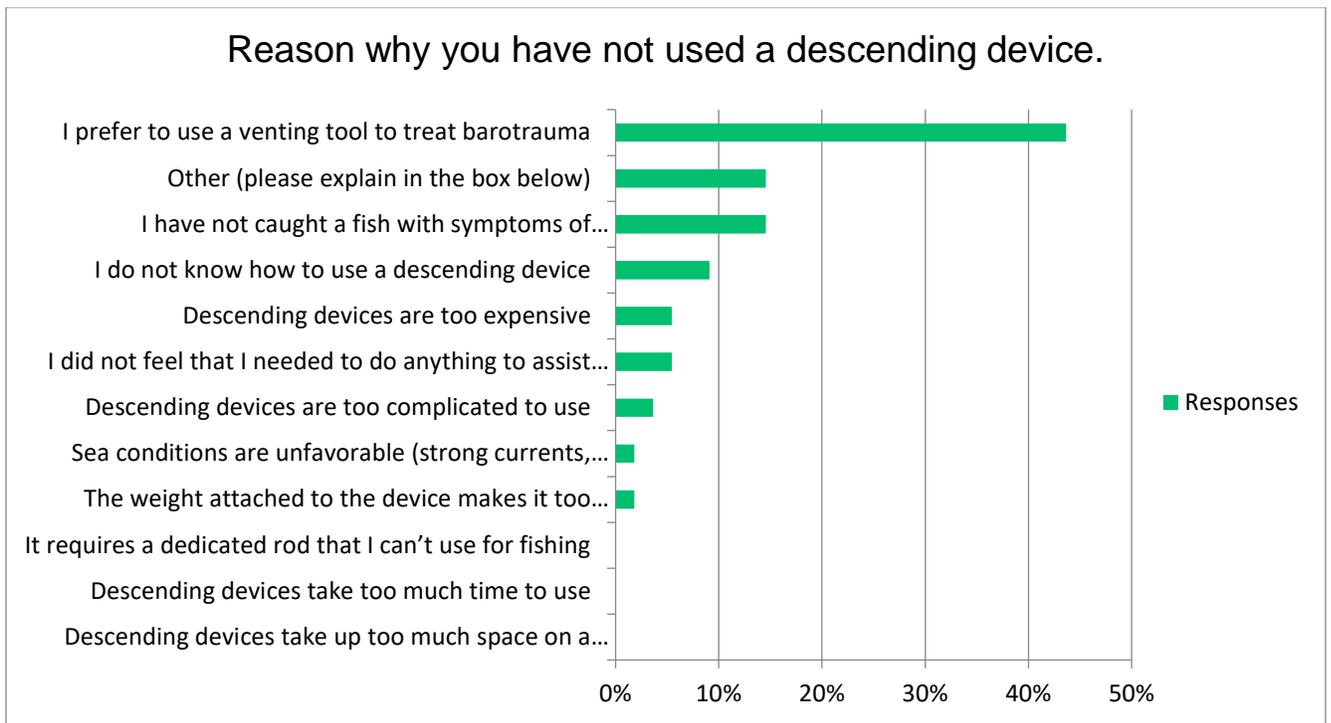


Why You Have Not Used a Descending Device

Only 55 respondents answered the question in this section.

#14. Indicate the most important reason why you have not used a descending device.

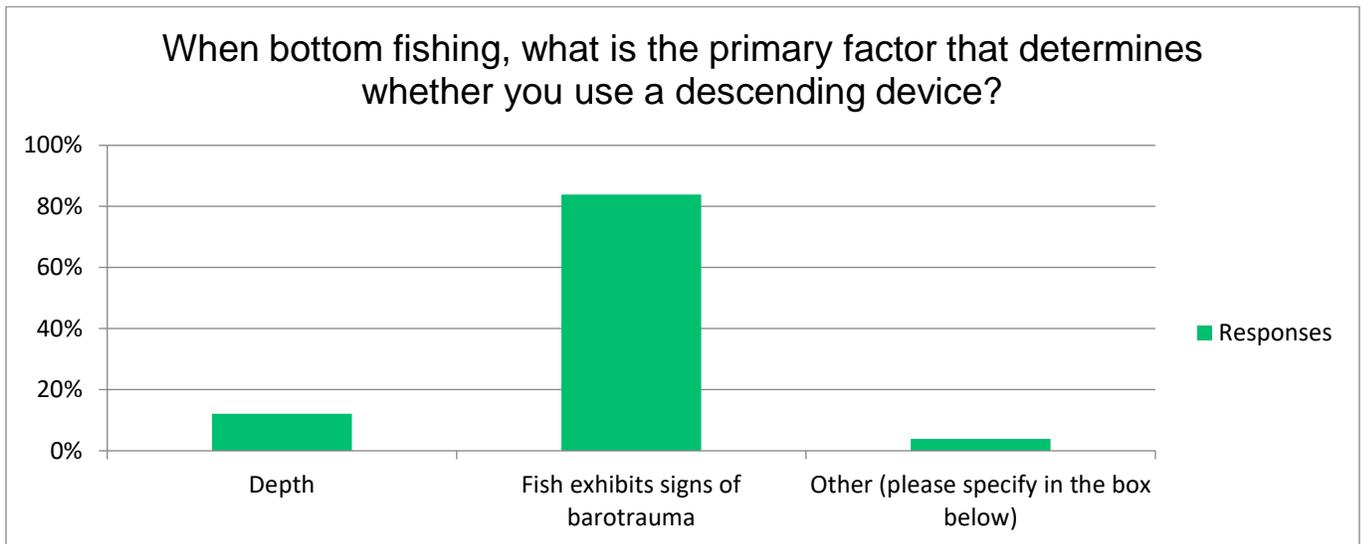
Only respondents who indicated they had not used a descending device when releasing fish with barotrauma were taken to this question, then they were taken directly to question 25. Of those respondents, the majority (43.64%) indicated they have not used a descending device because “I prefer to use a venting tool to treat barotrauma.” Other common responses included “Other” (14.55%) and “I have not caught a fish with symptoms of barotrauma” (14.55%). There were nine open-ended “Other” responses, which indicated not needing to use a device, others on board use a device, the fish still dies, and not knowing about the devices until this survey.



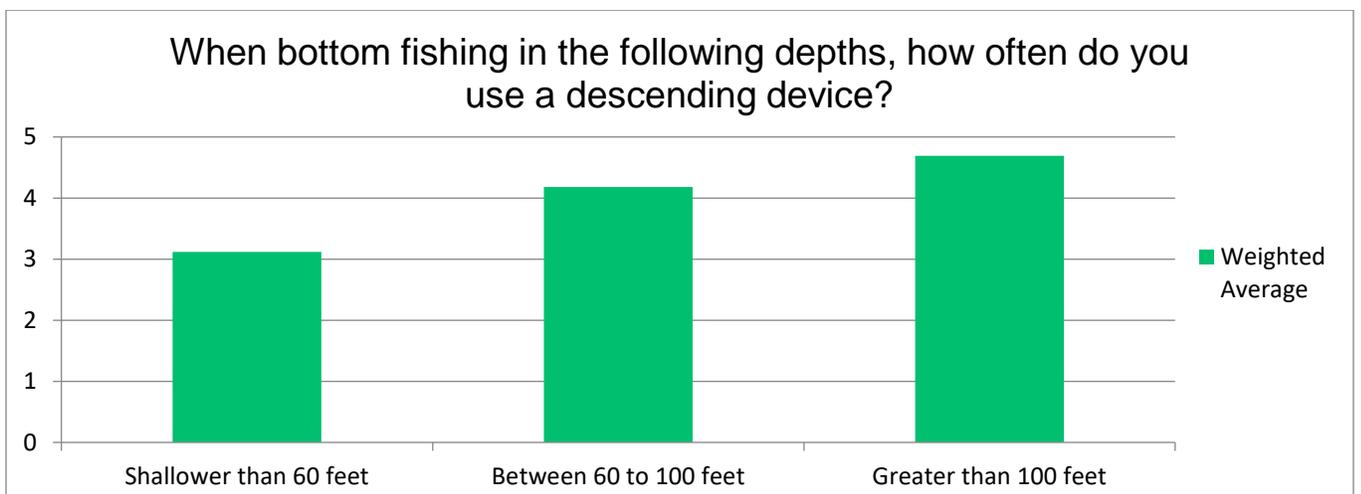
Past Use of Descending Devices

Questions 15-24 were only presented to respondents who indicated that they own a descending device and had used a descending device when releasing fish with barotrauma; there were 280 respondents to each question in this section.

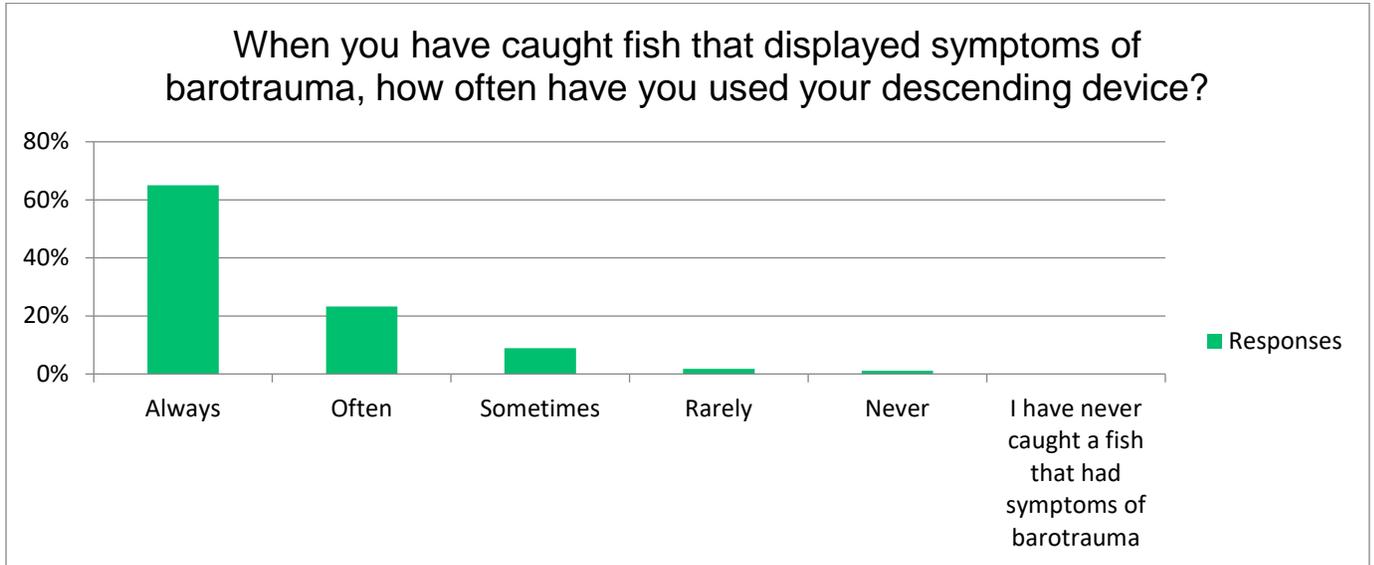
#15. When bottom fishing, what is the primary factor that determines whether you use a descending device? Most respondents (83.93%) indicated that “fish exhibits signs of barotrauma” is the primary factor in determining whether they use a descending device. This is a promising finding, since devices should only be used if the fish shows signs of barotrauma and cannot swim down on their own. Only 12.14% of respondents chose “depth” and just 3.93% chose “Other.” Responses for “Other” included lethargy, both depth and signs of barotrauma, out of season, undersized, non-target species, and speed fish is brought to the surface.



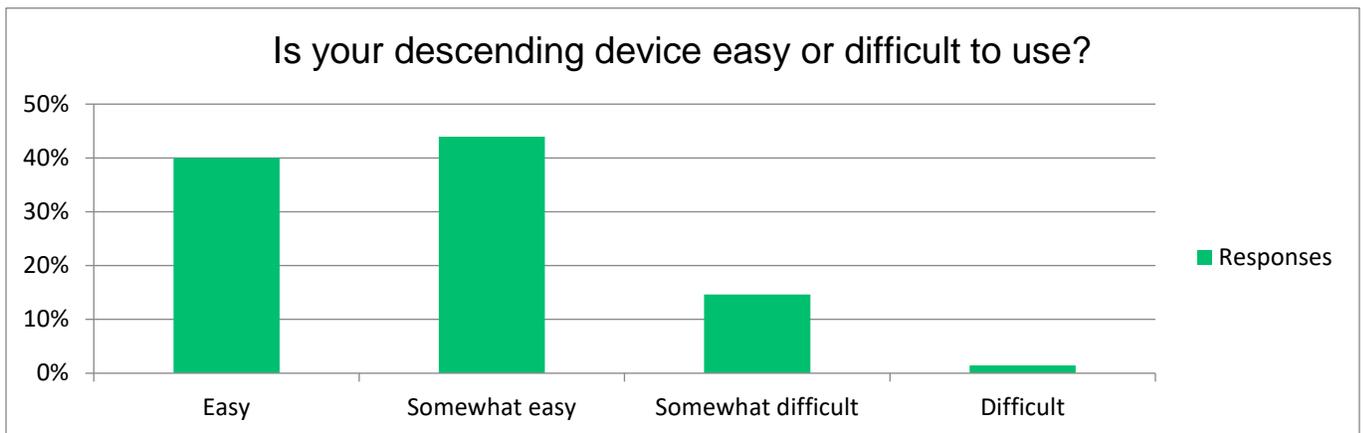
#16. When bottom fishing in the following depths, how often do you use a descending device? Using weighted averages of answer choices (1 = never, 5 = always), findings suggest that respondents most often use a descending device when fishing in depths greater than 100 feet, followed by 60-100 feet, then less than 60 feet. This indicates that more fish exhibit barotrauma in deeper waters, which aligns with current knowledge of the effects of barotrauma.



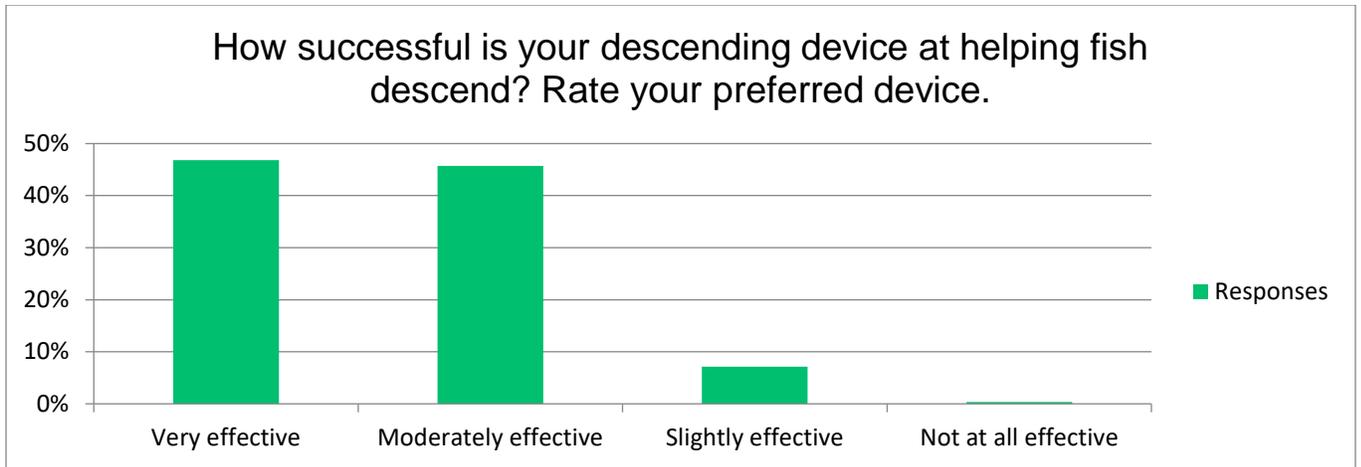
#17. When you have caught fish that displayed symptoms of barotrauma, how often have you used your descending device when releasing the fish? Most respondents (65%) said they “always” use a descending device when fish show signs of barotrauma. Just 23.21% said “often,” 8.93% said “sometimes,” 1.79% said “rarely,” and only 1.07% said “never.” None of the respondents chose “I have never caught a fish that had symptoms of barotrauma.”



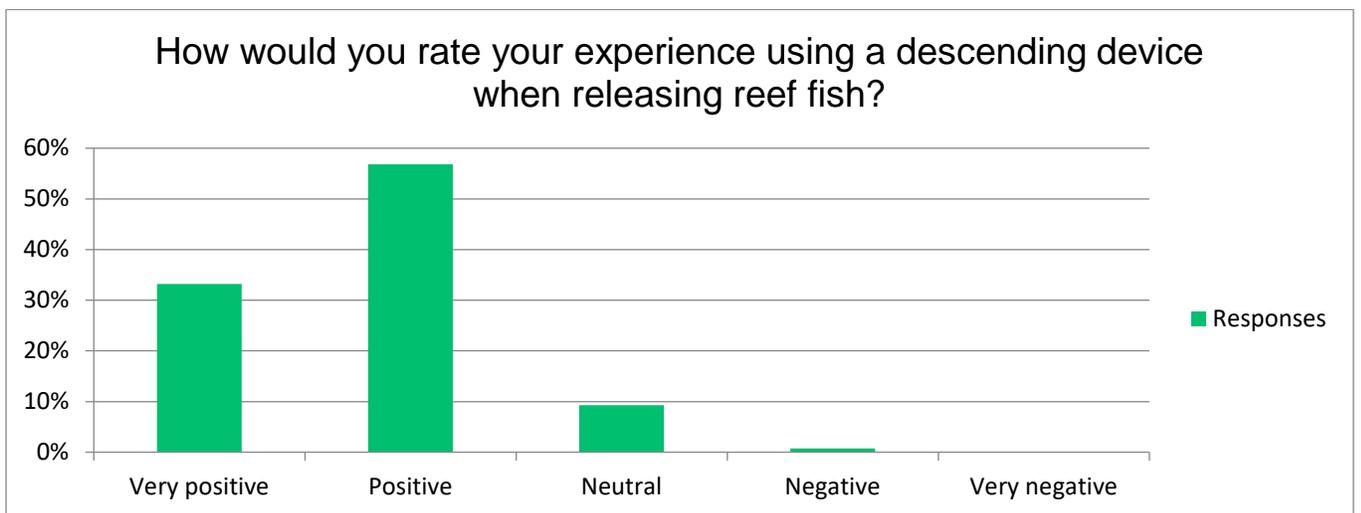
#18. Is your descending device easy or difficult to use? If you own or have used more than one style of device, rate ease of use based upon your preferred device. Most respondents chose “easy” (40.00%) or “somewhat easy” (43.93%). Less chosen responses for ease of use were “somewhat difficult” (14.64%) and “difficult” (1.43%).



#19. How successful is your descending device at helping fish descend? If you own or have used more than one style of device, rate ease of use based upon your preferred device. Most respondents rated their descending device as “very effective” (46.79%) or “moderately effective” (45.71%). Less chosen responses were “slightly effective” (7.14%) and “not at all effective” (0.36%).



#20. How would you rate your experience using a descending device when releasing reef fish? Most respondents rated their experience using a descending device as “positive” (56.79%), while 33.21% chose “very positive.” Of the respondents, 9.29% chose “neutral” and only 0.71% chose “negative.” None of the respondents chose “very negative.”

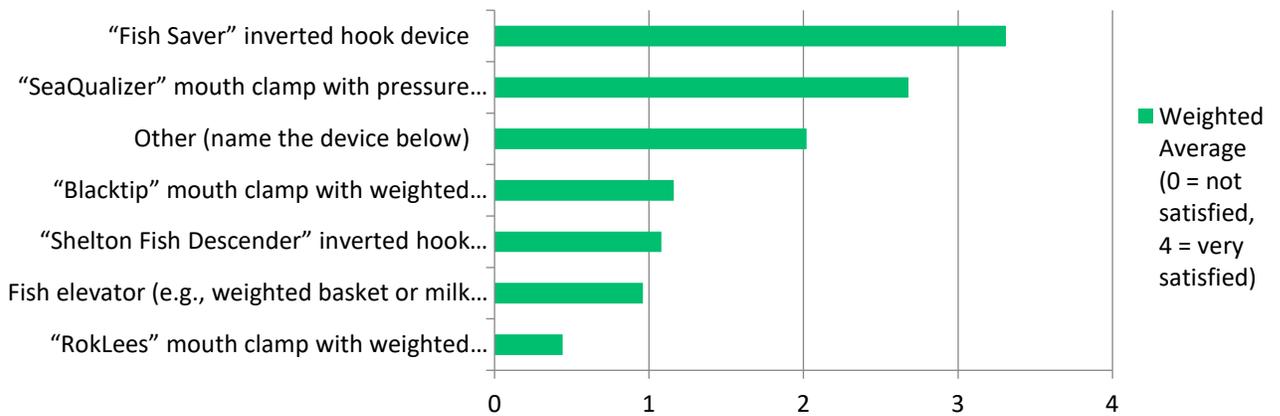


#21. If you answered “Neutral,” “Negative,” or “Very Negative” above, please explain.

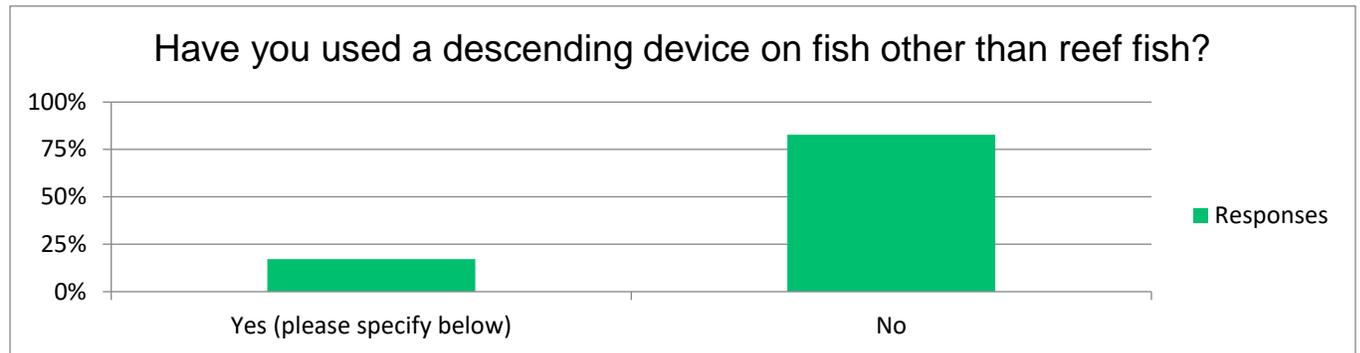
There were 29 responses to this open-ended question. Many respondents mentioned that descending devices don’t always work; are cumbersome, heavy, and difficult to use; make it easy for predators to target released fish; may injure fish; provide an unknown survival rate for descended fish; and are frustrating because they take time away from fishing.

#22. Please indicate your satisfaction with using the following types of descending devices for reef fish with barotrauma. Using weighted averages of answer choices (0 = not satisfied, 4 = very satisfied), the “Fish Saver” and “SeaQualizer” descending devices indicated the highest levels of satisfaction, followed by “Other” devices. A few responses for “Other” described a homemade descending device, but many described a venting tool. This misunderstanding between the definition of venting tool and descending device shows that more education is needed on barotrauma mitigation tools. The video shown before the initial surveys were administered may have helped to clear up this misunderstanding.

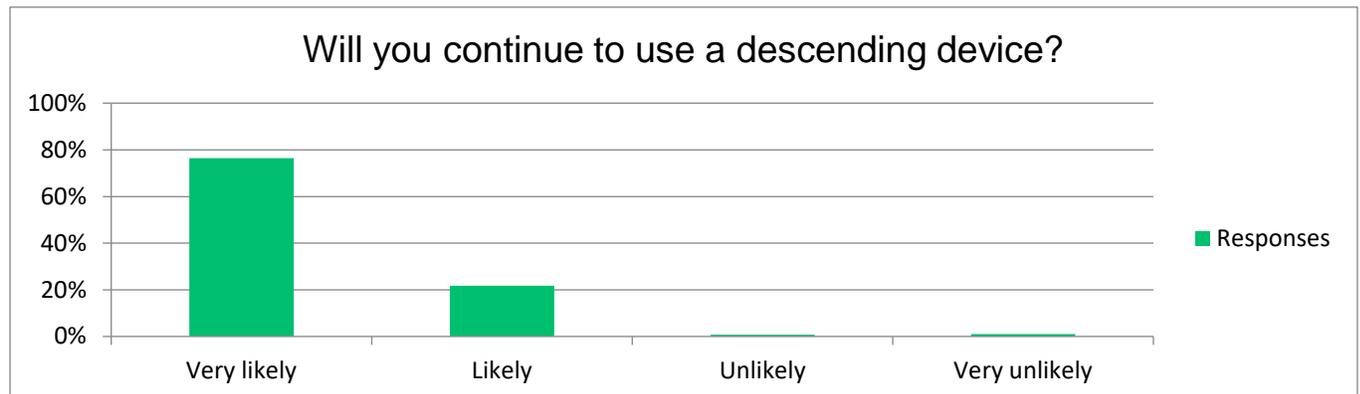
Please indicate your satisfaction with using the following types of descending devices for reef fish with barotrauma.



#23. Have you used your descending device on any fish other than reef fish (snapper, grouper, etc.)? The majority of respondents (82.86%) indicated that they have not used their descending device on fish other than reef fish. Only 17.14% of respondents indicated that they have used their descending device on other species, including catfish, striped bass, cobia, red drum, snook, remora, and any fish that cannot get back down on their own.

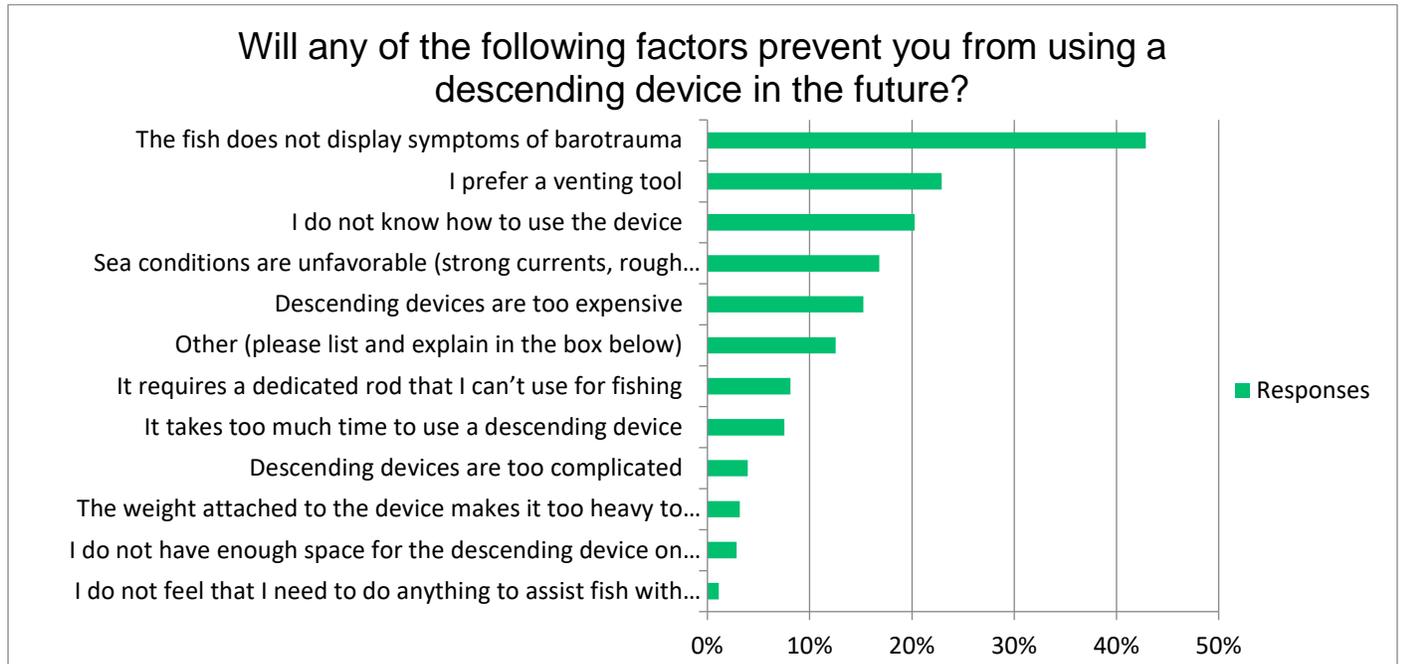


#24. What is the likelihood that you will continue to use a descending device? Most respondents (76.43%) indicated they are "very likely" to continue using a descending device in the future. Only 21.79% chose "likely," 0.71% chose "unlikely," and 1.07% chose "very unlikely."



Future Use of Descending Devices

#25. Based on your experience, will any of the following factors prevent you from using a descending device in the future? This question was answered by 1,540 respondents. The most common response (42.86%) for why the respondent would not use a descending device in the future was if “The fish does not display symptoms of barotrauma.” This finding is promising because it shows that a majority of respondents know not to use a device unless the fish is suffering from barotrauma.



#26. Do you have any comments or thoughts regarding your participation in this survey or the use of descending devices? Respondents provided 545 open-ended comments regarding the study, barotrauma, and descending devices. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.

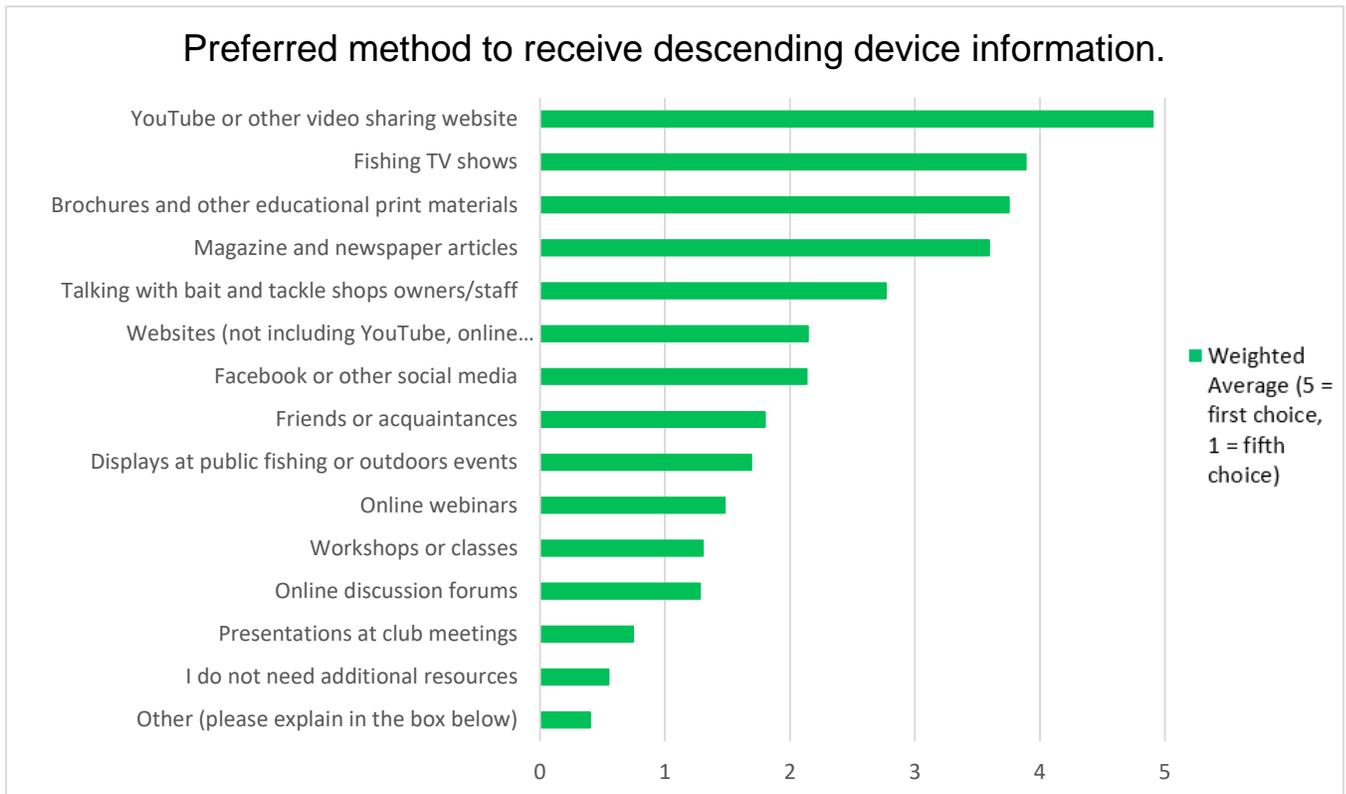


Please Tell Us More About You

#27. How would you prefer to receive information about descending devices? Please indicate your top five choices. This question was answered by 1,413

respondents. Using weighted averages of answer choices (5 = first choice, 1 = fifth choice), the most frequently selected first choice (and the highest weighted average across all choices) was for sharing information via “YouTube or other video sharing website.” This was followed closely by “fishing TV shows,” “brochures and other educational print materials,” and “magazine and newspaper articles.” Less frequently selected first choices were (in order of preference) “talking with bait and tackle shops owners/staff,” “websites (not including YouTube, online discussion forums, and social media),” “Facebook or other social media,” “friends or acquaintances,” and “displays at public fishing or outdoors events.” The least selected first choices were (in order of preference) “online webinars,” “workshops or classes,” “online discussion forums,” “presentations at club meetings,” “I do not need additional resources,” and “Other.” The most common response to “Other” was to receive a direct email from FWC.

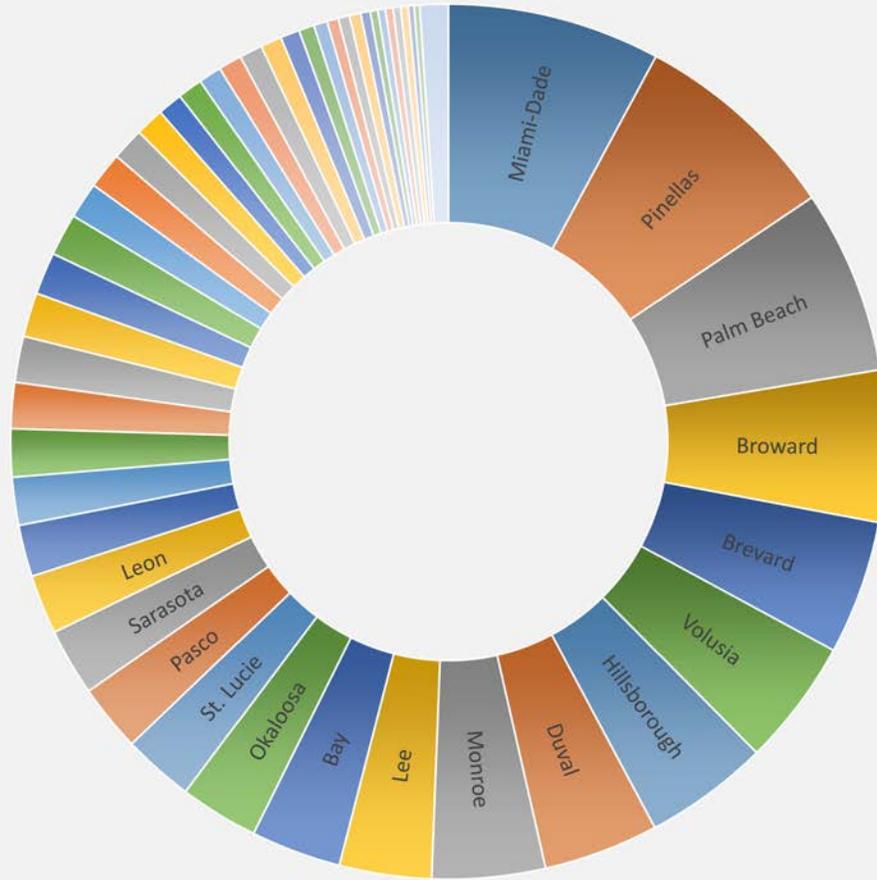
These findings suggest that highly visual methods of receiving information, such as YouTube videos and fishing shows, are more preferred by reef fish anglers. However, traditional print media such as articles and brochures are also desired. Interestingly, presentations, workshops, online forums, webinars, and displays at public events were least preferred by respondents. It is important to note that these findings should not be generalized to the angling public as a whole.



#28. Name: First name and last name were collected for 1,413 respondents to keep track of potential participants who could move forward in the study process.

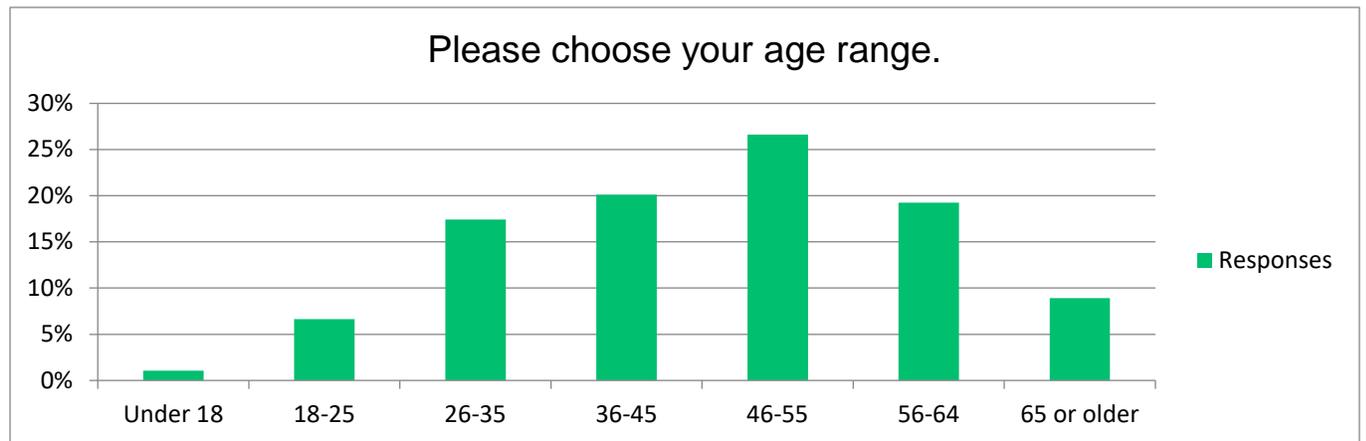
#29. County of residence. No county had a vast majority of respondents, however Miami-Dade had the most (7.86%, 111 people), followed closely by Pinellas (7.71%, 109 people), Palm Beach (6.79%, 96 people), and Broward (5.59%, 79 people). The chart below shows labels for counties with at least 2% of respondents. Counties with less than 2% of respondents are shown in the chart, but are not labeled. Additional data is available from the author.

County of residence.



#30. Please choose your age range: Of the 1,413 respondents that answered this question, most (26.61%) were in the 46-55 age group, followed by 36-45 (20.1%), 56-64 (19.25%), 26-35 (17.41%), 65 or older (8.92%), 18-25 (6.65%), and under 18 (1.06%).

Please choose your age range.



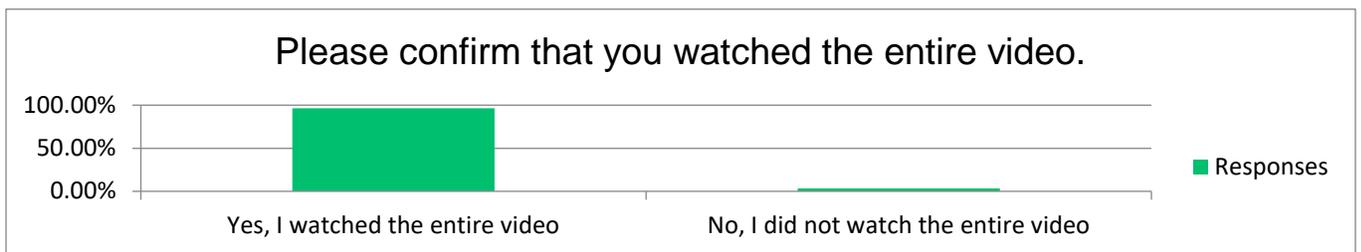
#31. Please enter the same email address to which this survey link was sent. Email addresses were collected for 1,413 respondents and used to contact prospective participants with an offer to move forward in the study process. This data can be requested from the author.

2) A: Initial Survey for Participants (pre-study)

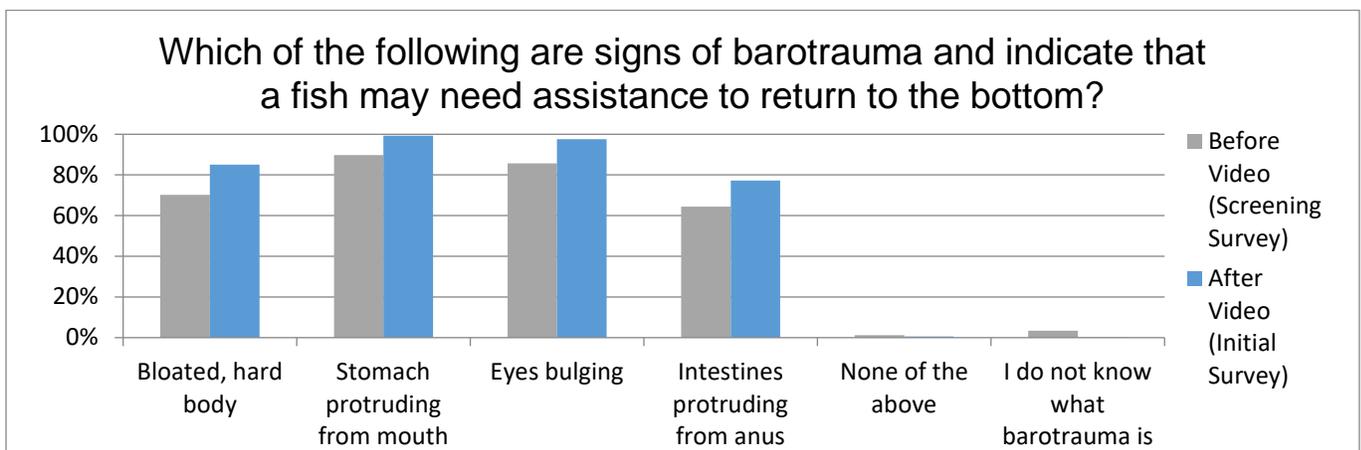
The initial survey for participants was provided via a link in an email that was sent to 1,097 anglers in June and early July. These anglers were selected because they did not yet own a device and they completed the initial survey before all devices were allocated. Anglers were asked to watch a 3.5-minute video on barotrauma and descending devices before taking the survey (the video was embedded in the first page of the survey). There were 667 people who responded at least partially to the initial survey for participants and 650 fully-completed surveys, resulting in a 59.25% response rate. After removing duplicates and those who did not fully-complete the initial survey, 634 descending devices were mailed to participants.

Understanding of Barotrauma

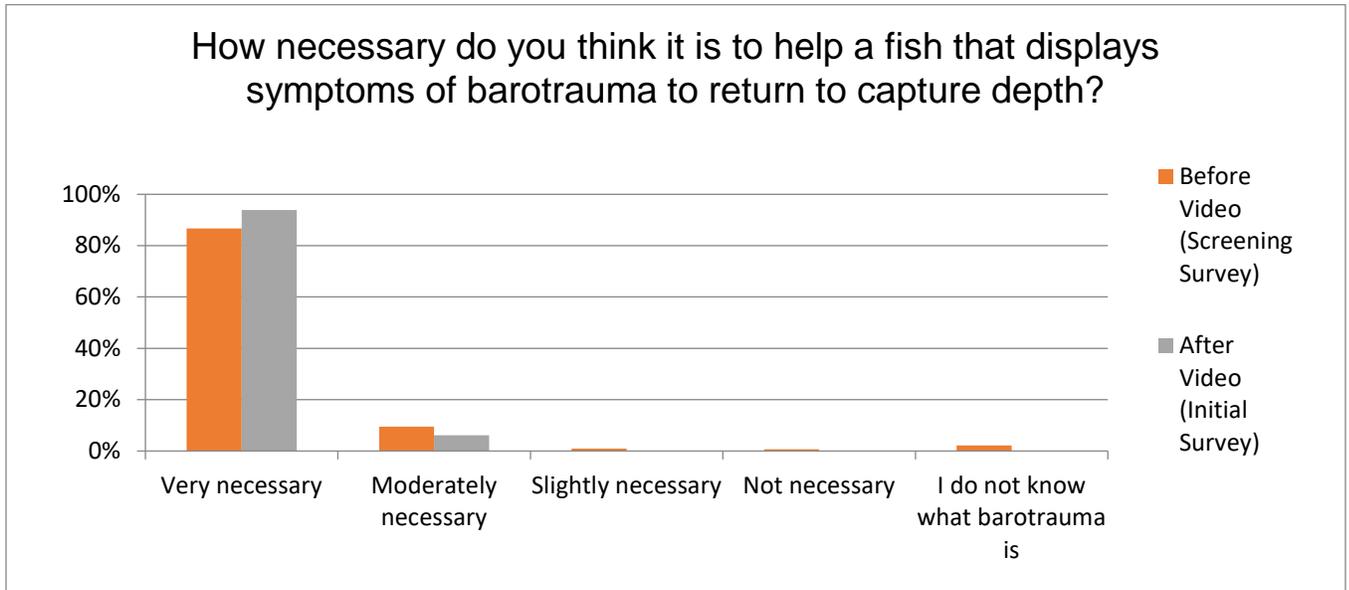
#1. Please confirm that you watched the entire video. A vast majority (96.55%) of the 667 respondents to this question indicated that they watched the video, which was embedded in the first page of the survey. Those who did not watch the video (3.45%) gave reasons such as the video didn't start, they couldn't find the video, Survey Monkey skipped the video or would not let them go back to it, they had previously watched the video, or they did not receive the video link.



#2. Which of the following are signs of barotrauma and indicate that a fish may need assistance to return to the bottom? Most of the 667 respondents are aware of the signs of barotrauma, and respondents' knowledge of barotrauma increased after watching the educational barotrauma video. The answer chosen most often was "stomach protruding from mouth" (99.25%, up from 89.79% in the screening survey), followed by "eyes bulging" (97.60%, up from 85.63%), "bloated, hard body" (85.01%, up from 70.24%), and "intestines protruding from anus" (77.21%, up from 64.42%). These four responses were all significantly different at $P < .05$ when comparing screening to initial surveys, indicating that participants learned about barotrauma from watching the video. Only 0.60% of respondents selected "none of the above" (down from 1.14%) and 0.15% selected "I do not know what barotrauma is" (down from 3.42%).

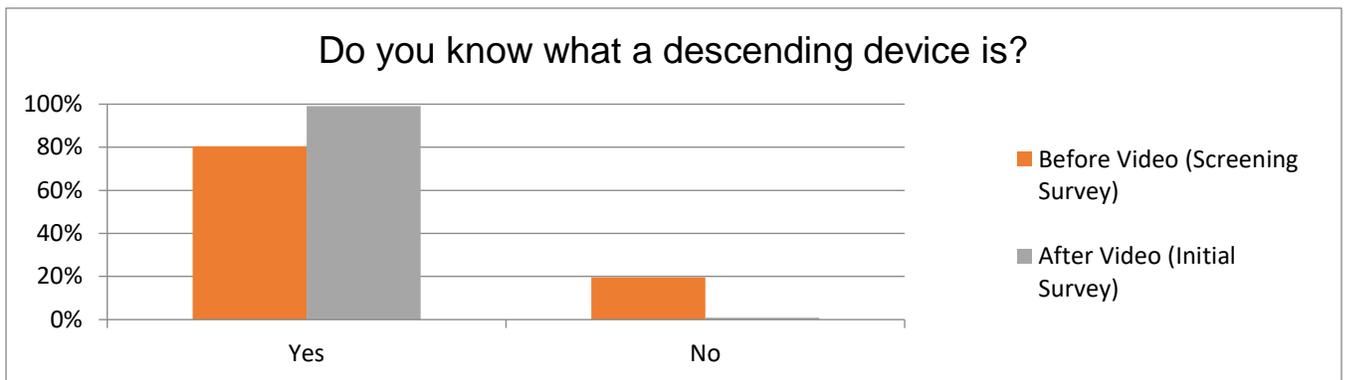


#3. How necessary do you think it is to help a fish that displays symptoms of barotrauma to return to capture depth? Compared to the screening survey, a higher percentage of respondents indicated that assisting fish with barotrauma is “very necessary” (93.85%, an increase from 86.72%, which was significantly different at $P < .05$), while all other answers were chosen less often, indicating that the video taught respondents about the importance of assisting fish with barotrauma. “Moderately necessary” was chosen by 6.15% of respondents (down from 9.52%), while no respondents chose “slightly necessary,” “not necessary,” and “I do not know what barotrauma is” (down from 0.91%, 0.63%, and 2.22%, respectively).

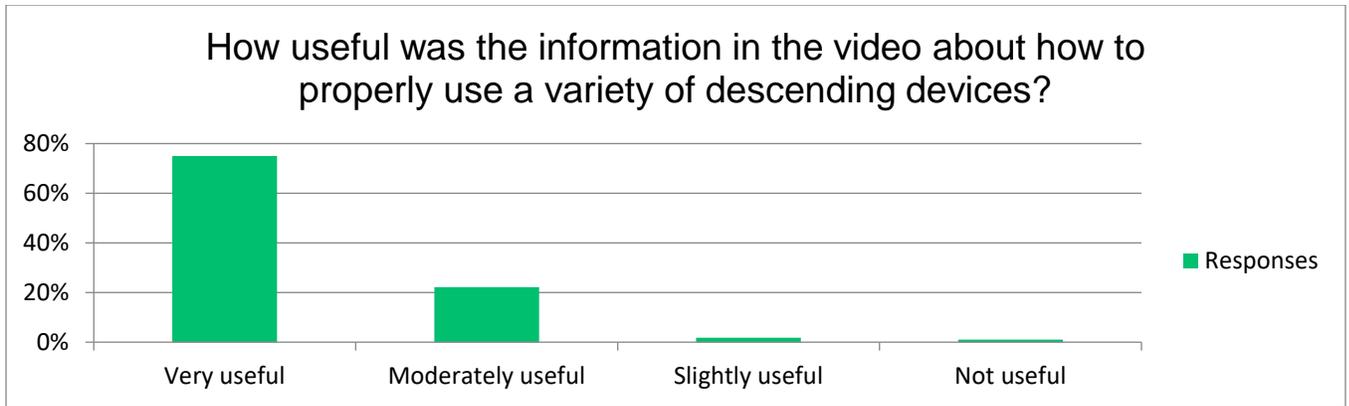


Using a Descending Device

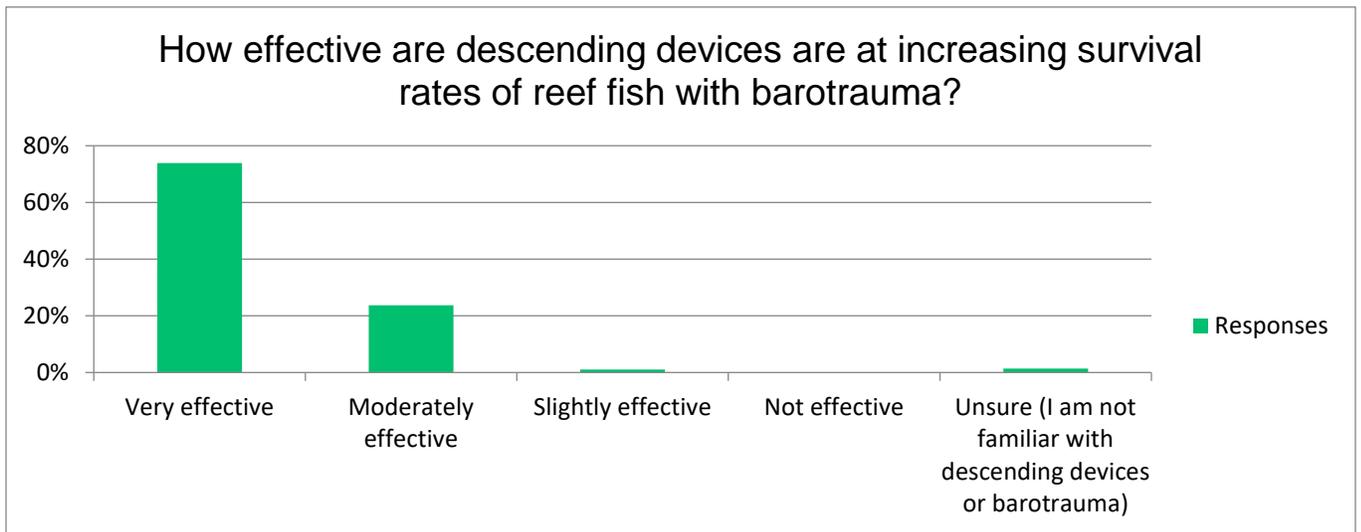
#4. Do you know what a descending device is? Compared to the screening survey, a higher percentage of respondents (99.09%, up from 80.42%, which was significantly different at $P < .05$) indicated that they knew what a descending device is, with only 0.91% (down from 19.58%) indicating that they did not know. This finding shows that respondents learned about descending devices by watching the video.



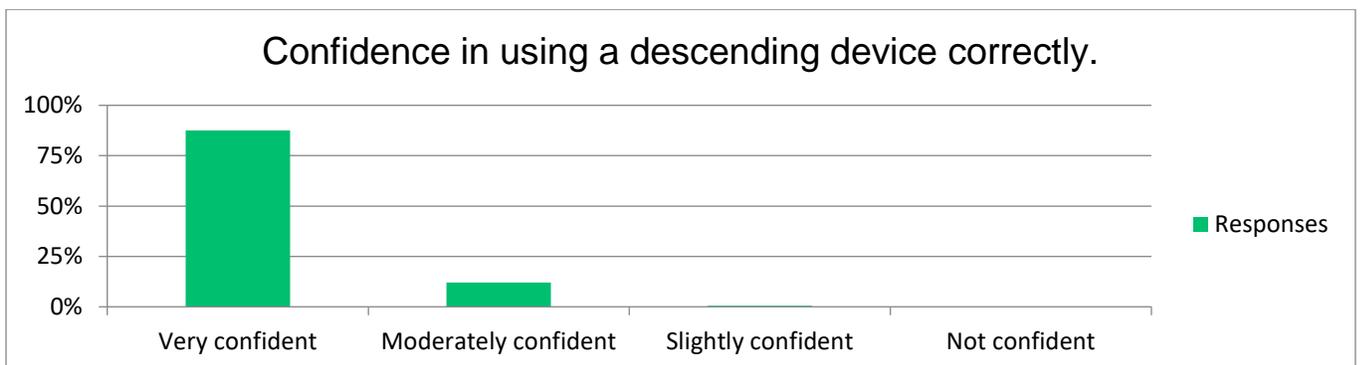
#5. How useful was the information in the video about how to properly use a variety of descending devices? Most respondents (74.92%) indicated that the video was “very useful,” while only 22.21% found it “moderately useful” and very few respondents found it “slightly useful” (1.81%) or “not useful” (1.06%).



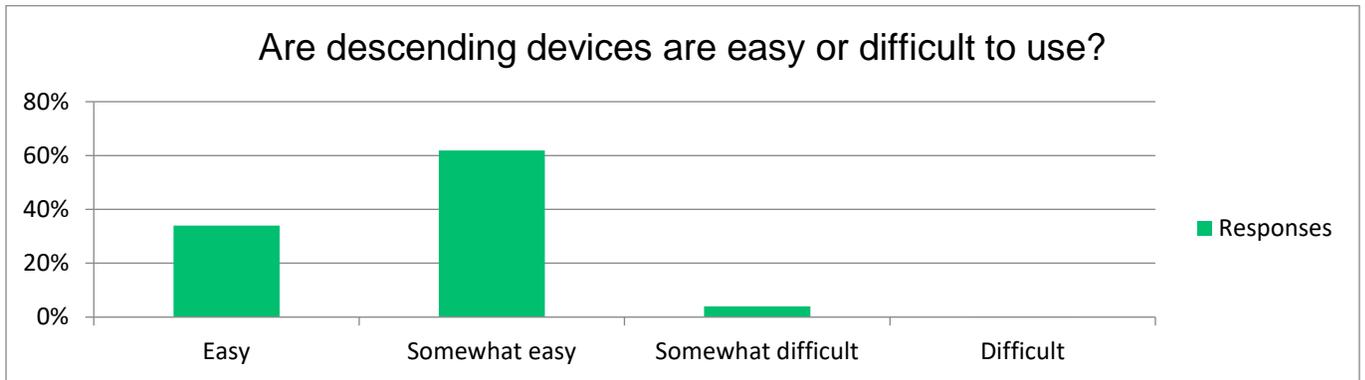
#6. How effective do you think descending devices are at increasing the survival rates of reef fish with barotrauma? Most respondents indicated that descending devices are “very effective” (73.87%) at increasing survival rates of reef fish with barotrauma. Just 23.72% chose “moderately effective,” only 1.06% chose “slightly effective,” no respondents chose “not effective,” and very few chose “unsure” (1.36%).



#7. How confident are you that you can use a descending device correctly? Most respondents were “very confident” (87.46%) that they could use a descending device correctly. Only 12.08% were “moderately confident,” very few were “slightly confident” (0.45%), and none of the respondents chose “not confident.”

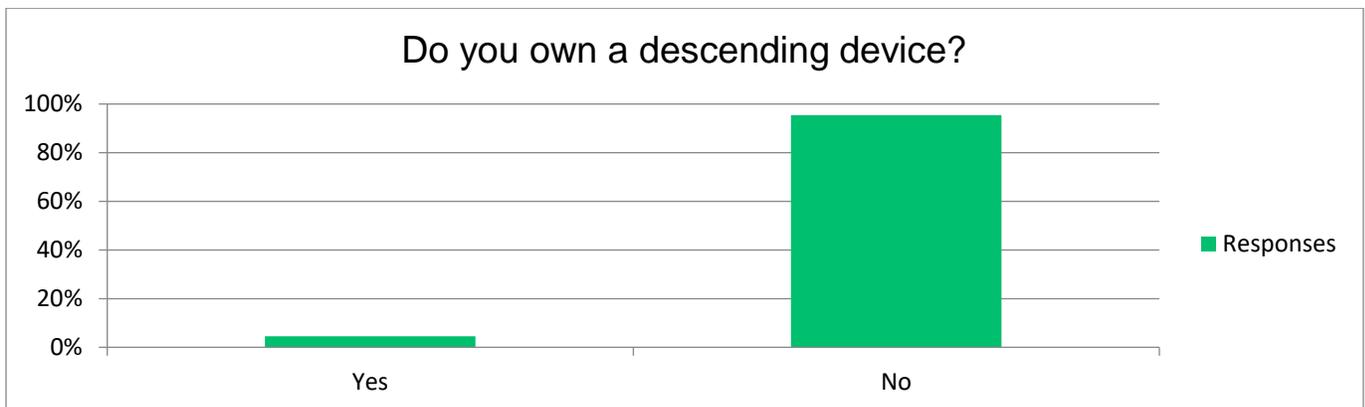


#8. Do you think that descending devices are easy or difficult to use? Almost all respondents indicated that they think it is “easy” (33.99%) or “somewhat easy” (61.93%) to use a descending device. Only 3.93% chose “somewhat difficult” and just 0.15% chose “difficult.”

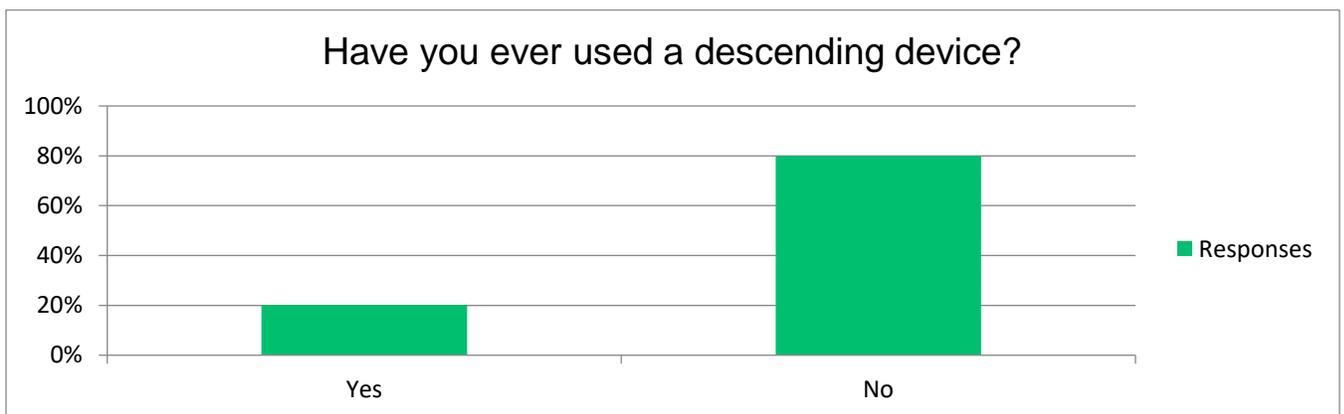


Experience with Descending Devices

#9. Do you own a descending device? The majority (95.47% or 632 people) of respondents indicated “no” they do not own a descending device, while 4.53% (30 people) chose “yes.” This finding confirms that FWC provided most descending devices to anglers who did not own one.

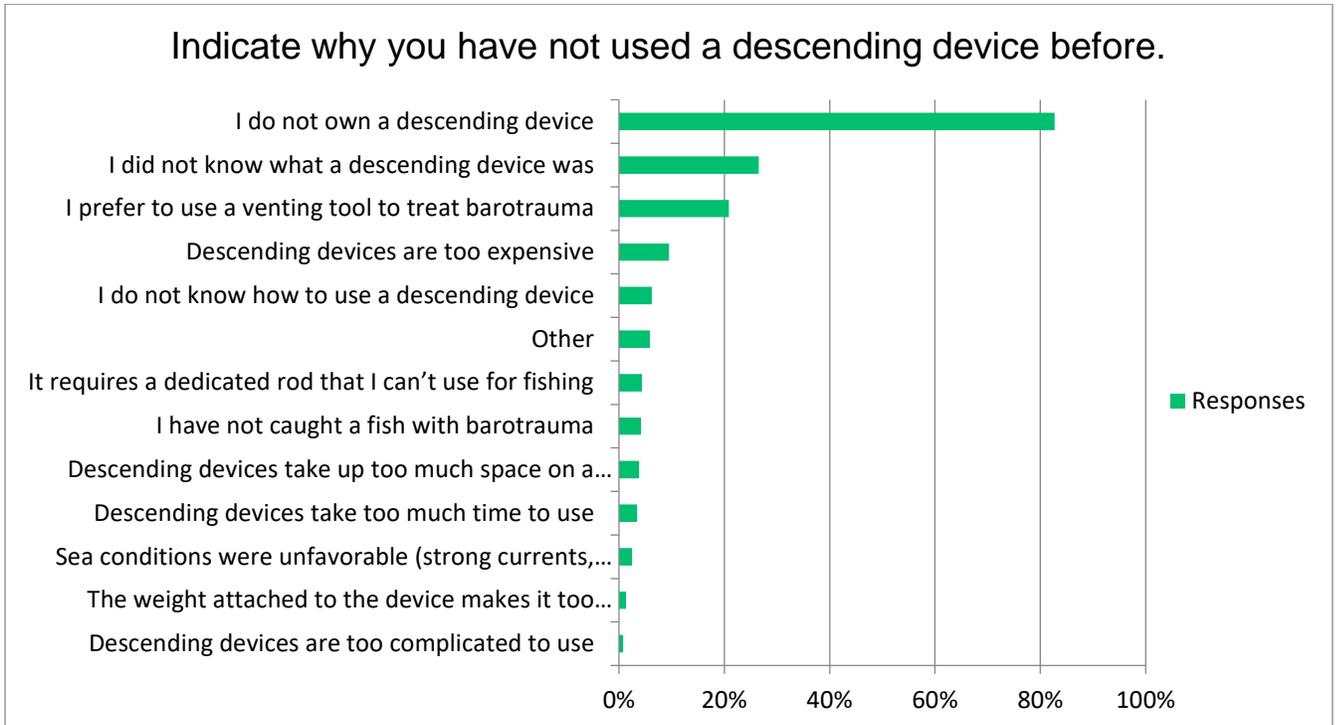


#10. Have you ever used a descending device when releasing fish with barotrauma? A majority (79.91%) of the 662 respondents indicated “no” they had not used a descending device before, while 20.09% chose “yes.” Respondents who answered “yes” were taken directly to question 12.



Why You Have Not Used a Descending Device

#11. Please indicate why you have not used a descending device before. This question was only presented to respondents who indicated that they have never used a descending device. Of the 527 respondents, the majority (82.73%) indicated “I do not own a descending device” as the reason why they have not used a descending device before. Less chosen responses were “I did not know what a descending device was” (26.57%) and “I prefer to use a venting tool to treat barotrauma” (20.87%). These findings indicate a need to make descending devices more accessible to anglers and to provide more outreach on the use of descending devices as barotrauma mitigation tools.



Please Tell Us More About You

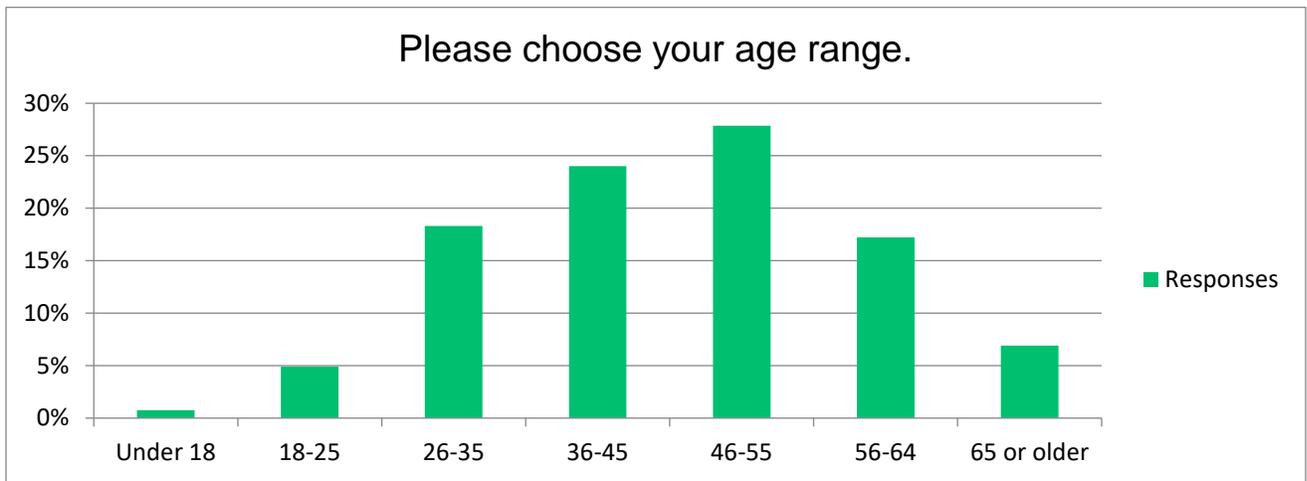
#12. Do you have any comments or thoughts regarding your participation in this study or the use of descending devices? Respondents provided 310 open-ended comments regarding the study, barotrauma, and descending devices. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.



#13. Please provide your name. First name and last name were collected for 650 respondents to keep track of participants during the study process.

#14. Please provide your mailing address and phone number. This information was collected for 650 respondents so that descending devices could be mailed to participants. Data may be requested from the author.

#15. Please choose your age range. Of the 650 respondents that answered this question, most (27.85%) were in the 46-55 age group, followed by 36-45 (24%), 26-35 (18.31%), 56-64 (17.23%), 65 or older (6.92%), 18-25 (4.92%), and under 18 (0.77%). This distribution is similar to the age ranges chosen by screening survey respondents.



#16. Please enter the same email address to which this survey link was sent. Email addresses were collected for 650 respondents and used to maintain contact with participants during the study process. This data can be requested from the author.

2) B: Initial Survey for Volunteers (pre-study)

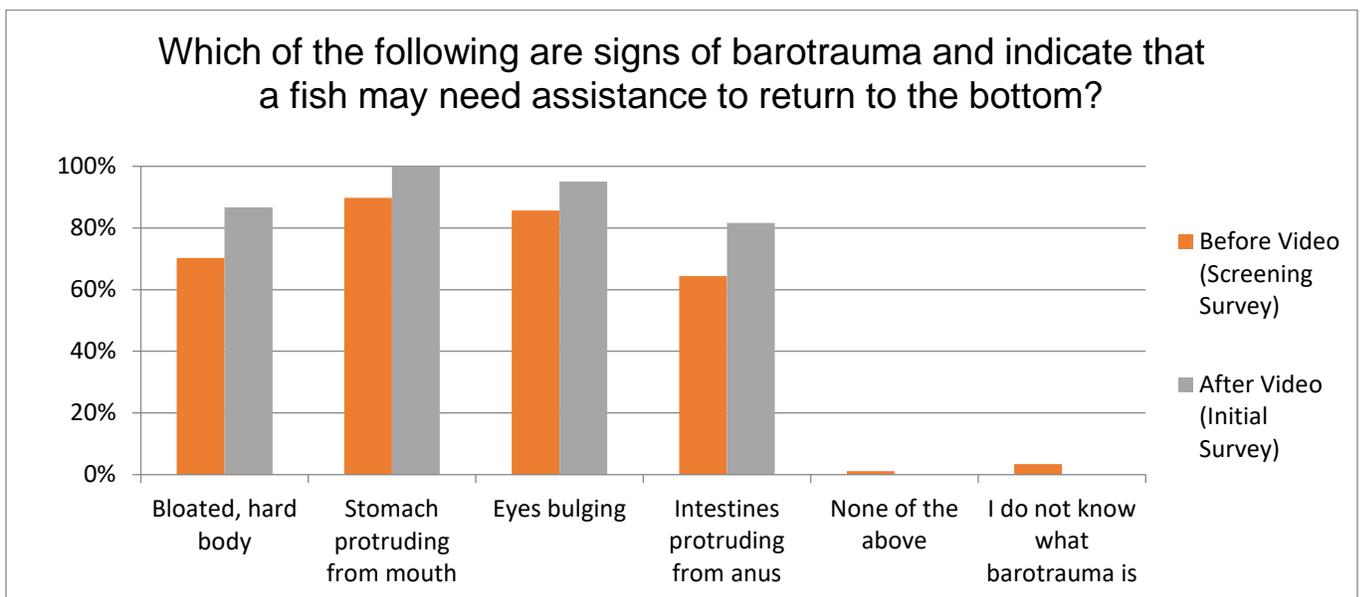
The initial survey for volunteers was provided via a link in an email that was sent to 291 anglers from June through August. Anglers were asked to watch a 3.5-minute video on barotrauma and descending devices before taking the survey (the video was embedded in the first page of the survey). There were 60 people who responded at least partially to the initial survey for volunteers and 57 fully-completed surveys, resulting in a 19.58% response rate.

Understanding of Barotrauma

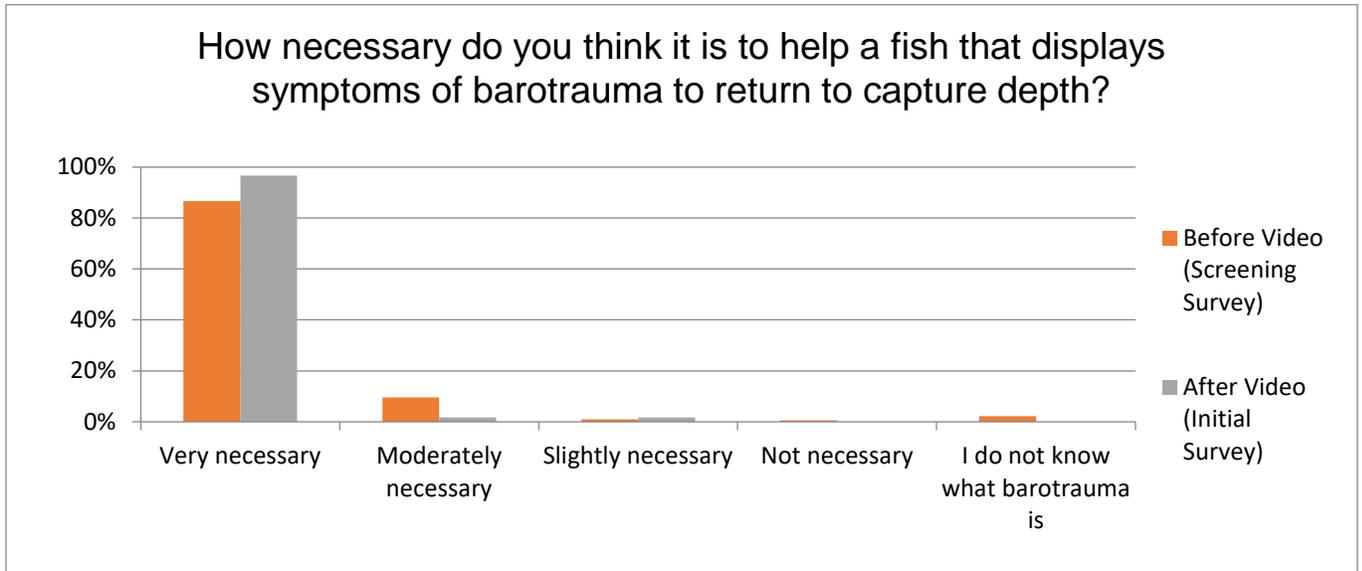
#1. Please confirm that you watched the entire video. The majority (95%) of the 60 respondents to this question indicated that they watched the video, which was embedded in the first page of the survey. Those who did not watch the video (5%) mentioned that they did not have time and that Survey Monkey would not let them go back to the video later.



#2. Which of the following are signs of barotrauma and indicate that a fish may need assistance to return to the bottom? Most of the 60 respondents are well aware of the signs of barotrauma, and respondents' knowledge of barotrauma increased after watching the educational barotrauma video. The answer chosen most often was "stomach protruding from mouth" (100%, up from 89.79% in the screening survey, which was significantly different at $P < .05$), followed by "eyes bulging" (95%, up from 85.63%), "bloated, hard body" (86.67%, up from 70.24%, which was significantly different at $P < .05$), and "intestines protruding from anus" (81.67%, up from 64.42%, which was significantly different at $P < .05$). No respondents selected "none of the above" and "I do not know what barotrauma is).

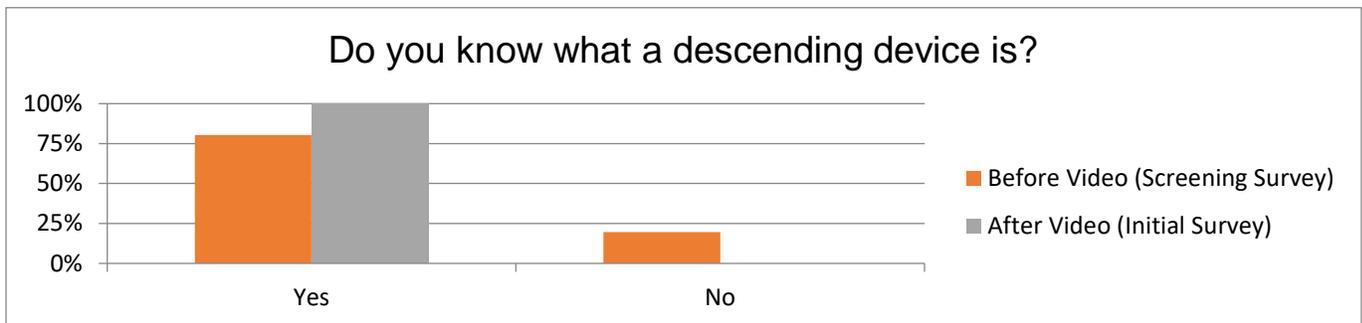


#3. How necessary do you think it is to help a fish that displays symptoms of barotrauma to return to capture depth? Compared to the screening survey, a higher percentage of respondents indicated that assisting fish with barotrauma is “very necessary” (96.67%, up from 86.72%, which was significantly different at $P < .05$), while all other answers were chosen much less often, indicating that the video taught respondents about the importance of assisting fish with barotrauma. Only 1.67% of respondents chose “moderately necessary” (down from 9.52%) and 1.67% chose “slightly necessary” (down from 0.91%). No respondents chose “not necessary” and “I do not know what barotrauma is” (down from 0.63% and 2.22%, respectively).

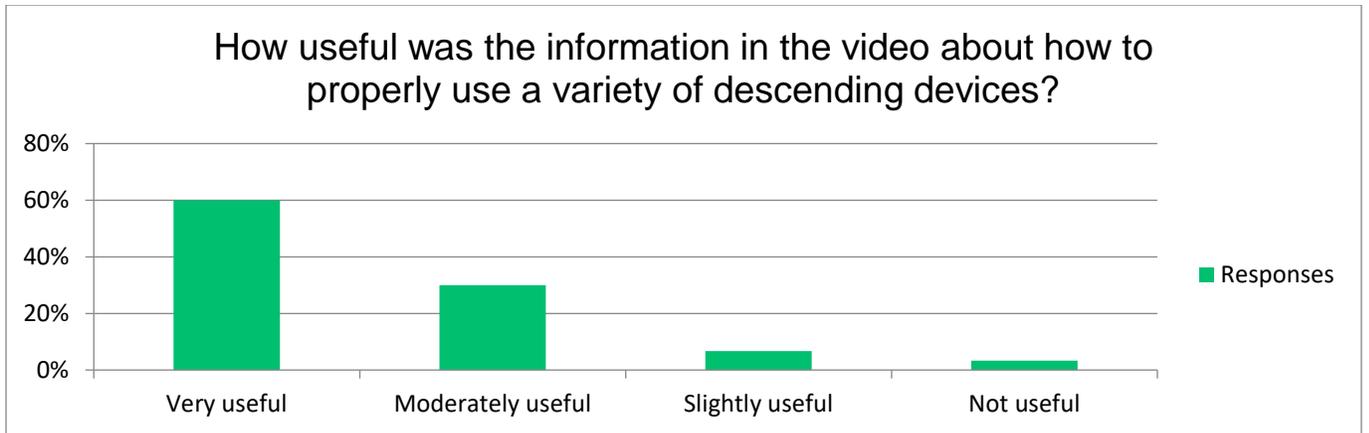


Using a Descending Device

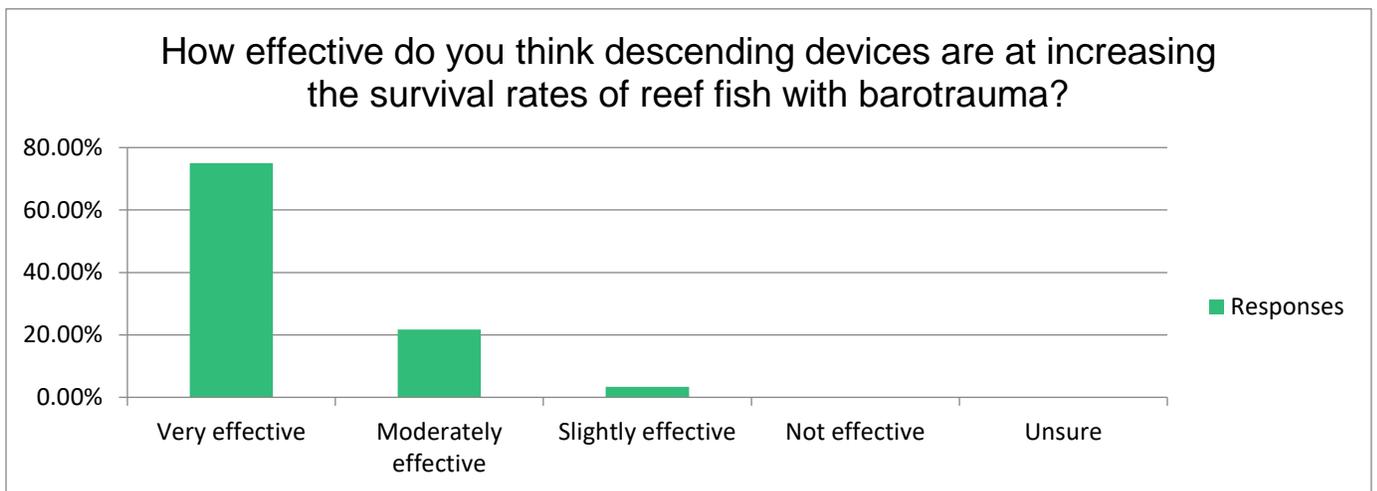
#4. Do you know what a descending device is? All of the respondents (100%, up from 80.42% in the screening survey, which was significantly different at $P < .05$) indicated that they know what a descending device is, while none of the respondents indicated that they did not know (down from 19.58%). This finding makes sense because anglers that already own a descending device (75% of respondents to this survey; see question 9) should know what a descending device is. Also, the video may have helped anglers who do not own a device to learn about descending devices.



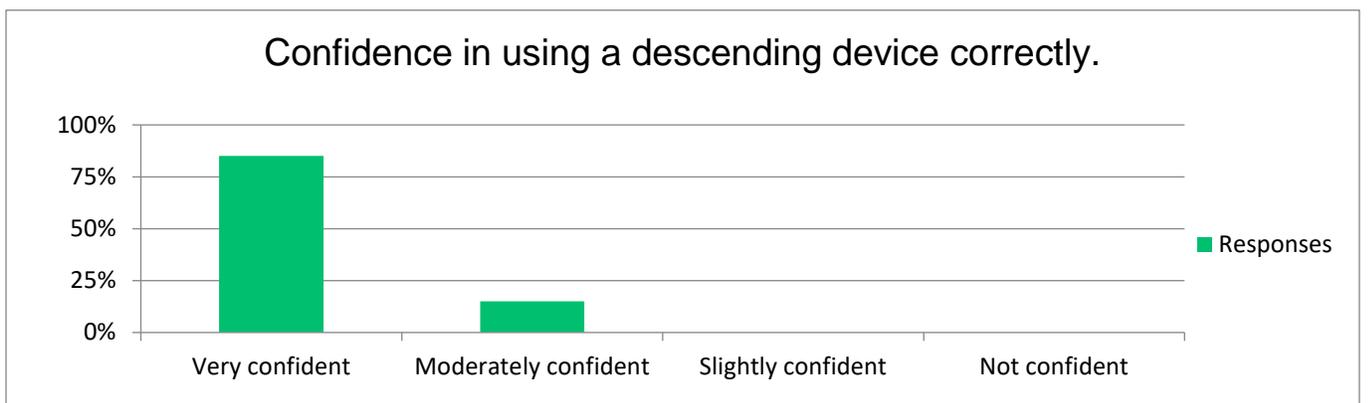
#5. How useful was the information in the video about how to properly use a variety of descending devices? The majority of respondents (60%) indicated that the video was “very useful,” while 30% found it “moderately useful.” Very few respondents found it “slightly useful” (6.67%) or “not useful” (3.33%).



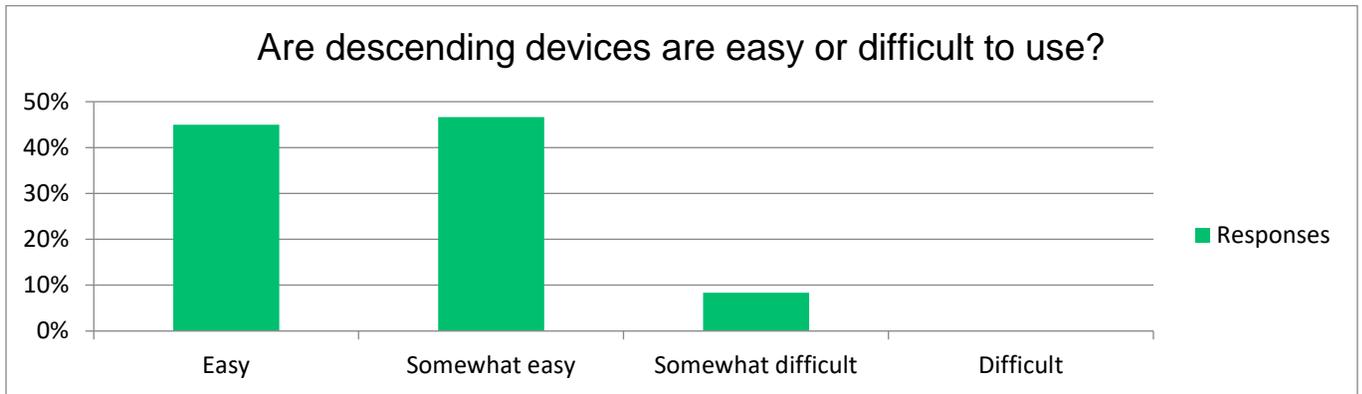
#6. How effective do you think descending devices are at increasing the survival rates of reef fish with barotrauma? Most respondents indicated that descending devices are “very effective” (75%) at increasing survival rates of reef fish with barotrauma. Just 21.67% chose “moderately effective” and only 3.33% chose “slightly effective.” No respondents chose “not effective” and “unsure.”



#7. How confident are you that you can use a descending device correctly? Most respondents were “very confident” (85%) that they could use a descending device correctly. Only 15% were “moderately confident.” None chose “slightly confident” or “not confident.”

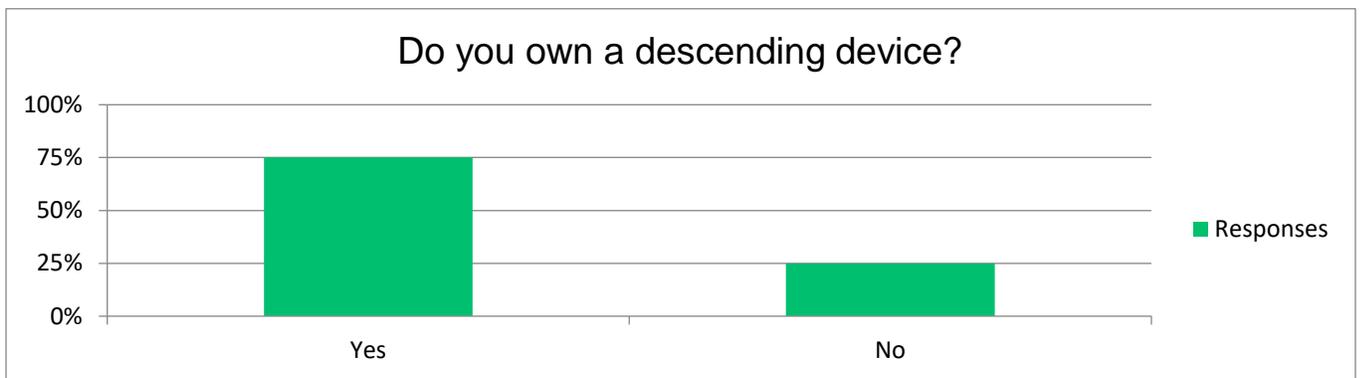


#8. Do you think that descending devices are easy or difficult to use? Almost all respondents indicated that they think it is “easy” (45%) or “somewhat easy” (46.67%) to use a descending device. Only 8.33% chose “somewhat difficult” and none chose “difficult.”

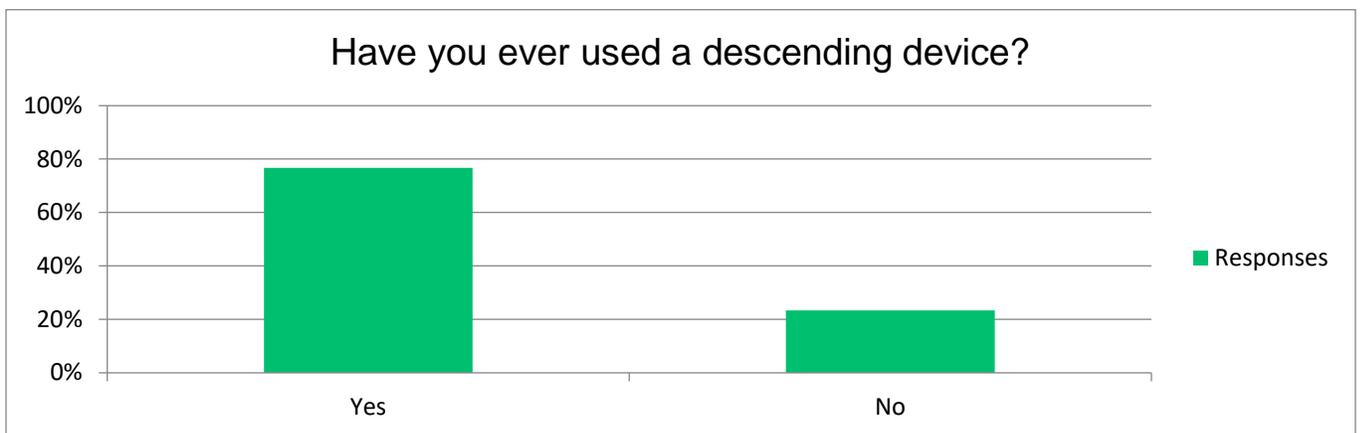


Experience with Descending Devices

#9. Do you own a descending device? A majority (75%) of respondents indicated “yes” they do own a descending device, while 25% indicated “no” they do not own a descending device.

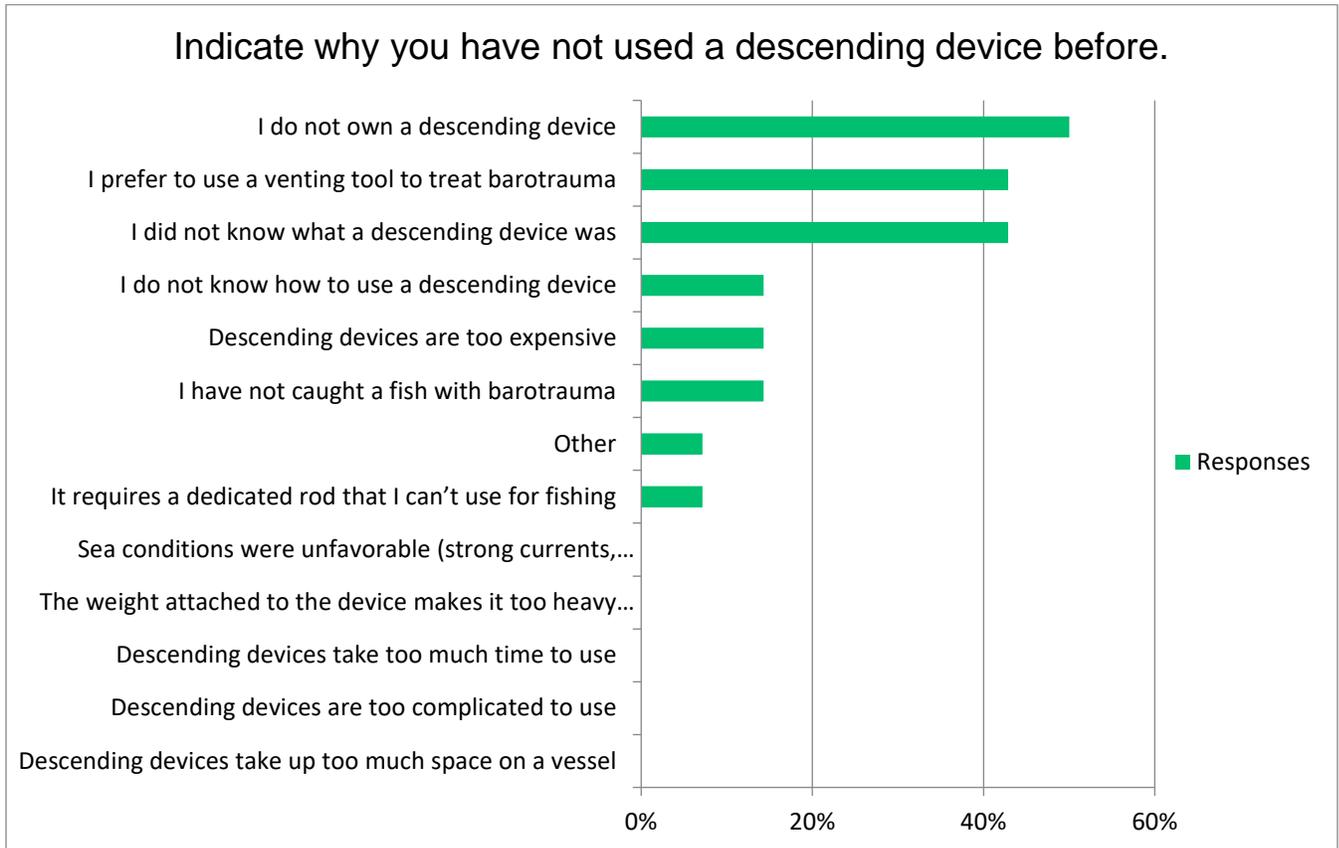


#10. Have you ever used a descending device when releasing fish with barotrauma? A majority (76.67%) of the 60 respondents indicated “yes” they have used a descending device, while 23.33% chose “no.” Respondents who answered “yes” were taken directly to question 12.



Why You Have Not Used a Descending Device

#11. Please indicate why you have not used a descending device before. Of the 14 respondents to this question, most indicated “I do not own a descending device” (50%), “I prefer to use a venting tool to treat barotrauma” (42.86%), and “I did not know what a descending device was” (42.86%) as the reason why they have not used a descending device before. These findings indicate a need to make descending devices more accessible to anglers and to provide more outreach on the use of descending devices as barotrauma mitigation tools.



Please Tell Us More About You

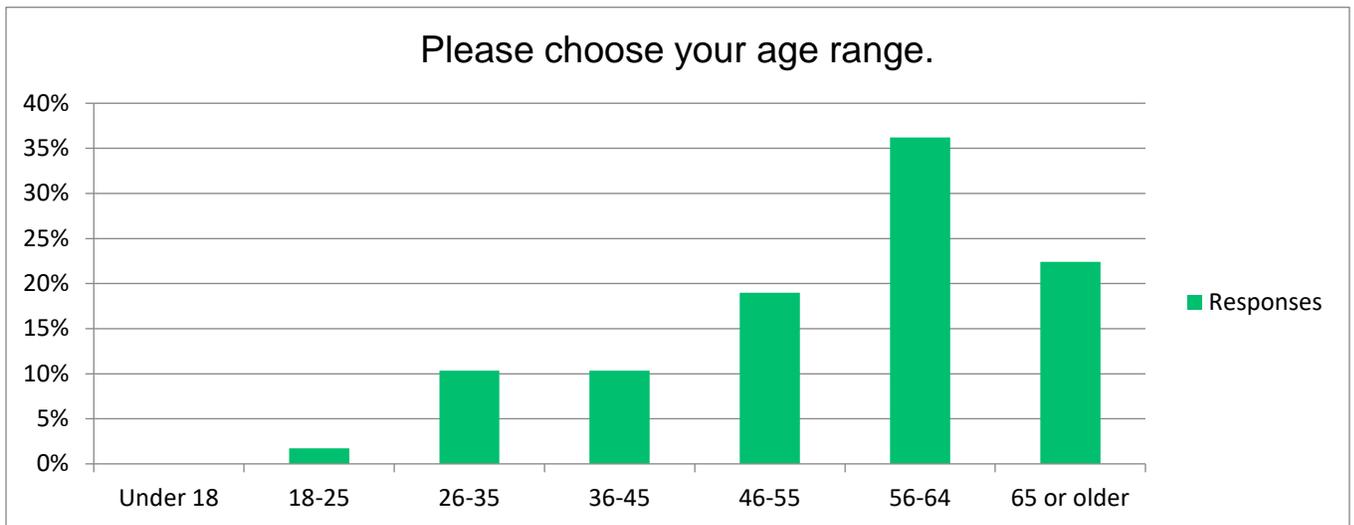
#12. Do you have any comments or thoughts regarding your participation in this study or the use of descending devices? Respondents provided 29 open-ended comments regarding the study, barotrauma, and descending devices. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.

Fish Participate Device Survival Rate Boat

#13. Please provide your name. First name and last name were collected for 58 respondents to keep track of volunteers during the study process.

#14. Please provide your mailing address and phone number. This information was collected for 58 respondents. Data may be requested from the author.

#15. Please choose your age range. Of the 58 respondents that answered this question, most (36.21%) were in the 56-64 age group, followed by 65 or older (22.41%) and 46-55 (18.97%). Few were in the 26-35 (10.34%) and 36-45 (10.34%) age ranges, while only 1.72% were 18-25 and none were under 18. These findings indicate that anglers who already owned a descending device or were willing to provide their own device for the study were generally older, mid-40s and upwards. This distribution differs from the age ranges of respondents to the screening survey and initial survey for participants (who would receive a device from FWC), which generally ranged in age from their mid-20s to mid-50's.



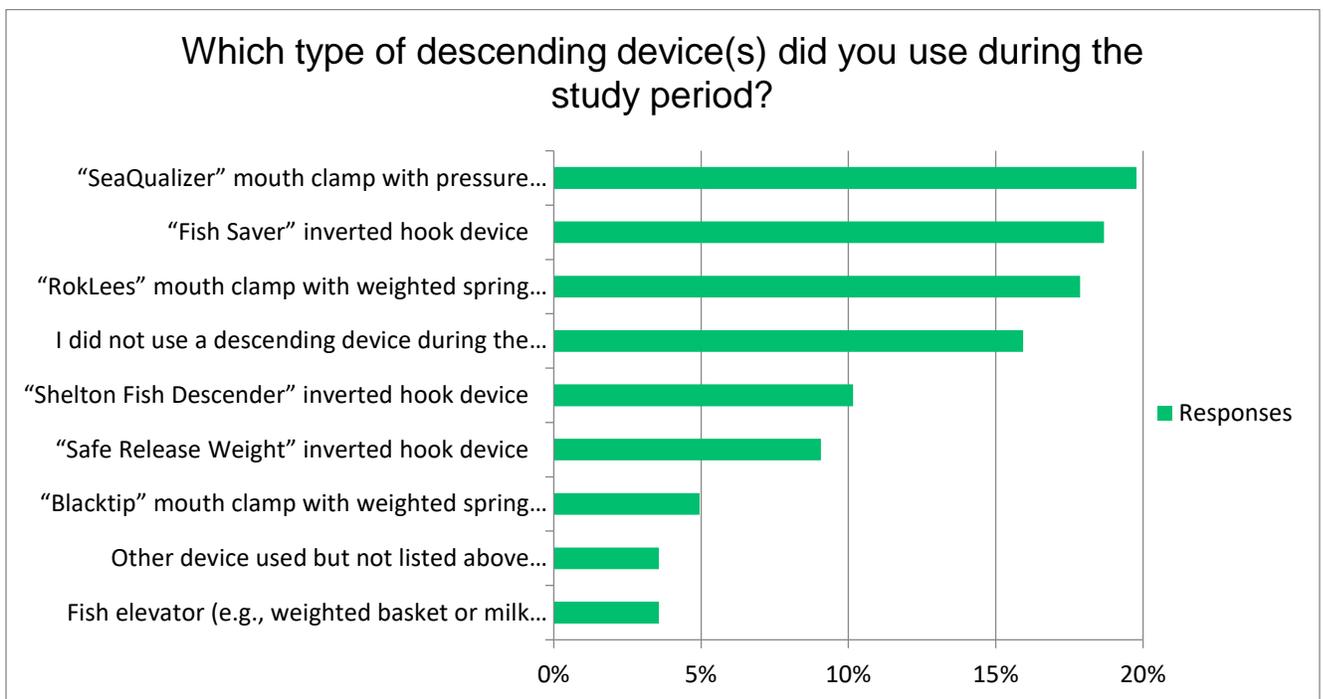
#16. Please enter the same email address to which this survey link was sent. Email addresses were collected for 58 respondents and used to maintain contact with volunteers during the study process. This data can be requested from the author.

3) A: Follow-up Survey for Participants (post-study)

The follow-up survey for participants was provided via a link in an email that was sent to 633 anglers on Nov. 1, 2017. Participants were asked to complete the follow-up survey by Nov. 14, 2017. There were 364 people who responded at least partially to the follow-up survey for participants and 345 fully-completed surveys, resulting in a 54.5% response rate.

Type of Descending Device Used During the Study

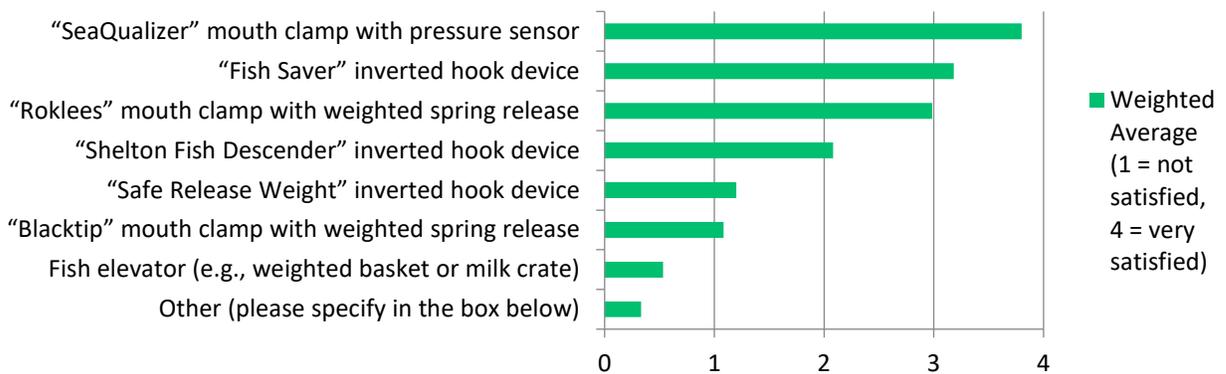
#1. Which type of descending device(s) did you use during the study period? Most respondents used a SeaQualizer (19.78%), Fish Saver (18.68%), or RokLees (17.86%) descending device during the study. Shelton Fish Descender was used by 10.16%, 9.07% used a Safe Release Weight, 4.95% used a Blacktip, and 3.57% used a Fish elevator. Of the respondents, 15.93% “did not use a descending device during the study period” and 3.57% chose “Other” (answer descriptions included venting tools and weighted hook devices).



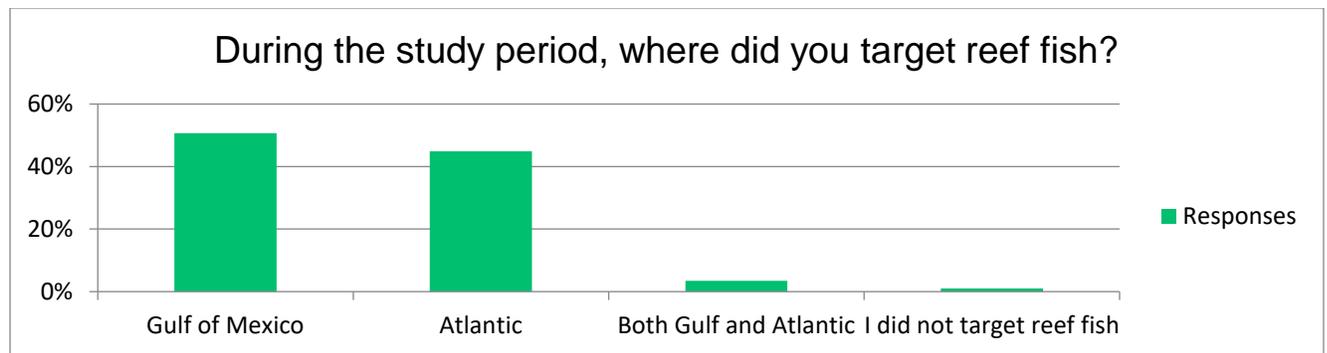
Descending Device Use During the Study

#2. Please indicate your satisfaction with using the following types of descending devices for reef fish with barotrauma during the study period (only indicate satisfaction for the devices you used). There were 292 respondents to this question. Using weighted averages of answer choices (1 = not satisfied, 4 = very satisfied), the highest level of satisfaction was with the “SeaQualizer” device, followed by the “Fish Saver,” “RokLees,” and “Shelton Fish Descender.” The “Safe Release Weight,” “Blacktip,” “Fish elevator,” and “Other” were ranked the lowest overall. The four descriptions listed for “Other” included: “n/a,” “6-8 ounce weights used to take them down,” “turkey injector needle,” and “Captain Roy’s.”

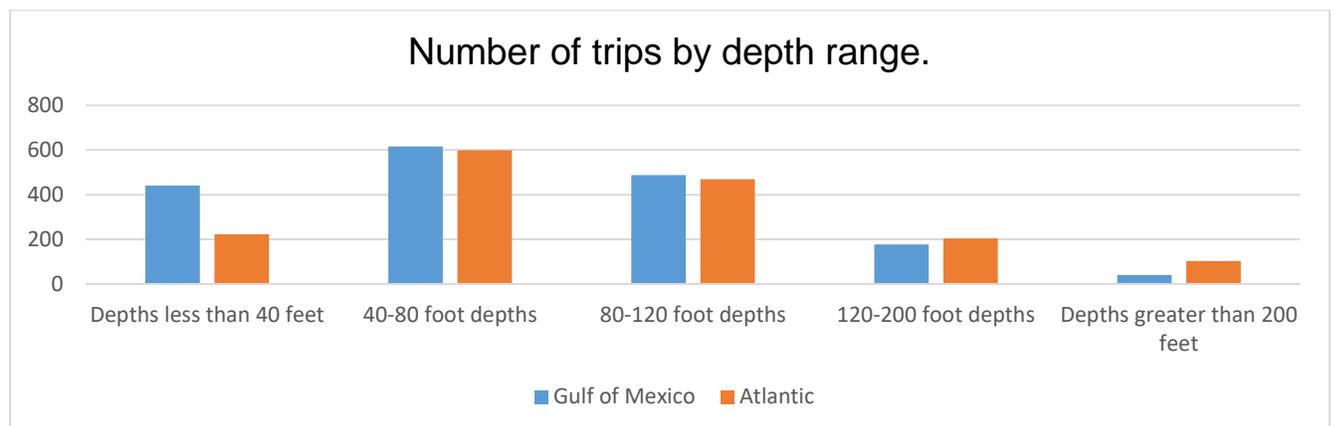
Satisfaction with using the following types of descending devices for reef fish with barotrauma during the study period.



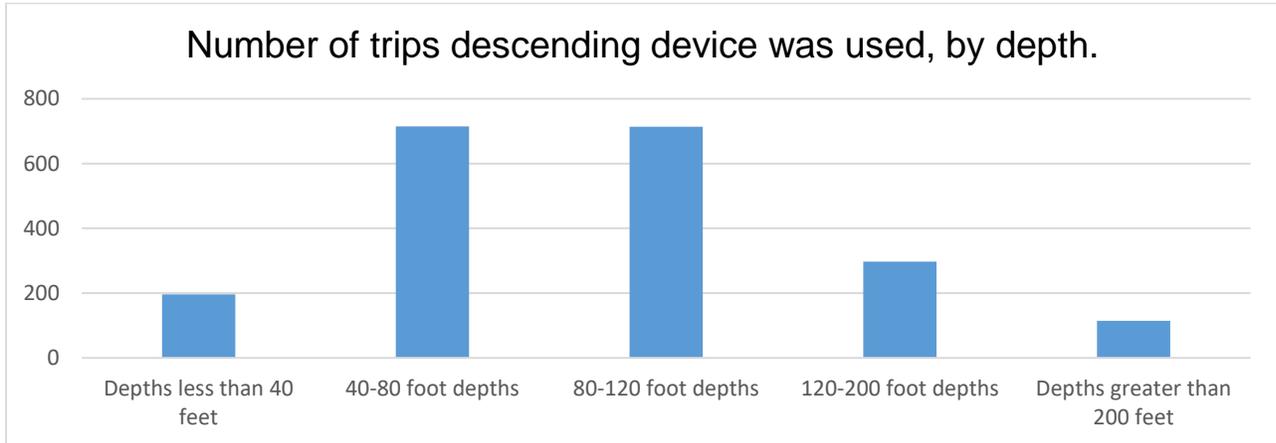
#3. During the study period, where did you target reef fish (snapper, grouper, etc.)? Of the 292 respondents, 50.68% targeted reef fish in the Gulf of Mexico and 44.86% in the Atlantic. Only 3.42% chose "Both Gulf and Atlantic" and just 1.03% chose "I did not target reef fish."



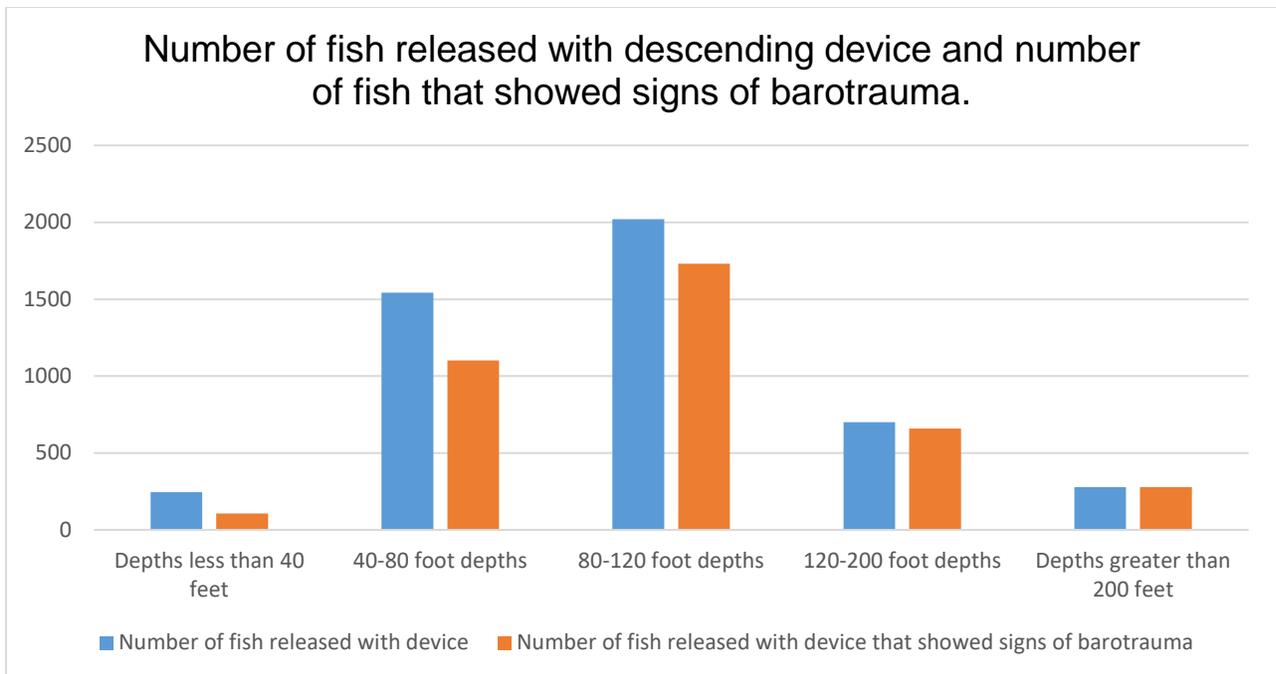
#4. During the study period, how many trips did you take in the following depths to target reef fish (snapper, grouper, etc.) in the Gulf of Mexico and/or Atlantic? The 291 respondents took a total of 1,763 trips in the Gulf of Mexico and 1,598 trips in the Atlantic Ocean. On average, each participant took 11-12 trips to target reef fish during the study period. In both the Gulf and Atlantic, most trips were taken in the 40-80 foot and 80-120 foot depth ranges. These are depths where barotrauma is likely to occur, but not always.



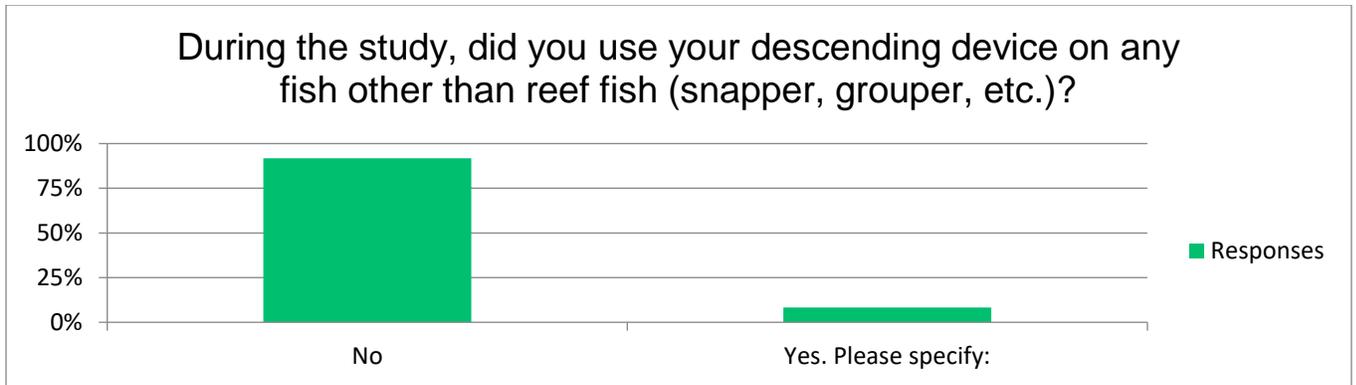
#5. During the study period, please indicate the number of trips that you used a descending device, how many fish you released with a descending device, and how many fish showed signs of barotrauma. The 292 respondents used a descending device on a total of 2,037 trips. Most of those trips were taken at 40-80 foot depths (35.1%) or 80-120 foot depths (35.05%). These are depths where barotrauma is likely to occur.



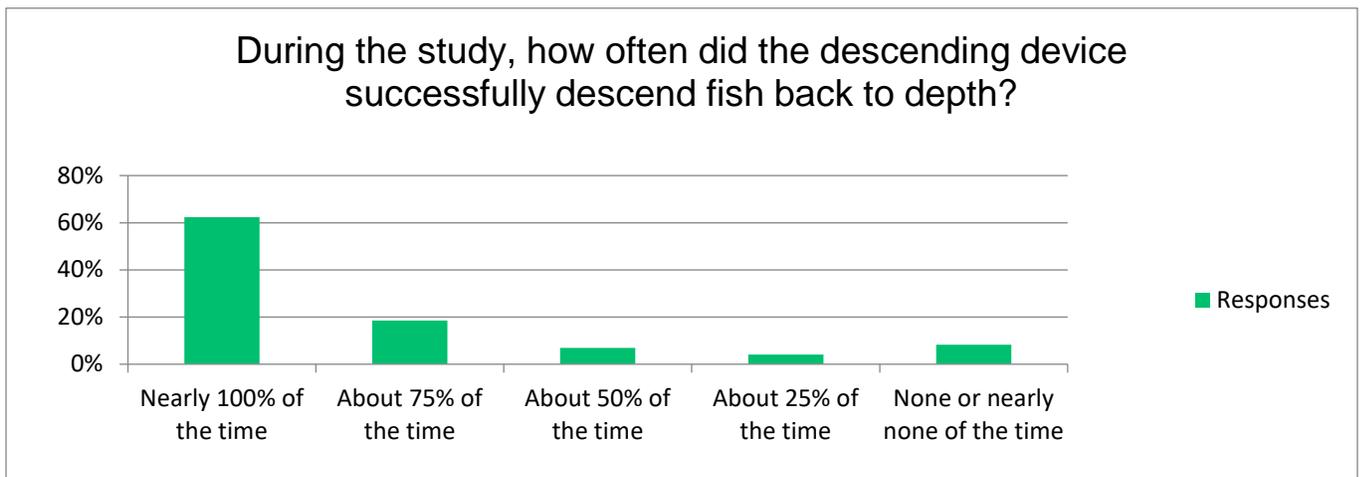
Of the 292 respondents, most of the fish released with a descending device were caught in 40-80 foot depths or 80-120 foot depths. The number of fish released with a device that showed signs of barotrauma at those depths is slightly lower, indicating that not all fish caught from those depths will have barotrauma symptoms. This could also indicate that anglers may be compelled to use the device in deep waters, even if the fish doesn't show signs of barotrauma.



#6. During the study, did you use your descending device on any fish other than reef fish (snapper, grouper, etc.)? Most of the 292 respondents used the device on just reef fish (91.78%), while only 8.22% indicated they used the device on fish other than reef fish. Open-ended responses for these species included mackerel, flounder, redfish, and remora.

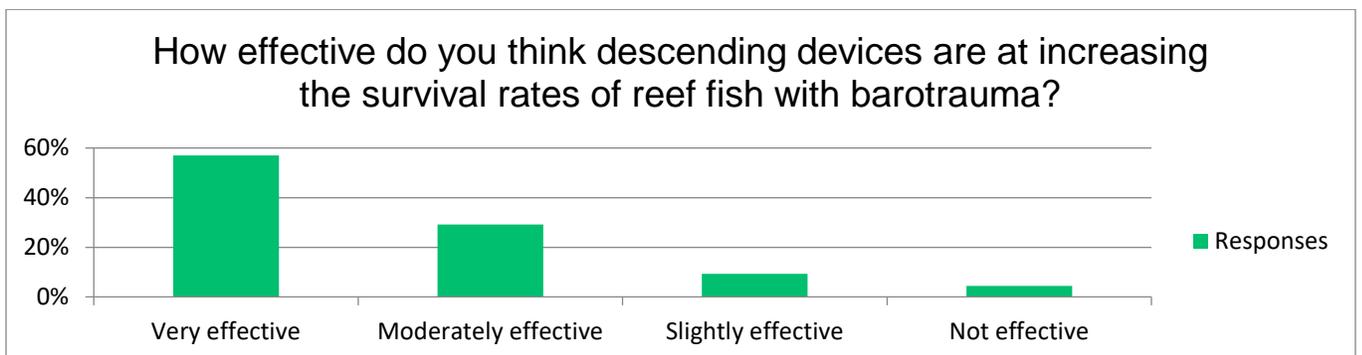


#7. During the study, how often did the descending device successfully descend fish back to depth? Most of the 292 respondents (62.33%) indicated their descending device was successful at descending fish back to depth “nearly 100% of the time.” Of the respondents, 18.49% chose “about 75% of the time,” 6.85% chose “about 50% of the time,” 4.11% chose “about 25% of the time,” and 8.22% chose “none or nearly none of the time.”

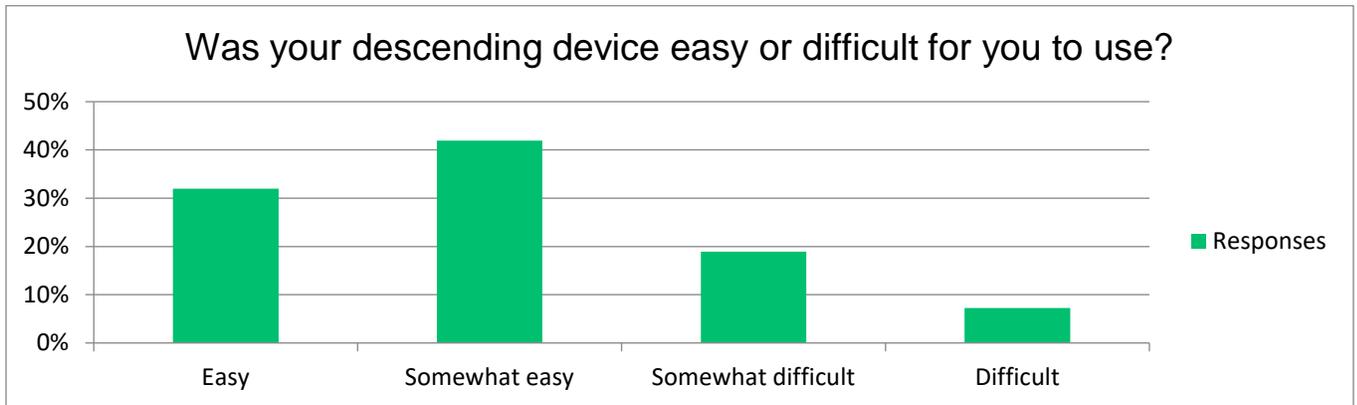


Evaluation of Experience Using Descending Device(s)

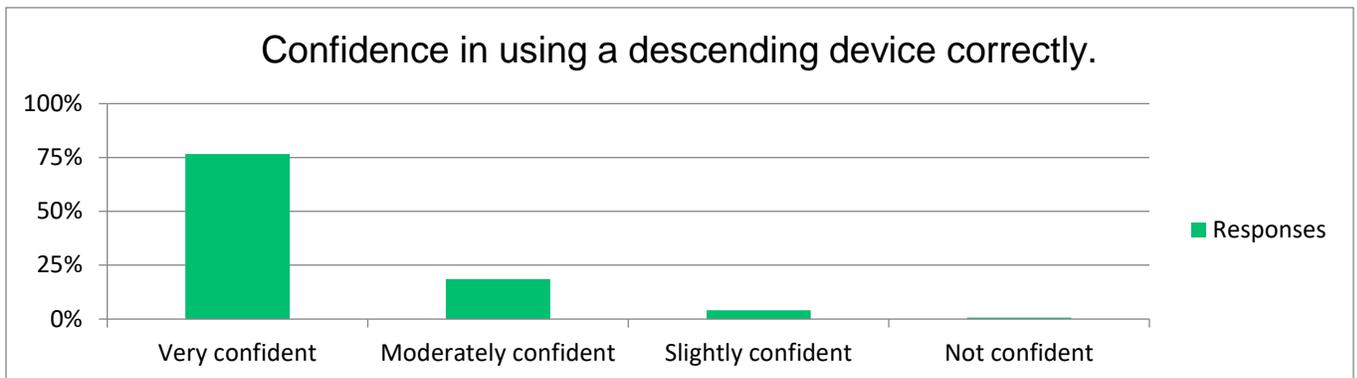
#8. Based on your experience in this study, how effective do you think descending devices are at increasing the survival rates of reef fish with barotrauma? Most of the 291 respondents (57.04%) think that descending device are “very effective” at increasing the survival rates of reef fish with barotrauma, while 29.21% chose “moderately effective.” Only 9.28% chose “slightly effective” and just 4.47% chose “not effective.”



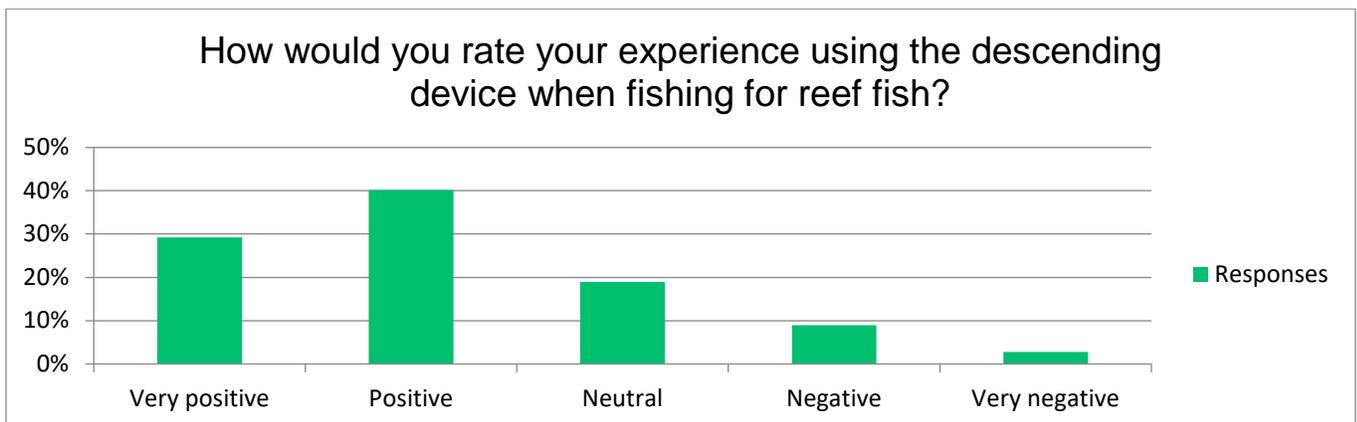
#9. Was your descending device easy or difficult for you to use? Most of the 291 respondents think descending devices are “easy” (31.96%) or “somewhat easy” (41.92%) to use, while 18.9% chose “somewhat difficult” and only 7.22% chose “difficult.”



#10. How confident are you that you can use a descending device correctly? A majority of the 291 respondents (76.63%) are “very confident” they can use a descending device correctly, while 18.56% chose “moderately confident.” Only 4.12% chose “slightly confident” and just 0.69% chose “not confident.”



#11. How would you rate your experience using the descending device when fishing for reef fish? Most respondents rated their experience as “very positive” (29.21%) or “positive” (40.21%). Of the respondents, 18.9% chose “neutral,” 8.93% chose “negative,” and 2.75% chose “very negative.”



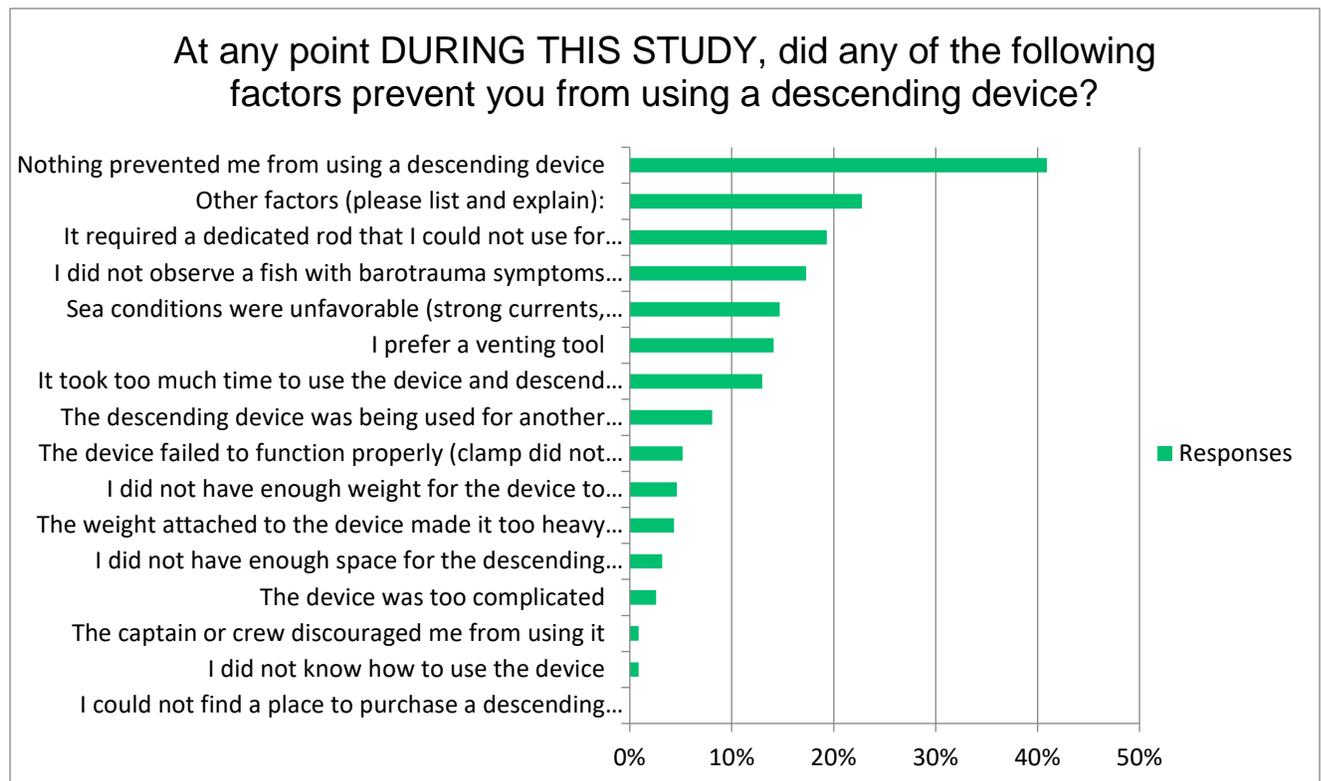
#12. If you answered “Neutral,” “Negative,” or “Very Negative” above, please explain:

Open-ended responses from 95 anglers mentioned: descending devices were time consuming, not easy to use, did not work on large fish, were cumbersome and heavy, needed a lot of weight to work, required a heavy-duty dedicated rod, attracted sharks and other predators, and did not work as well as venting. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.



Additional Feedback Regarding Descending Devices

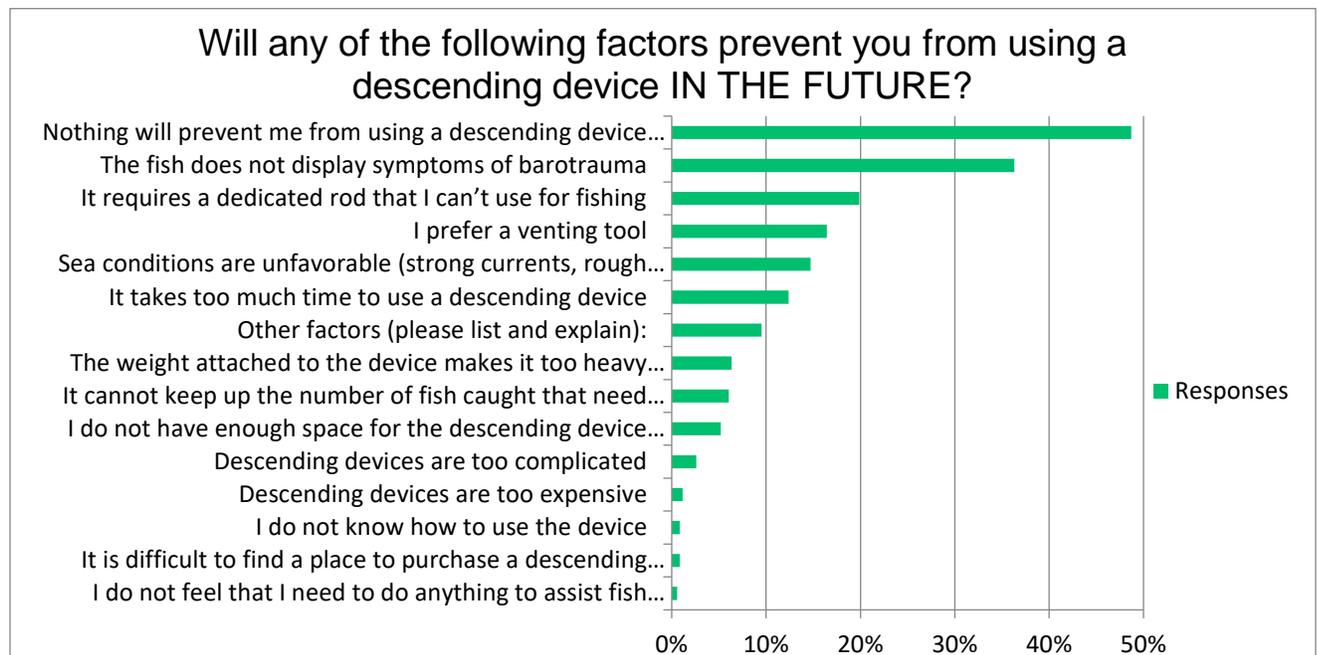
#13. At any point DURING THIS STUDY, did any of the following factors prevent you from using a descending device? The most common response (40.92%) was “Nothing prevented me from using a descending device,” followed by “Other factors” (22.77%). Additional top answers included “It required a dedicated rod that I could not use for fishing” (19.31%), “I did not observe a fish with barotrauma symptoms at any time during this study” (17.29%), “Sea conditions were unfavorable (strong currents, rough seas, etc.)” (14.7%), “I prefer a venting tool” (14.12%), and “It took too much time to use the device and descend a fish” (12.97%).



Open-ended responses for “Other factors” mentioned: fish were too large, fish were too small, not all reef fish showed signs of barotrauma, fish were sometimes hooked in the gill plate and did not survive, Hurricane Irma impacts, rough sea conditions, sharks, porpoises, dolphins, forgot device at home or lost device, charter boat with no mate, prefer venting tools, needed multiple devices, need a smaller device that works, used homemade device, issue with changing weights to accommodate different sizes of fish, clamp spring was too weak, basket flipped over on surface, lack of instructions and proper materials, inconvenient to dedicate a rod with strong line and to stow weights, difficult to handle large active fish with the inverted hook without excessive handling and damage to the fish, device tangled up other fishermen, lack of boat space, difficult to attach fish to inverted hook, takes time to learn, hard to do alone, didn’t receive device in time, and not catching enough fish. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word’s frequency of use) is shown below to help visualize the comments for “Other factors.”



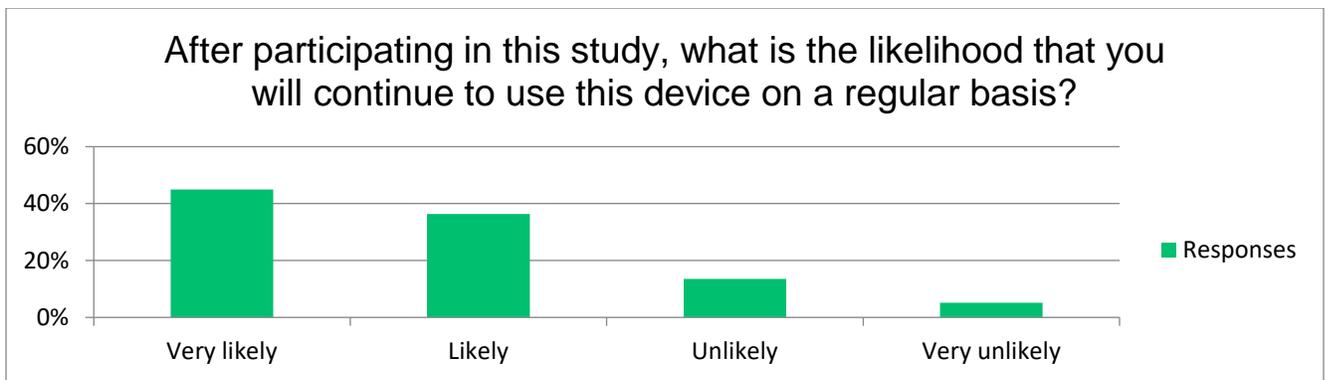
#14. Based on your experience during this study, will any of the following factors prevent you from using a descending device IN THE FUTURE? (select all that apply) The most common response (48.7%) was “Nothing will prevent me from using a descending device in the future,” followed by “The fish does not display symptoms of barotrauma” (36.31%). Additional top answers included “It requires a dedicated rod that I can’t use for fishing” (19.88%), “I prefer a venting tool” (16.43%), “Sea conditions are unfavorable (strong currents, rough seas, etc.)” (14.7%), “It takes too much time to use a descending device” (12.39%), and “Other” (9.51%).



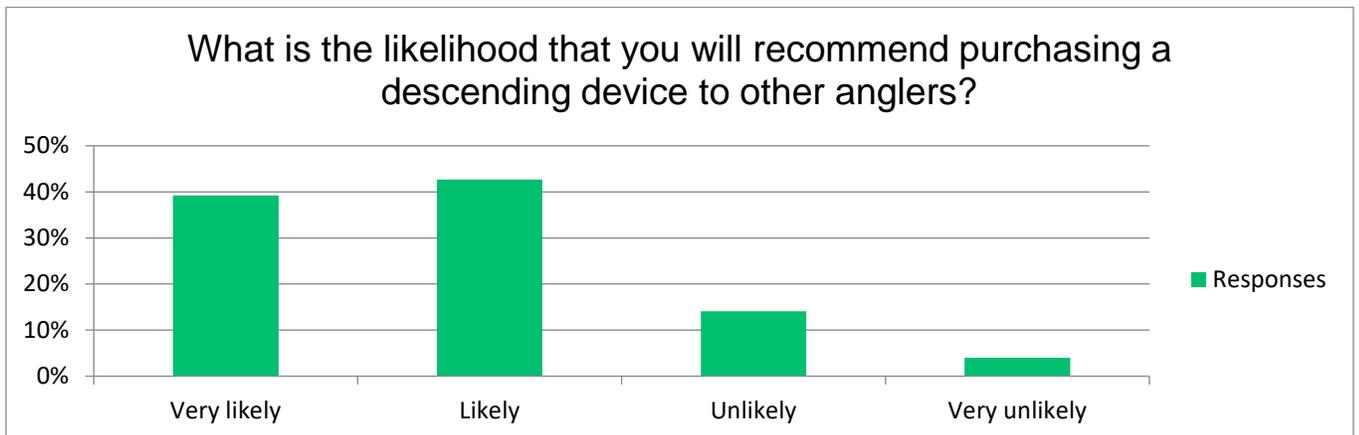
The open-ended responses for “Other factors” mentioned the following: Does not mean I will always use one, if it does not interfere with service to my clients, size of fish, prefer their own method, lack of confidence, could lose device to sharks, unable to verify if fish survives, whether device is reliable, if get a different or better device, needs to be faster, venting is faster and less stress on fish, not enough room, need good instructions and materials, predators eat the fish, too many fish need descending at one time, only use if fish has barotrauma, takes two people, and size of fish. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments for “Other factors.”

Fish Saver ^{Sharks} Water ^{Release} Venting Tool
 Survival Boat Needs Believe ^{Bottom} Prefer ^{Weight}
 Able

#15. After participating in this study, what is the likelihood that you will continue to use this device on a regular basis? Most respondents indicated they are “very likely” (44.96%) or “likely” (36.31%) to continue to use a descending device regularly. Only 13.54% said “unlikely” and 5.19% said “very unlikely.”

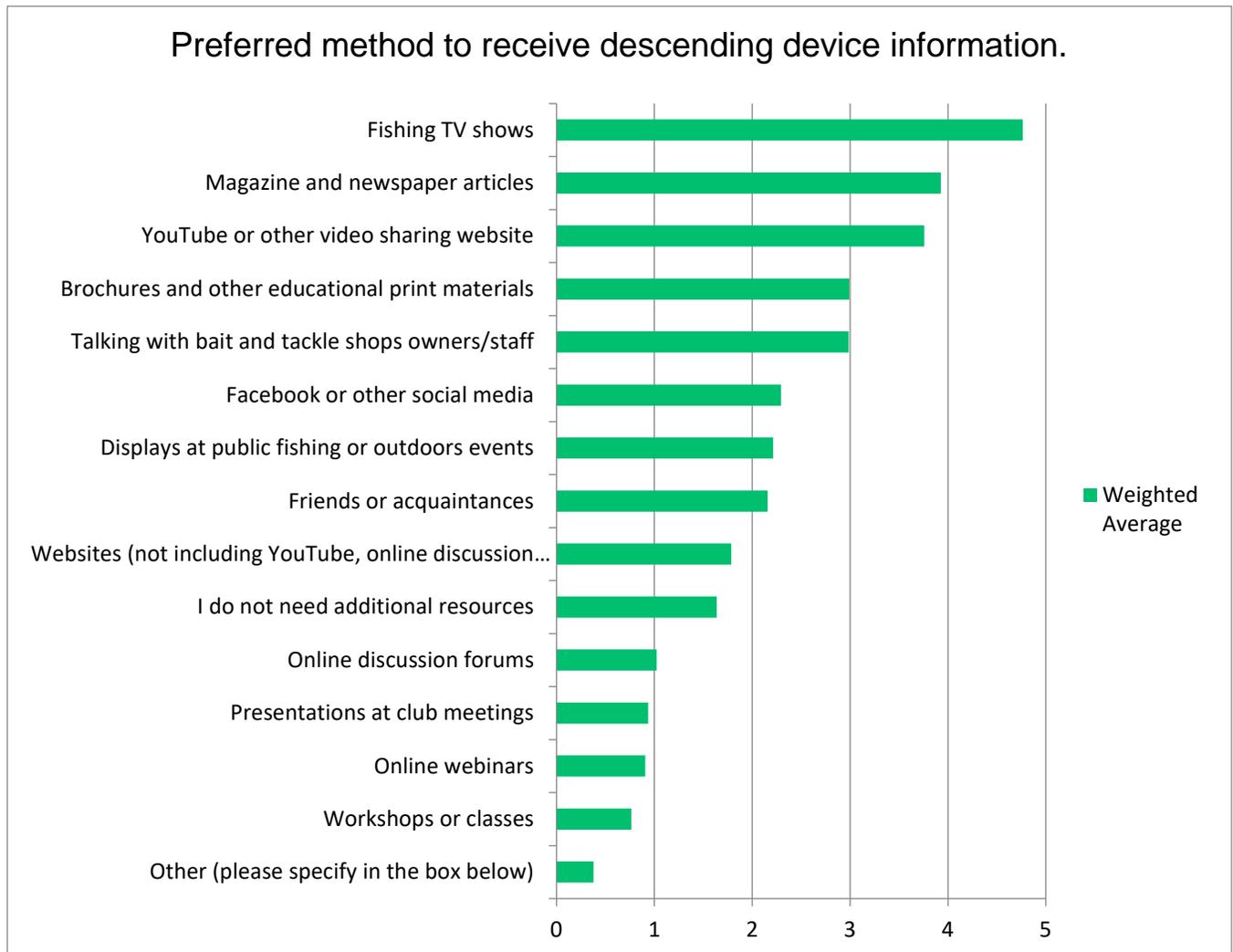


#16. After participating in this study, what is the likelihood that you will recommend purchasing a descending device to other anglers? Most respondents indicated they are “very likely” (39.19%) or “likely” (42.65%) to recommend purchasing a descending device. Only 14.12% chose “unlikely” and 4.03% chose “very unlikely.”



Please Tell Us More About You

#17. How would you prefer to receive information about descending devices? Please indicate your top five choices (first choice through fifth choice). This question was answered by 345 respondents. Using weighted averages of answer choices (5 = first choice, 1 = fifth choice), “fishing TV shows” was the most highly-ranked answer chosen by anglers. Additional top-ranked responses included “magazine and newspaper articles,” “YouTube or other video sharing website,” “brochures and other educational print materials,” and “talking with bait and tackle shops owners/staff.”



#18. Do you have any comments or thoughts regarding your participation in this study or the use of descending devices? Respondents provided 197 open-ended comments regarding the study, barotrauma, and descending devices. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.

SeaQualizer Milk Crate Continue Great Program
Dedicated Rod Help Protect Wish Bit Tricky Boat
Period Weight Grouper Release Hurricane
Venting Love Study Recommend
Descending
Device Unable Opportunity
Better Results Weather Trigger Fish Bottom Needle
Fish Saver Hard

#19. Please provide your name. First name and last name were collected for 345 respondents to keep track of participants who took part in the study process.

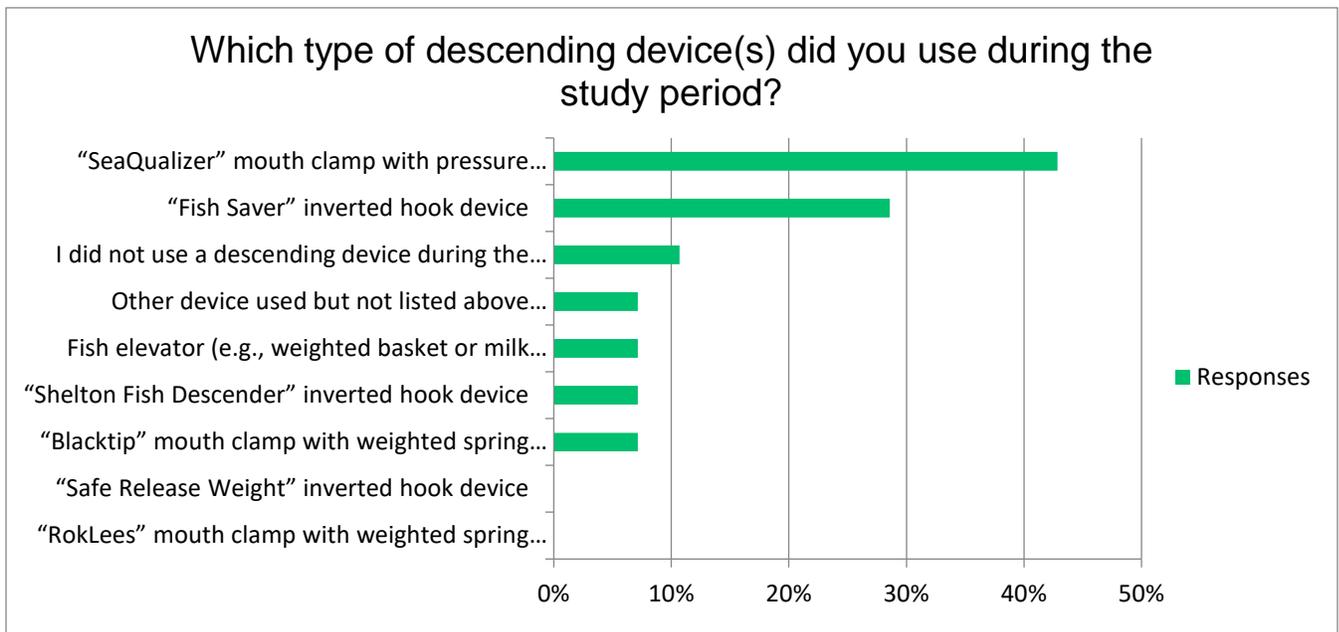
#20. Please enter the same email from which you received this survey link. Email addresses were collected for 345 respondents and can be used to maintain contact with participants after the study process. This data can be requested from the author.

3) B: Follow-up Survey for Volunteers (post-study)

The follow-up survey for volunteers was provided via a link in an email that was sent to 56 anglers on Nov. 1, 2017. Volunteers were asked to complete the follow-up survey by Nov. 14, 2017. There were 28 people who responded at least partially to the follow-up survey for volunteers and 26 fully-completed surveys, resulting in a 46.43% response rate.

Type of Descending Device Used During the Study

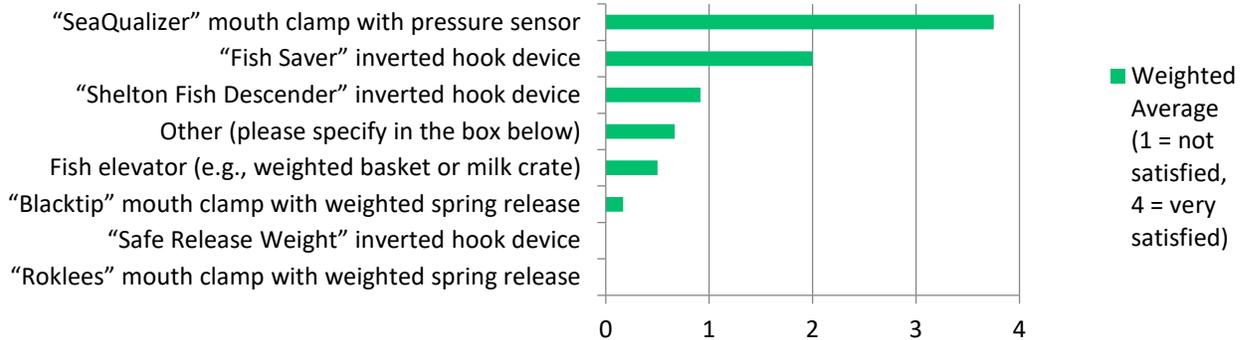
#1. Which type of descending device(s) did you use during the study period? Most respondents (42.86%) indicated that they used a “SeaQualizer” during the study, followed by 28.57% that used a “Fish Saver.” “Blacktip,” “Shelton Fish Descender,” “Fish elevator,” and “Other” were each chosen by 7.14% of respondents. The “Other” answer descriptions included a homemade device and a venting tool. No respondents used a “RokLees” or “Safe Release Weight.” Of the respondents, 10.71% indicated that they did not use a descending device during the study period.



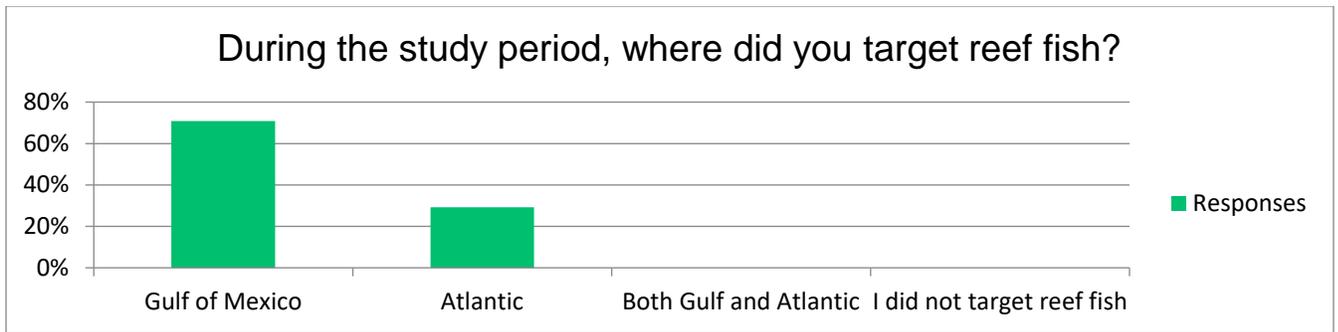
Descending Device Use During the Study

#2. Please indicate your satisfaction with using the following types of descending devices for reef fish with barotrauma during the study period (only indicate satisfaction for the devices you used). There were 24 respondents to this question. Using weighted averages of answer choices (1 = not satisfied, 4 = very satisfied), the highest level of satisfaction was with the “SeaQualizer” device, followed by the “Fish Saver,” “Shelton Fish Descender,” and “Other” devices. The two descriptions for “Other” included “a device I made” and “needle venting tool.” The “Fish elevator” and the “Blacktip” ranked lowest overall. The “Safe Release Weight” and “RokLees” were not used by volunteers during the study period.

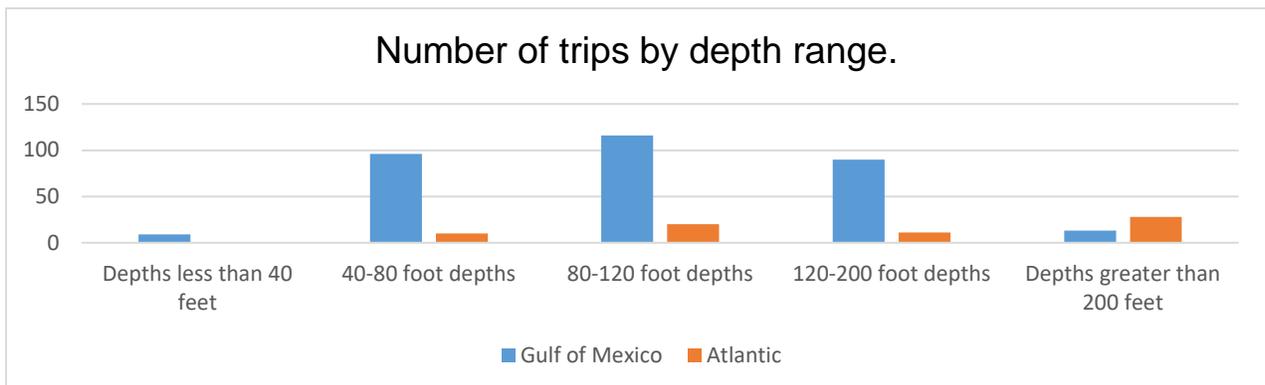
Satisfaction with using the following types of descending devices for reef fish with barotrauma during the study period.



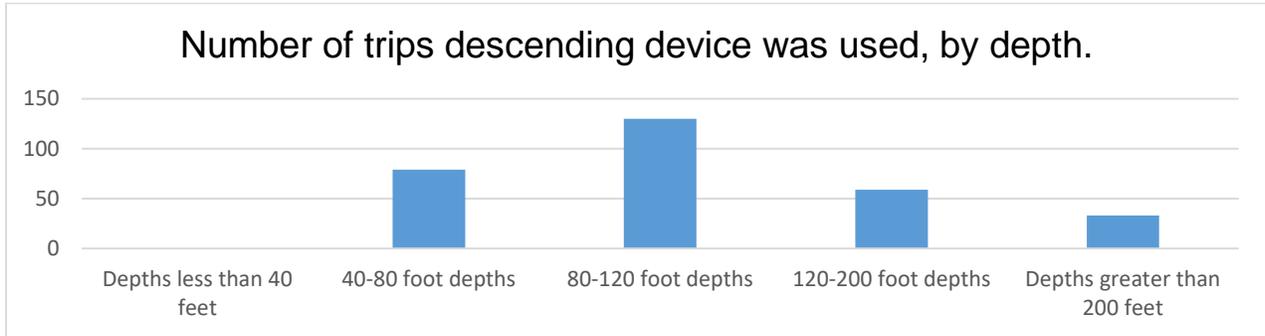
#3. During the study period, where did you target reef fish (snapper, grouper, etc.)? Most respondents targeted reef fish in the Gulf of Mexico (70.83%), while only 29.17% targeted reef fish in the Atlantic. No respondents chose "both Gulf and Atlantic" or "I did not target reef fish."



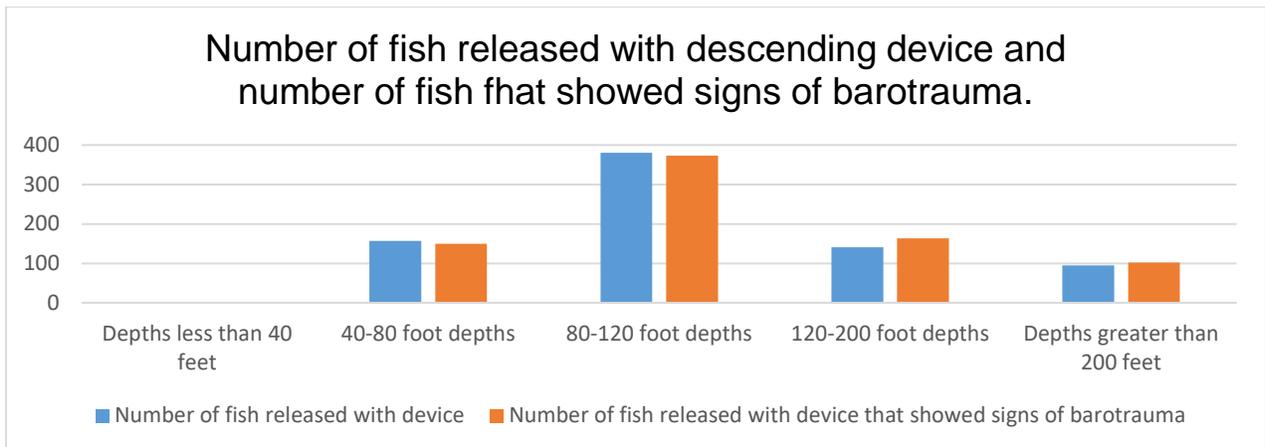
#4. During the study period, how many trips did you take in the following depths to target reef fish (snapper, grouper, etc.) in the Gulf of Mexico and/or Atlantic? The 24 respondents took a total of 324 trips in the Gulf of Mexico and 69 trips in the Atlantic Ocean. On average, each volunteer took 16 trips to target reef fish during the study period. In the Gulf of Mexico, most trips were taken in 80-120 foot depths (35.8%), followed by 40-80 foot (29.63%) and 120-200 foot (27.78%). In the Atlantic, fishing activity most commonly occurred at depths greater than 200 feet (40.58%) when compared to the other depth ranges. This is most likely due to the difference in depth contours between the Gulf of Mexico and Atlantic coasts.



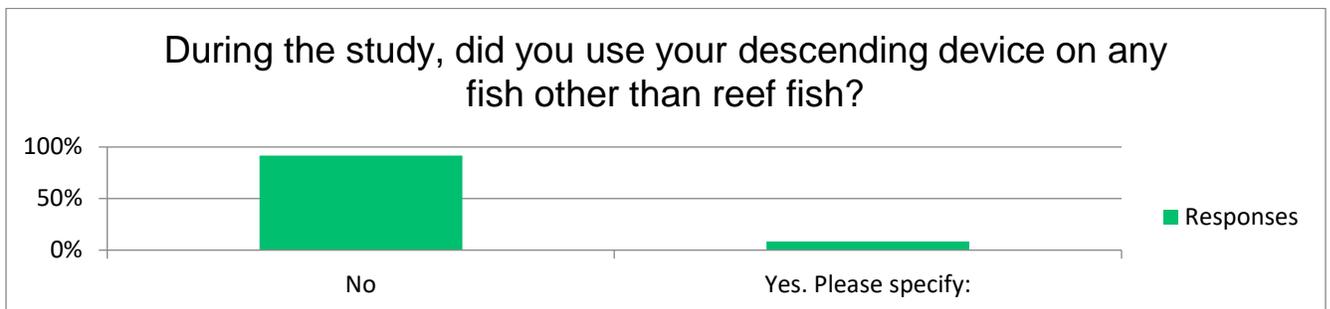
#5. During the study period, please indicate the number of trips that you used a descending device, how many fish you released with a descending device, and how many fish showed signs of barotrauma. The 24 respondents used a descending device on a total of 301 trips. Most of those trips were taken at 80-120 foot depths (43.19%). These are depths where barotrauma is likely to occur.



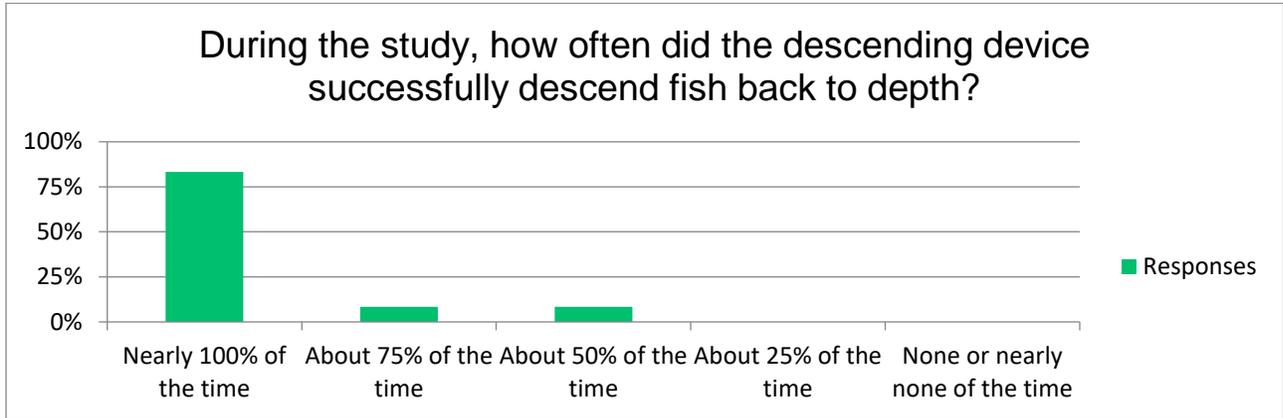
Of the 24 respondents, most of the fish released with a descending device were caught in 80-120 foot depths (49.16%). The number of fish released with a device that showed signs of barotrauma at those depths is slightly lower (47.34%), indicating that not all fish caught from those depths will have barotrauma symptoms. This could also indicate that anglers may be compelled to use the device in deep waters, even if the fish doesn't show signs of barotrauma.



#6. During the study, did you use your descending device on any fish other than reef fish (snapper, grouper, etc.)? Most respondents used the device on just reef fish (91.67%), while only 8.33% indicated they used the device on fish other than reef fish. Open-ended responses for these species included redfish.

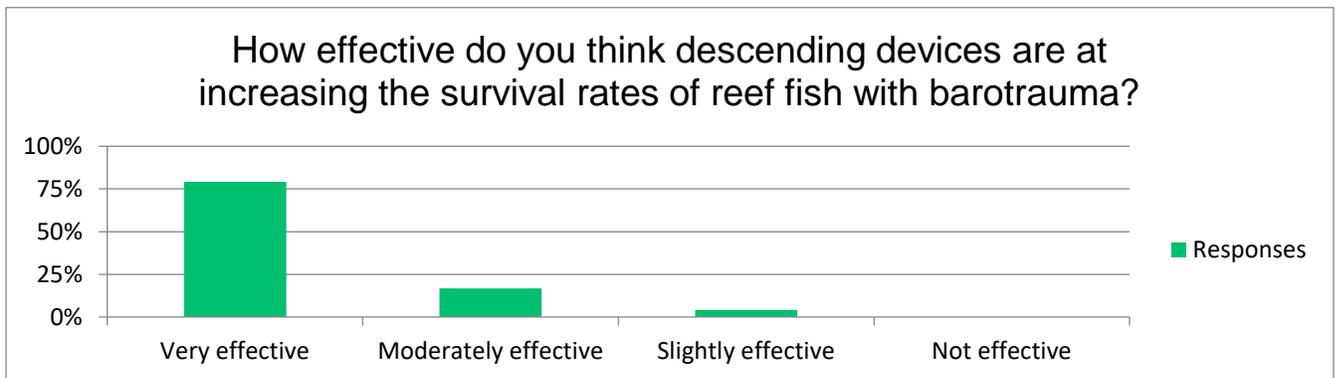


#7. During the study, how often did the descending device successfully descend fish back to depth? Most respondents (83.33%) indicated their descending device was successful at descending fish back to depth “nearly 100% of the time.” The choices “about 75% of the time” and “about 50% of the time” were each chosen by 8.33% of respondents. No respondents chose “about 25% of the time” or “none or nearly none of the time.”

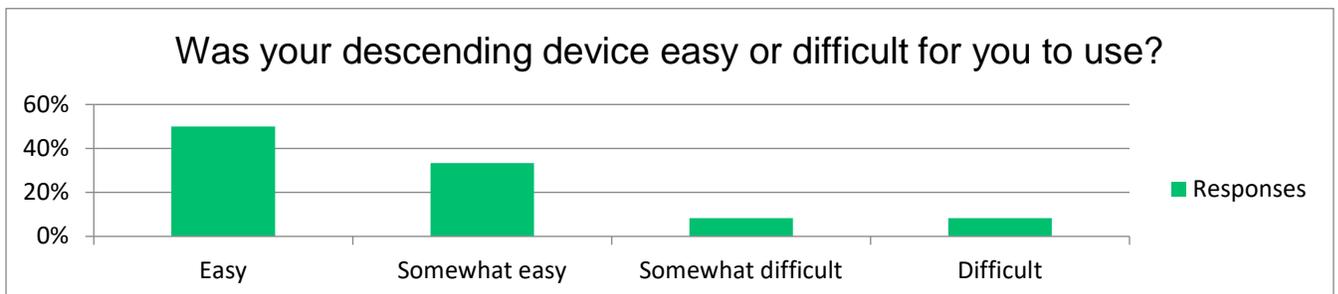


Evaluation of Experience Using Descending Device(s)

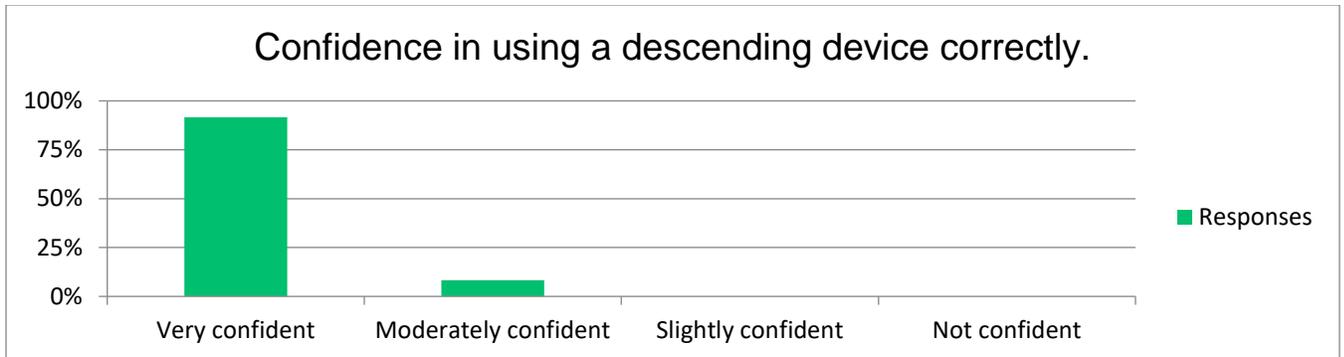
#8. Based on your experience in this study, how effective do you think descending devices are at increasing the survival rates of reef fish with barotrauma? Most respondents (79.17%) think that descending devices are “very effective” at increasing the survival rates of reef fish with barotrauma. Only 16.67% chose “moderately effective,” just 4.17% chose “slightly effective,” and none of the respondents chose “not effective.”



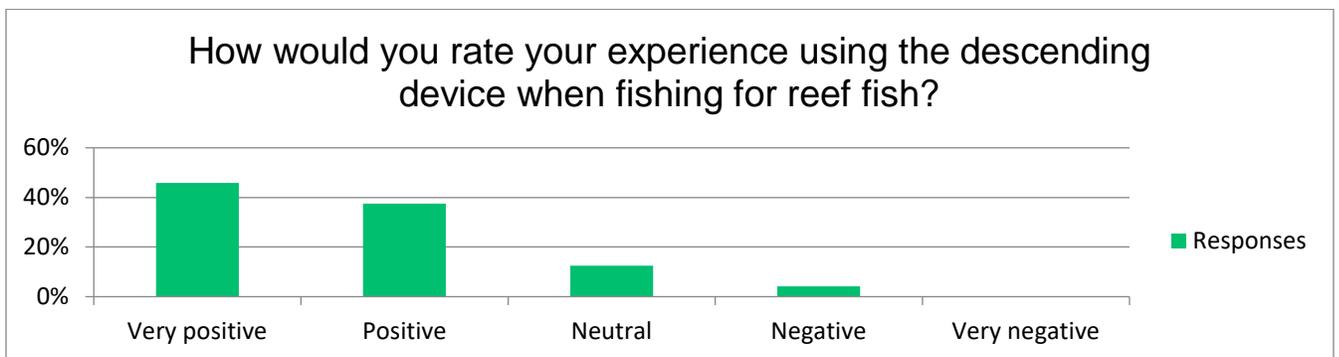
#9. Was your descending device easy or difficult for you to use? Half of the respondents (50%) think descending devices are “easy” to use. “somewhat easy” was chosen by 33.33% of respondents, while “somewhat difficult” and “difficult” were each chosen by 8.33%.



#10. How confident are you that you can use a descending device correctly? A vast majority of respondents (91.67%) are “very confident” they can use a descending device correctly, while only 8.33% chose “moderately confident.” None of the respondents chose “slightly confident” or “not confident.”



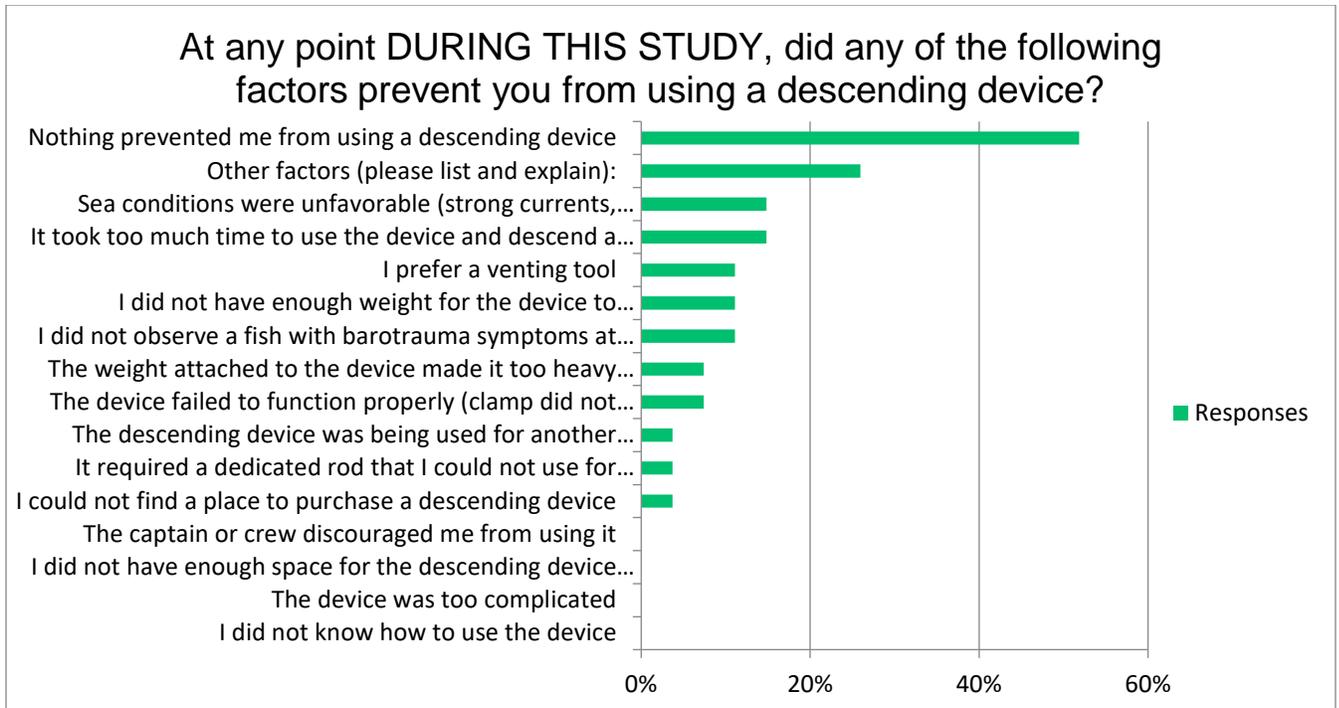
#11. How would you rate your experience using the descending device when fishing for reef fish? A majority of respondents rated their experience as “very positive” (45.83%) or “positive” (37.50%). Only 12.5% chose “neutral” and 4.17% chose “negative.” None of the respondents chose “very negative.”



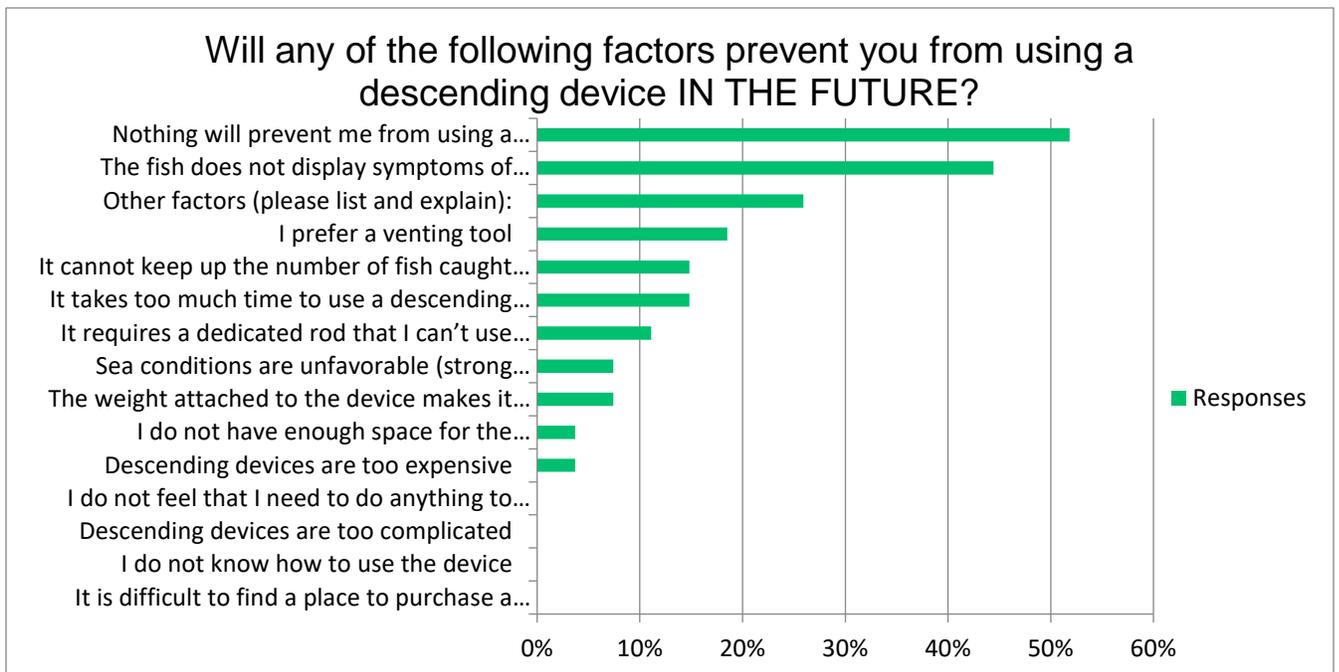
#12. If you answered “Neutral,” “Negative,” or “Very Negative” above, please explain: Four people answered this open-ended question. Responses mentioned: descending devices don't handle larger fish (eight or more pounds) very well; extra weights are needed to make devices function, but more weights make devices hard to retrieve; devices were used with downriggers because of heavy weights, but downriggers take up space and add complexity; devices get in the way; venting tools work better and faster; and devices are a time-consuming hassle, especially when fish are biting.

Additional Feedback Regarding Descending Devices

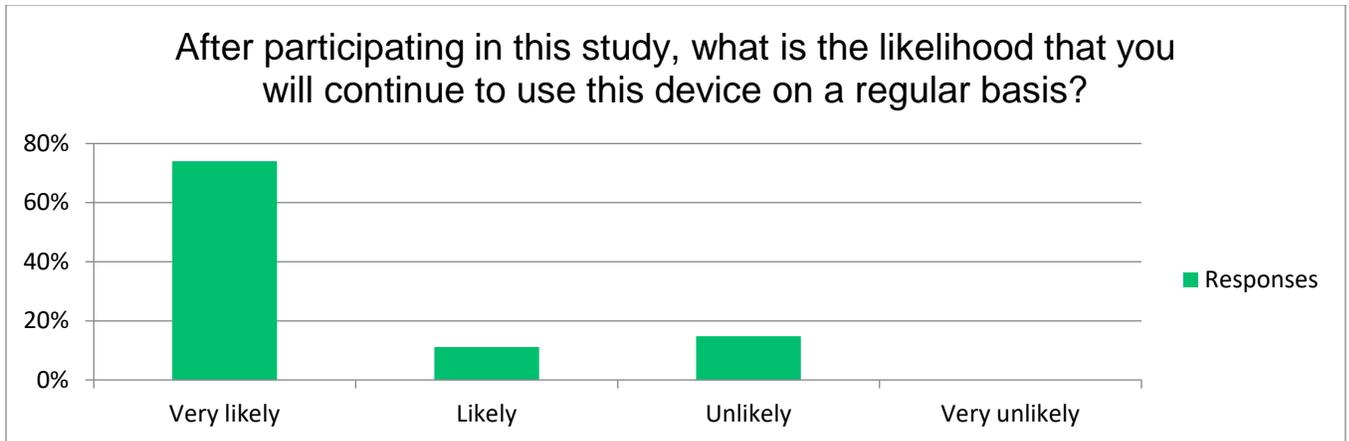
#13. At any point DURING THIS STUDY, did any of the following factors prevent you from using a descending device? (select all that apply) The most common response (51.85%) was “Nothing prevented me from using a descending device,” followed by “Other factors” (25.93%). Open-ended responses for “Other factors” mentioned: too much weight needed for larger fish, difficult to get mouth clamp to lock on triggerfish, downrigger cable broke and device was lost, would rather vent fish, and descending devices are more time consuming than venting.



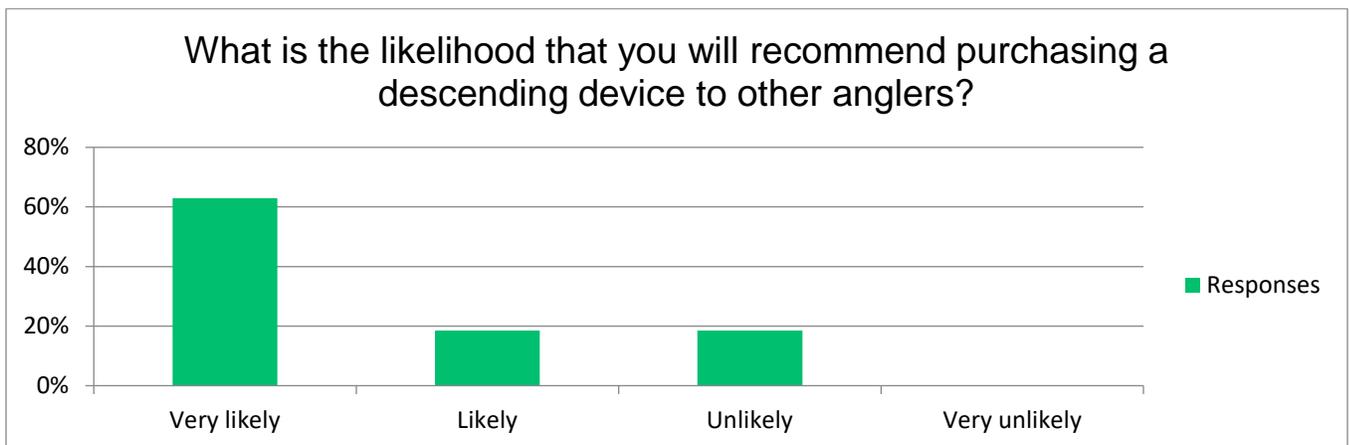
#14. Based on your experience during this study, will any of the following factors prevent you from using a descending device IN THE FUTURE? (select all that apply) The most common response (51.85%) was “Nothing will prevent me from using a descending device in the future,” followed by “The fish does not display symptoms of barotrauma.” Additional top answers included “Other factors” (25.93%) and “I prefer a venting tool” (18.52%). Written descriptions for “Other” included statements that venting tools are faster if the descending device isn’t set up prior to catching the fish and descending devices are too laborious to use in waters deeper than 200 feet.



#15. After participating in this study, what is the likelihood that you will continue to use this device on a regular basis? Most respondents (74.07%) indicated they are “very likely” to continue to use a descending device regularly. Of the respondents, 11.11% said “likely,” 14.81% said “unlikely,” and none of the respondents said “very unlikely.”



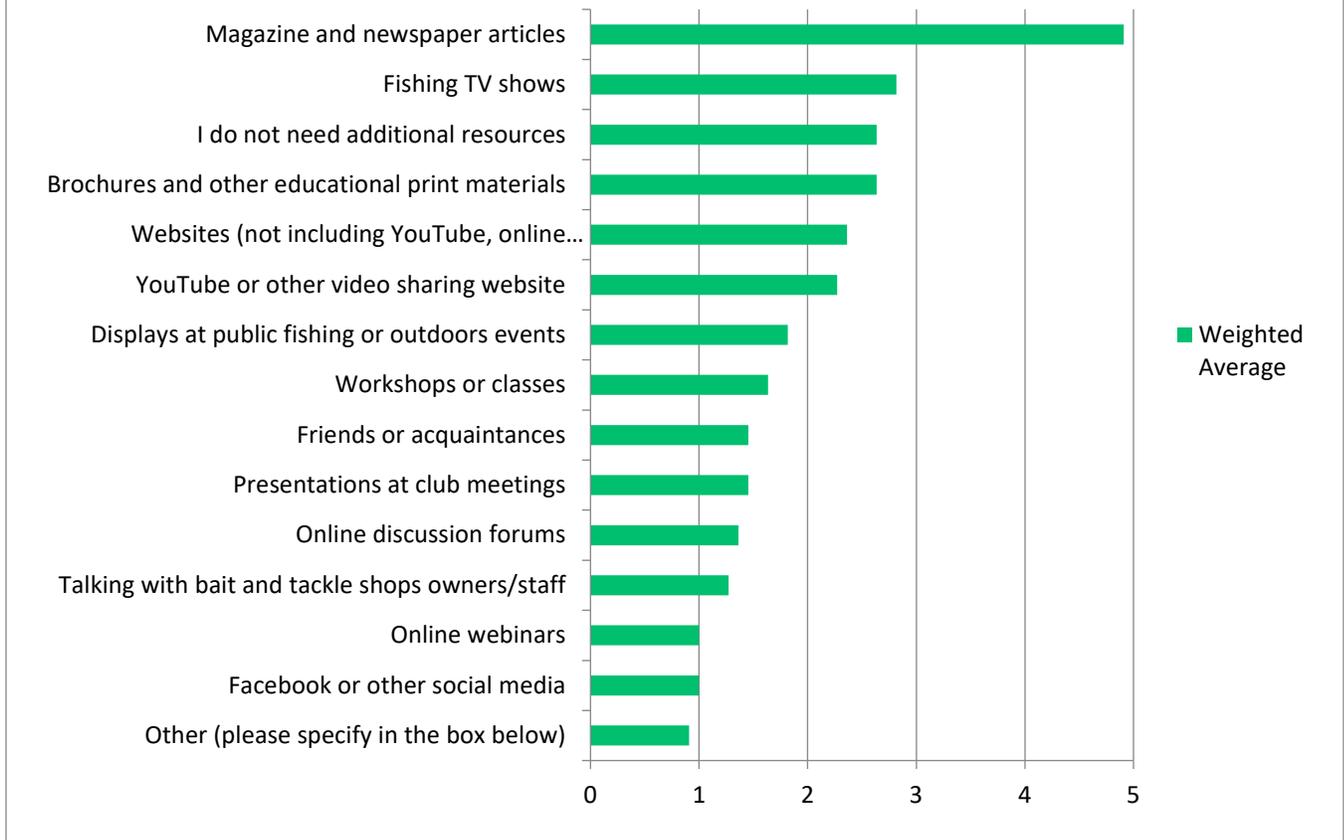
#16. After participating in this study, what is the likelihood that you will recommend purchasing a descending device to other anglers? Most respondents (62.96%) indicated they are “very likely” to recommend purchasing a descending device. “Likely” and “unlikely” were each chosen by 18.52% of respondents. No respondents chose “very unlikely.”



Please Tell Us More About You

#17. How would you prefer to receive information about descending devices? Please indicate your top five choices (first choice through fifth choice). This question was answered by 26 respondents. Using weighted averages of answer choices (5 = first choice, 1 = fifth choice), “magazine and newspaper articles” was the most highly-ranked answer chosen by anglers. Additional top-ranked responses included “fishing TV shows,” “I do not need additional resources,” “brochures and other educational print materials,” “Websites (not including YouTube, online discussion forums, and social media,” and “YouTube or other video sharing website.”

Preferred method to receive descending device information.



#18. Do you have any comments or thoughts regarding your participation in this study or the use of descending devices? Respondents provided 18 open-ended comments regarding the study, barotrauma, and descending devices. A word cloud (or graphic representation of the text associated with the comments, in which the size of each word is proportional to the word's frequency of use) is shown below to help visualize the comments. Data can be requested from the author.

Fish Needed Device Properly Think

#19. Please provide your name. First name and last name were collected for 26 respondents to keep track of volunteers who took part in the study process.

#20. Please enter the same email from which you received this survey link. Email addresses were collected for 26 respondents and can be used to maintain contact with volunteers after the study process. This data can be requested from the author.

Statistical Analysis Results

Pairwise t-tests, a statistical method in which each subject is compared to themselves, were run to compare pre-study and post-study data for participants and determine if there were significant differences between each angler's responses from the initial survey to the follow-up survey. Interestingly, these statistical analyses show that participants thought descending devices were more difficult to use, less effective, and had less confidence in using them after the study. The types of difficulties participants encountered when using descending devices included the need for a dedicated rod and reel, unfavorable sea conditions, and preference for a venting tool. Results of the statistical analyses are shown in *Table 2*.

Survey	Effectiveness	Confidence	Ease of Use
Initial Survey (pre-study)	3.76	3.90	3.35
Follow-up Survey (post-study)	3.43	3.71	3.00

Table 2. Results of Pairwise t-tests Run on Participant Data for Initial and Follow-up Surveys (using a scale of 1 to 4, with 4 being the highest or most positive response; $P < .00$)

However, 82% of participants said they would use a descending device in the future and 81% said they would recommend descending devices to a friend. These results suggest that descending devices may be complicated and time-consuming to use, but these negatives are not significant enough to greatly affect use. In addition, follow-up survey responses of volunteers were slightly more positive than those of participants, suggesting that since volunteers really wanted to be a part of the study and had to provide their own descending device, they were already more inclined to say positive things about descending devices.

Discussion

High survey response rates for the participant group and volunteer group indicate a high level of interest in taking part in the study and in improving reef fish survival rates post-barotrauma. However, it is important to note that anglers who took part in this study are more likely to use descending devices and are more likely to want to be engaged with the FWC. Anglers were not chosen by a random sample and results of this study should not be applied to the entire population of all Florida reef fish anglers.

The SeaQualizer was the most used descending device during the study, followed closely by the Fish Saver and the RokLees; however, none of the volunteers used the RokLees, most likely because none of them owned one. The SeaQualizer was rated for the highest levels of satisfaction in the follow-up survey, followed by the Fish Saver, RokLees, and Shelton Fish Descender. On average, participants took about 12 trips to target reef fish during the study period, while volunteers took about 16 trips. Most of these trips were taken at 40-120 foot depths, and descending devices were most often used at 40-120 foot depths during the study.

Most anglers indicated that they believed devices were successful at descending fish “nearly 100% of the time” during the study period, but there were some concerns about anglers not really knowing whether a fish survived after release. Most anglers thought descending devices were “very effective” at increasing the survival rates of reef fish with barotrauma, however many open-ended responses noted that venting tools can work as well or better than descending devices depending on the situation.

Most anglers thought descending devices were “somewhat easy” or “easy” to use and were “very confident” that they can use descending devices correctly. Angler experience when using the device was most often rated as “positive” or “very positive.” The majority of anglers indicated that “Nothing prevented me from using a descending device” during the study and that “Nothing will prevent me from using a descending device in the future.” Anglers indicated that if “The fish does not display symptoms of barotrauma” it would prevent them from using a descending device. Most anglers said they are “very likely” or “likely” to continue using a descending device regularly and to recommend purchasing a descending device to other anglers.

Interestingly, statistical analysis of the pre-study and post-study data shows that participants thought descending devices were more difficult to use, less effective, and had less confidence in using them after the study. However, when compared to the survey results, these findings suggest that although descending devices may be complicated and time-consuming to use, the negatives are not significant enough to greatly affect descending device use. There is no perfect solution to reducing reef fish discard mortality, but the results of this study suggest that descending devices could be a viable tool used by anglers to assist in reef fish management and help maintain healthy reef fish populations for the future.

References

National Oceanic and Atmospheric Administration, 2017. Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Aug. 7, 2017.

<http://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index>

T. Jarvis, Erica & Lowe, Christopher. (2008). The effects of barotrauma on the catch-and-release survival of southern California nearshore and shelf rockfish (*Scorpaenidae*, *Sebastes* spp.). Canadian Journal of Fisheries and Aquatic Sciences. 65. 1286-1296. 10.1139/F08-071.

L. Rogers, Bonnie & Lowe, Christopher & Fernández-Juricic, Esteban. (2011). Recovery of visual performance in rosy rockfish (*Sebastes rosaceus*) following exophthalmia resulting from barotrauma. Fisheries Research - FISH RES. 112. 1-7. 10.1016/j.fishres.2011.08.001.

Campbell, Matthew & Tolan, James & Strauss, Richard & Diamond, Sandra. (2010). Relating angling-dependent fish impairment to immediate release mortality of red snapper (*Lutjanus campechanus*). Fisheries Research - FISH RES. 106. 64-70. 10.1016/j.fishres.2010.07.004.

Hall, Karina & Broadhurst, Matt & Butcher, Paul. (2013). Clinical signs of barotrauma in golden perch, *Macquaria ambigua* (Richardson), and associated effects on post-release mortality and health. Journal of fish diseases. 37. 10.1111/jfd.12103.

Beverly Sauls, Tiffanie Cross, Oscar Ayala. (2016). Testing an alternative method for the safe release of reef fishes caught on hook-and-line gear in the recreational fishery in the Gulf of Mexico. Final report for the Bycatch Reduction Engineering Program (BREP), NOAA Fisheries Office of Science and Technology, Grant Number: NA13NMF4720270.

Jacob W. Brownscombe, Andy J. Danylchuk, Jacqueline M. Chapman, Lee F.G. Gutowsky, Steven J. Cooke. (2017). Best practices for catch-and-release recreational fisheries – angling tools and tactics. Fisheries Research - FISH RES. 186. 693-705.